THE UNIVERSITY OF ALABAMA IN HUNTSVILLE
SCHOOL OF PRIMARY MEDICAL CARE

FINAL REPORT
ENVIRONMENTAL CONTROL
MEDICAL SUPPORT TEAM

Submitted To:
Space Station Development Project Office
George C. Marshall Space Flight Center
National Aeronautics and Space Administration
Marshall Space Flight Center, AL 35812

Prepared By:
William J. Crump, M.D., Principle Investigator
Director, Consortium for the Space Life Sciences
School of Primary Medical Care

and

Melvin V. Kilgore, Jr.
Technical Studies Coordinator,
Consortium for the Space Life Sciences

UAH Research Report Number 742

October, 1988
INTRODUCTION

This report summarizes the activities conducted in support of the Environmental Control and Life Support Team during December 7, 1987 through September 30, 1988. The majority of the ongoing support has focused on the ECLSS area. Through a series of initial meetings with the ECLSS team and technical literature review, an initial list of critical topics was developed. These were prioritized by Dr. Randy Humphries' group. Subtasks were then identified or additional related tasks received as action items from the ECLSS group meetings and the team worked to provide the required information.

Although most of the efforts during this period were focused on providing MSFC personnel with information regarding specific questions and problems related to ECLSS issues, other efforts regarding identifying an ECLSS Medical Support Team and constructing data bases of technical information was also initiated and completed. Each of the specific tasks are discussed in the following Section.

SPECIFIC TASKS

1.0 Determine areas of need where medical consideration and design requirements interface.

Through a series of meetings with the ECLSS team and technical literature review, an initial list of critical topics was produced. These were prioritized by Dr. Randy Humphries' group and structured as an outline. Sub-tasks were then identified, and the team worked to provide the required information. The working outline that was developed is presented in Appendix A. The original prioritized tasks are presented below:

- Provide support to the mechanical design and integration of test systems as related to microbiological concerns.
- Assist with design of Human Subjects Test Protocols
- Interpretation and recommendations pertaining to air/water quality requirements
- Assist in determining the design specifications required as related to the Technical Demonstration Program
- Develop data base of all microorganisms recovered from previous subsystem testing
- Estimates of health risk of individual microbes to test subjects
- Assist with setting limits for safety of test subjects
- Health monitoring of test subjects
o Assist in the preparation of test plans

o Assist in the development of a QA/QC program to assure the validity, accuracy and precision of the analyses

o Assist in developing test plans required for future "man in the loop" testing

2.0 Assemble Support Team

As the specific ECLSS questions were delineated, team members were recruited and the tasks were assigned. There was initial discussion with members of the Colleges of Science, Engineering, Nursing, Liberal Arts, and the School of Primary Medical Care as well as the Johnson Research Center within the University of Alabama in Huntsville. Contacts were also made in the Physiology Departments of the University of Alabama in Birmingham (UAB) and Vanderbilt University. In addition, further contacts have been made from the School of Biostatistics and Biomathematics at UAB, the Athletic Drug Testing Laboratory located at Vanderbilt University, the Space Research Center located at Texas A & M University and the Botany and Microbiology Department at Auburn University. Because the primary focus at this point is environmental microbial control, the personnel utilized during this period have been expert in this area.

With the past experience of these efforts in hand, a primary Medical Support team can be defined which can offer the general expertise required by the MSFC Environmental Control/Life Support team for future efforts. A brief description of the key positions is provided below:

Family Physician

The majority of medical questions arising from life support design cross traditional specialty barriers and require a systems approach. The modern specialist in Family Medicine is broadly trained in abnormalities of all organ systems, unconstrained by patient age or gender. In addition, Family Practice training includes extensive exposure to medical care as a systems issue as well as the interactions of the physical and social environment in an individual's health, performance and illness. The family physician will monitor the team's activities and provide the necessary general perspective to keep the group on target.

Environmental Health Physician

Many of the health concerns of ECLSS testing and operation are similar to ground based occupational and environmental health needs. The team member most qualified to address these issues must have training beyond the M.D. degree to include a Master's Degree or equivalent in Public Health or Occupational Medicine. This physician will become intensely involved in hardware design, integration, and operation, and will review each step for health and safety concerns.
Technical Studies Coordinator

Successful completion of many of the necessary tasks will require supplemental and adjunct activities of a variety of technical and professional personnel. This might include literature searches, laboratory based research and verification, or support to problem understanding and proposed resolutions. The technical studies coordinator will be responsible for the coordination and supervision of technical personnel. In addition, he will be responsible for the timely completion of all required sub-tasks delegated to technical and specialized personnel. The technical studies coordinator must be versed in chemistry, microbiology, toxicology, ECLSS hardware and operation as well as have a basic understanding of medical issues.

Environmental Toxicologist

A large portion of the Phase III test activities will involve the operation and performance evaluation of ECLSS hardware. A major concern of these test activities involve the safety and health maintenance of the test subjects involved. The environmental toxicologist will play a major role in the identification of health and safety concerns of the test subjects and in addition provide valuable information regarding the detection and identification of chemical and microbial contamination of the waste and product streams associated with the ECLSS.

Chemist

The methods of detection and identification of chemical contaminants will be of upmost importance to both the performance evaluation of the ECLSS hardware and the verification of water quality. An individual versed in chemical and instrumental methodology will provide the necessary inputs required for the establishment of test plans, verification of laboratory performance and assurance of test subject safety.

Microbiologist

Many of the non-medical questions which arise are related to microbiology. For this reason, it is important to have knowledgeable representation in this field with direct experience in enumeration, detection and identification of environmental as well as medically significant microorganisms. In addition, microbiologists will play important roles in the establishment of test plans and microbial control options for the ECLSS test bed.

Information Management

The large volume of scientific and technical information requires electronic collation to facilitate interpretation and information transfer. In addition, integration of sub-component reports to complete task reports will require extensive technical merging and editing. The information specialist is responsible for these activities as well as other support functions such as interfacing with contract and support personnel, preparing and delivering presentations, and coordinating and facilitating information searches.
Specialized Professionals

Because of the diversity of the potential problems which might arise during the course of the Phase III activities it will be essential to call upon specialized individuals to answer and provide insight to particular questions. These individuals, although not be needed on a full time basis, may be called upon at any time for the resolution of specific tasks. Below are some experts identified at this time.

Toxicologist/Pharmacologist
Filtration and Separation
Instrumental Design
Biostatistician

The resumes of the current team members are included in Appendix B.

3.0 Construct Data Base of Background Technical Information

At the present time, over 500 individual articles have been manually classified. This information was computerized, and is continually updated as further information is produced by the regular literature searches. A current listing of these articles is presented in bibliography format with the abstracts (if available) in Appendix C. In addition, a bibliography produced by the National Library of Medicine that provides ready access to many of the important subject headings is included in Appendix D.

4.0 Provide Ongoing Technical Support to Development Project Office

The majority of this ongoing support has actually focused in the ECLSS area, with regular contacts with Dr. Humphries’ Team. Periodically, action items would be delegated to the UAH Medical Support Team. Oftentimes, these action items were specific topics within a general topic area initially defined as high priority. Presented in Appendix E is the current information obtained and recommendations for the individual topic areas and action items. All pertinent supporting information is included in Appendix F. Copies of all presentation material used by the UAH team are provided in Appendix G.
FUTURE THRUSTS

Below are areas identified from the original prioritized tasks and others which have developed which require further efforts.

- Assist with setting limits for safety of test subjects
- Assist in the development of test protocols necessary for institutional review
- Assist in the establishment and preparation of test plans
- Assist in the development of a QA/QC program to assure the validity, accuracy and precision of the analyses
- Identify and evaluate the removal of various drugs and/or pharmaceuticals by the urine reclamation system.
- Develop data base of all microorganisms recovered from previous subsystem testing
- Estimates of health risk of individual microbes to test subjects
- Assist in determining the design specifications required as related to the Technical Demonstration Program
- Assist in developing test plans required for future "man in the loop" testing

BUDGET SUMMARY

A summary of expenditures for the contract period is presented in Appendix H.
APPENDIX A
Task Outline
MASTER OUTLINE
3/3/88

TASK OUTLINE

Phase III Test Activities
Medical Aspects

1.0 Provide support to the mechanical design and integration of test systems as related to microbiological concerns.
   1.1 General Recommendations
   1.2 Material Recommendations
   1.3 System Integration
   1.4 Sampling Ports
   1.5 Sterilization/Decontamination
   1.6 Operational Requirements

2.0 Assist with design of Human Subjects Test Protocols
   2.1 Test Subject Protocols
   2.2 Human Subject Guidelines
      2.21 Institutional Review Board
      2.22 System Certification
      2.23 Subject Injury
      2.24 Supporting Documents
         2.241 JSC HRPPC (Appendix A)
         2.242 HHS (Appendix B)
         2.243 UAH IRB (Appendix C)

3.0 Assist in determining the design specifications required as related to the Technical Demonstration Program
   3.1 Documentation Review
   3.2 Current water/air quality requirements review
   3.3 Recommendations
4.0 Interpretation of air/water quality requirements

4.1 Identify current air/water quality requirements

4.2 Develop and justify air/water quality requirements for recycled air and water

4.3 Provide recommendations pertaining to above

5.0 Develop data base of all microorganisms recovered from previous subsystem testing

5.1 Biochemical Characterization of Unknowns

5.2 Identification of Presumptive Organisms

5.3 FAME profiling of isolates

5.4 Establish data base of isolates with respect to source

5.5 Identify isolates which potentially represent health risks

5.6 Characterize isolates based on susceptibility/resistance to antimicrobials

6.0 Estimates of health risk of individual microbes to test subjects

7.0 Assist with setting limits for safety of test subjects

8.0 Health monitoring of test subjects

8.1 Delineation of parameters to monitor well subjects

8.2 Guidelines for managing sick subjects

9.0 Assist in the preparation of test plans

9.1 Microbiological

9.2 Chemical

10.0 Assist in the development of a QA/QC program to assure the validity, accuracy and precision of the analyses

11.0 Assist in developing test plans required for future "man in the loop" testing
APPENDIX B
Resumes of Key Personnel
CURRICULUM VITAE

NAME: William J. Crump, M.D.

POSITION: Director of Research, Family Medicine

RANK: Associate Professor of Family Medicine

OFFICE ADDRESS: UAH Medical Clinics
Family Medicine Program
201 Governor's Drive, S.W.
Huntsville, Alabama 35801

HOME ADDRESS: 230 Teakwood Drive
Huntsville, Alabama 35801
(205) 882-3608

BIRTHDATE AND PLACE: June 14, 1953
Savannah, Georgia

SEX: Male

MARITAL STATUS: Married, four children

SOCIAL SECURITY NUMBER: 260-82-1826

EDUCATION:

University of Georgia, 1971-1975, B.S., 1975
Vanderbilt University School of Medicine, 1975-1979, M.D., 1979
Residency, Family Practice, University of Alabama in Birmingham,
1979-1982
Family Medicine Faculty Development Fellowship, University of
North Carolina at Chapel Hill, 1982-1983

CERTIFICATION AND LICENSURE:

American Board of Family Practice, July 1982
Alabama Medical License, 1980-present
Tennessee Medical License, 1984-present

ACADEMIC APPOINTMENTS:

Associate Professor of Family Medicine, University of Alabama in
Huntsville, School of Primary Medical Care, September 1986-
present
Assistant Professor of Family Medicine, University of Alabama in
Huntsville, School of Primary Medical Care, March 1983-September
1986
Adjunct Assistant Professor, University of Alabama in Huntsville,
School of Primary Medical Care, Department of OB/GYN, June 1985-
November 1985
Assistant Professor, Assistant Residency Director and Assistant
Educational Director, University of Alabama in Birmingham,
Department of Family Medicine, July 1982-March 1983
WILLIAM J. CRUMP, M.D.

Instructor and Chief Resident, University of Alabama in Birmingham, Family Practice Residency Program, 1981-1982

PROFESSIONAL ORGANIZATIONS:

American Academy of Family Physicians
Society of Teachers of Family Practice
Medical Association State of Alabama
Madison County Medical Society
North American Primary Care Research Group

HONORS AND AWARDS:

First Place Award for Academic Division Research Papers, AAFP 36th Annual Assembly, October 1984
Outstanding Family Practice Faculty, University of Alabama in Huntsville, School of Primary Medical Care, Family Practice Residency Program, 1983-1984
Mead Johnson Award Alternate, 1981
Fellowship in Primary Care, Vanderbilt University School of Medicine, 1977
Justin Potter Medical Scholarship, 1975-1979

GRANTS:

Principal Investigator, "Family Practice Hospital Study Mini Grant," University of Alabama in Huntsville, School of Primary Medical Care, 1986-1987
Principal Investigator, "Anxiety, Cortisol, and Pregnancy Outcome Mini Grant," University of Alabama in Huntsville School of Primary Medical Care, 1986-1987
Principal Investigator, "A Sentinel Practice Network for Obstetrics," Family Health Foundation of America, 1985-1987, $35,000
Site Coordinator and Major Contributor for (Tri-Campus) Grant for Faculty Development in Family Practice, University of Alabama in Huntsville, School of Primary Medical Care 1984-1987, $382,5571
Principal Investigator, Family Medicine Graduate Training Grant, University of Alabama in Huntsville School of Primary Medical Care, 1984-1987, $340,000
Principal Investigator, Perinatal Outcome Analysis Mini-Grant, University of Alabama in Huntsville, School of Primary Medical Care 1984-1985

1A four-year scholarship to Vanderbilt University School of Medicine commemorating a Nashville businessman. Selection is "for distinguished academic performance, demonstrated personal, professional, and intellectual competence, and strong potential for leadership in medicine."
WILLIAM J. CRUMP, M.D.

Page 3

Principal Investigator, "Family Practice Perinatal Outcome Project," Family Health Foundation of America, 1983
Principal Investigator, "Social Support and the Maternal Perception of the Newborn," Family Health Foundation of America, 1982

SELECTED OFFICES, COMMITTEES
AND CONSULTATION:

Chief, Huntsville Hospital, Division of Family Practice, October 1987-September 1988
Vice-Chief, Huntsville Hospital, Division of Family Practice, October 1986-September 1987
Member, Alabama Journal of Medical Sciences Editorial Board, 1987-present
Board of Directors, Hope Place Shelter for Domestic Violence, 1987-present
Member, Alabama Chapter-American Academy of Family Physicians Research Committee, 1986-present
Member, University of Alabama in Huntsville Computer Users Advisory Committee, 1984-1986
Member, University of Alabama in Huntsville Joint Computer Network Access Committee, 1984-1985
Member, University of Alabama in Huntsville School of Primary Medical Care Advisory Committee on Promotions and Tenure, 1984-present
Member, University of Alabama in Huntsville School of Primary Medical Care Family Practice Residency Promotion Committee, 1984-present
Member, University of Alabama in Huntsville Human Subjects in Research Committee, September 1983-present
Chairman, University of Alabama in Huntsville School of Primary Medical Care Grants and Research Committee, 1983-present

ADMINISTRATIVE AND EDUCATIONAL POSITIONS:

Medical Director, Family Practice Clinics, University of Alabama in Huntsville School of Primary Medical Care, February 1987-present
Fellowship Coordinator, University of Alabama in Huntsville Family Medicine Program, 1986-present
Director of Research Division of Family Medicine, University of Alabama in Huntsville School of Primary Medical Care, April 1983-present
Family Medicine Faculty Development Fellowship, University of North Carolina at Chapel Hill, 1982-1983 (Concurrent with first faculty year)
CONFERENCES, MEETINGS
AND PRESENTATIONS:

"How to be an Aggressive Health Care Consumer Without Alienating Your Doctor," University of Alabama in Huntsville School of Primary Medical Care Community Seminar, May 1986
"The Premenstrual Syndrome - Medical and Psychological Aspects," Huntsville Hospital Center for Women's Health, March 1986 and May 1986
"The Alabama Perinatal Outcome System on a Model Information Network," Southeastern/Atlantic Regional Medical Library Services, Birmingham, Alabama, October 1985
"Perinatal Outcome Project - The Second Year," Plenary Session Presentation at the Alabama Chapter of the AAFP, Gulf Shores, Alabama, June 1985
"Sentinel Practice Systems: Obstetrics," Presentation at Regional STFM Meeting, Atlanta, Georgia, October 1984
"Perinatal Outcome Project," Plenary Session Presentation at the Alabama Chapter of the AAFP, Gulf Shores, Alabama, May 1984
"Family Practice - A Career Decision," Annual Presentation to Vanderbilt University School of Medicine Students, 1982-1985
"Psychosocial Determinants of Pregnancy Outcome," Presentation at Annual Fellows Convocation, University of North Carolina at Chapel Hill, June 1983

PUBLICATIONS:


"Behaviorial Dimensions of Normal Childbirth," Family Centered Maternity Care (Cybele) CME Module with G. Gayle Stephens, M.D., 1981
RESUME

NAME: Melvin Voorees Kilgore, Jr.

POSITION: Director, Analytical Research & Testing Laboratory

RANK: Research Associate

EDUCATION:

University of Alabama in Huntsville 1983 - 1986
Master's Degree, Biological Sciences 1987

Auburn University 1978-1980
Graduate Courses: Chemistry

Auburn University 1974 - 1978
B.S. Microbiology 1978

Short Courses and Seminars:

High Resolution Gas Chromatography, Hewlett Packard, Birmingham, AL, February, 1987


PROFESSIONAL AFFILIATIONS:

American Association for the Advancement of Science
American Society of Microbiology
American Chemical Society
Association of Official Analytical Chemists

PROFESSIONAL EXPERIENCE:

University of Alabama in Huntsville June 1984 - Present
The Kenneth E. Johnson Research Center

Southern Research Institute June 1983 - May 1984
Biotechnology Section
Position: Biochemist

University of Alabama in Huntsville Feb 1983 - May 1983
Kenneth E. Johnson Research Center
Graduate Research Assistant
PROFESSIONAL EXPERIENCE: (cont)

Energy Associates, Inc.  
Alternative Energy Division  
Technical Representative  
Jun 1980 - Jan 1983

Auburn University  
Chemistry Department  
Graduate Research Assistant  
Sep 1978 - May 1980

Alabama Water Improvement Commission  
Monitoring and Surveillance Section  
Microbiological Technician  
Sep 1975 - Dec 1977

PUBLICATIONS:


RESEARCH REPORTS:


RESEARCH REPORTS: (cont)


CONTRACTS AND GRANTS:

"Aquatic bioassay Testing," M. V. Kilgore, Jr., Project Director. Amoco Chemicals Corporation, January 1985 - September 1985 ($5,100.00).

"Analytical Laboratory Support for the Area Industry," M. V. Kilgore, Jr., Project Director. October 1984 - September 1985 ($20,000.00).

"Establishment of Test Plans for the Advanced Development Programs," M. V. Kilgore, Jr., Project Director. Boeing Aerospace Corporation, September 1985 - December 1985 ($8,172.00).

"Aquatic Bioassay Testing," M. V. Kilgore, Jr., Project Director. Amoco Chemical Corporation, November 1985 - September 1986 ($6,500.00).

"Establishment of Test Plans for the Advanced Development Programs," M. V. Kilgore, Jr., Project Director. Boeing Aerospace Corporation, January 1986 - October 1986 ($14,902.00).


"Design of a GC System for the Analysis of Reduced Sulfur Compounds," M. V. Kilgore, Jr., Project Director. Applied Technology Consultants, March 1986 - September 1986 ($7,000.00).

"Sampling and Trace Solvent Analysis of Ambient Air," M. V. Kilgore, Jr., Project Director, Intergraph Corporation, March 1986 - April 1986 ($1,900.00).
RESUME

NAME: WILLIAM F. ARENDALE

RESIDENCE: 1216 Stonehurast Dr. S.E. Phone: (205) 881-4631
Huntsville, AL 35801

BUSINESS: The University of Alabama Phone: (205) 895-6473
in Huntsville
Chemistry Department
Huntsville, AL 35899

DEGREES:

1939 Central High School, Murfreesboro, Tennessee
1942 B.S., Science and Mathematics, Middle Tennessee State University
1948 M.S. Chemistry, University of Tennessee
   Thesis: The Identification of Organo-Selenium
   Compounds Obtained by the Oxidation of Stilbazoles
   with Selenium Dioxide. (With Dr. C. A. Buehler)
1953 Ph.D., Chemistry-Physics, University of Tennessee
   Dissertation: Vibrational Spectra of Ketene ag Aerospacn
   Deuterated Ketenes. (With Dr. W. H. Fletcher)

EMPLOYMENT HISTORY

1983- Technical consultant to United Space Boosters, Inc.,
Huntsville Alabama. Contracted efforts have included
a study of the state-of-the-art related to sensors
for Automated Weather Observing Systems, sensors for
NDT/NDE systems, and materials and processes for
manufacturing optical components with emphasis on
fiber optic systems and optrode designs.

1978-1983 Technical Consultant to Hobgood, Calimafde et al,
Patent Attorneys, New York, N.Y. Moore vs. U.S.,
patent infringement related to castable, elastomeric
solid propellants.

1977-78 Technical consultant to Burns, Doane, Swecker and
U.S.

1966-70 The University of Alabama in Huntsville. Director,
Division of Natural Sciences and Mathematics.
Responsible for developing programs in biology,
chemistry, earth sciences, mathematics and physics.

1964-66 The University of Alabama in Huntsville. Assistant
Director of Research Institute.

1964- The University of Alabama in Huntsville. Professor of
Chemistry. Interaction of electromagnetic energy with matter, scattering from laser illuminated targets, and hyper-Raman spectroscopy. The chemistry of selenium as related to the ecological cycle and selenium deficiency diseases. Most recently, interest have been directed to real time monitoring systems.

Philosophy of science, epistemology, and pedagogy of science. Teaching assignments have included general chemistry, analytical chemistry, instrumental analysis emphasizing the design of analog and digital instrumentation, physical chemistry, environmental chemistry, and chemometrics.

1951-64
Thiokol Chemical Corporation, Huntsville, Alabama.
Chief Project Chemist, Head of Research Department, Director of Research and Assistant to General Manager and Technical Director. Thermodynamics related to rocket propulsion, chemistry of polysulfide and butadiene copolymers, synthesis of high energy compounds, and rheology of suspensions. New formulations developed for ablative plastics, reinforced plastics, fiberglass composites. Applications and properties of metal whiskers, titanium and high strength ferrous alloys. Supervised design of rocket otors and new plant facilities. Administrative assignments included responsibility for quality assurance program; safety program; personnel training programs; coordination of customer contacts; and preparation and monitoring of the Five-Year Plan and the Annual Operating Plan.

1950-51
University of Tennessee, Dissertation work for Ph.D.

1948-50
Union Carbide Chemicals Corporation, Oak Ridge, Tennessee. Research Chemist. Studies of the organometallic and phosphate complexes of iron, uranium, and vanadium as a function of proton and electron activity. Results applied to leaching of low grade uranium containing soils and processing of solutions obtained.

1948-49
University of Tennessee. Lecturer, Organic Chemistry, Oak Ridge Program.

1947-48
Chemical Warfare Service Research Fellow.

1946-47
University of Tennessee. Instructor, Organic Chemistry.

1944-46

PROFESSIONAL ACTIVITIES RELATED TO CURRENT RESEARCH INTERESTS:

I. Chemometrics and the measurement process. Applications have included: platinum and palladium complexes of compounds containing pyridine and selenium in configurations that favor five membered rings for screening as antitumor agents, and oximes and tertiary amines from selenophene as reactivators and inhibitors for phosphorylated acetyl cholinesterase. Instrumentation developments including rapid scan spectrophotometry, use of fiber optics, and optrodes for data acquisition, and real time data processing. Process monitoring in real time. New materials and processing methods for manufacturing optical components.

A. Professional Memberships.

1. American Chemical Society
2. American Physical Society

B. Publications and Presentations


II. Epistemology, philosophy of science, pedagogy of science

A. Professional memberships


5. Society of College Science Teachers. Committee on Science and Technology 1982-.

6. Alabama Science Teachers Association. Member of Committee on Science and Technology 1982-.


8. The Gorgas Scholarship Foundation, Inc., Trustee 1973-.

9. Rotary Club, Huntsville, Alabama. Member Scholarship Committee 1972-76. Member International Relations Committee 1977-78.

10. Chemistry Department Committee for Self-Study on State Department of Education Requirements for Teacher Certification.

B. Publications and Presentations


C. Reviews of Text for Journal of Chemical Education.


RESUME

NAME: Timothy Lee Huff
RANK: Research Analyst III
POSITION: Lead Microbiologist

EDUCATION:

B.S. in Microbiology, University of Alabama, 1980
M.S. in Microbiology, University of Alabama, 1982

Professional Societies and Honors:

Alpha Lambda Delta (Freshman Honorary)
Arts and Sciences Honors Program (inactive)
Dean's List 1976, 1979
President of Pasteur Society 1979-1980
Collegiate Civitan

SKILLS:

Bacterial Culture Curator
Regulation of Antibody Responses (adjuvant studies)
T and B Cell Collaboration
Tissue Culture (including cell line and hybridoma)
Column Chromatography (including gel and affinity)
Gel Electrophoresis
Chromosomal and Plasmid DNA Isolation and Characterization
Experience in Small Animal Handling
Protein Isolation/Purification/Concentration Techniques
Experience in the use of Automated Cell Sorter
Monoclonal Antibody Maintenance and Purification
Membrane Filtration Techniques
Isolation and Identification of Clinical and Environmental Bacteria
Wet Chemistry Techniques

PROFESSIONAL EXPERIENCE:

The University of Alabama in Huntsville
Kenneth E. Johnson Research Center
Position: Lead Microbiologist
Aug 1986 - Present

Oklahoma Medical Research Foundation
Oklahoma City, OK
Position: Research Assistant
Sep 1985 - June 1986

The University of Texas
Medical Branch
Department of Microbiology
Position: Research Associate
April 1982 - Aug 1985
PROFESSIONAL EXPERIENCE: (cont)

The University of Alabama
Department of Microbiology
Position: Graduate Teaching Assistant

Sep 1980 - March 1982

PUBLICATIONS:

Articles:


Abstracts:


Abstracts (cont)


Research Reports:


Submitted:

Stinson, R.S., T.L. Huff, J. Robinson, G. Sloan, R. Lemmon and A. Winters. Immunomodulation of *Bordetella pertussis* whole cell vaccine and acellular fractions. (Submitted to Infect. Immun.).


RESUME

NAME: Theresa Ann Curry

RANK: Research Analyst II

POSITION: Microbiologist

EDUCATION: May 1983: B.S. in Microbiology-University of Alabama in Huntsville.

HONORS AND ACTIVITIES: Alpha Lambda, Freshman Honor Society; Athletic Scholarship-1980; Alumni Association Scholarship-1981; Dean's list-five quarters; Tri-Beta National Biological Honor Society-President-1982-83; Who's Who Among Students In American Universities and Colleges; Voted "Outstanding Senior".

PROFESSIONAL AFFILIATIONS: American Society for Microbiology
American Society for Quality Control

PROFESSIONAL EXPERIENCE:

The University of Alabama in Huntsville
Kenneth E. Johnson Research Center
Position: Microbiologist

Aug 1983 - Aug 1986

Augusta Reading Foundation
School for Dyslexic & Hyperkinetic Children
Position: Biology Teacher

Sep 1986 - Aug 1987

Kendall Company
Microbiology Division
Position: Laboratory Supervisor

Aug 1987 - Present

Employed 3 years with the Kendall Company as Microbiology Laboratory Supervisor. Main responsibilities include supervision of seven (7) technicians which perform bioburden and resistance studies, sterility testing, LAL pyrogen testing and support testing for the company. Other responsibilities include environmental monitoring, certifying equipment (including production sterilizers) and product, and validating biological indicators.
PROFESSIONAL EXPERIENCE: (cont)

The University of Alabama in Huntsville
Department of Biological Sciences
Position: Laboratory Technician

1981 - 1983

Responsibilities included: Preparation of media, buffers, microbiological reagents and stains, maintenance of stock cultures and departmental animal room. Familiar with Public Health rules for treatment of laboratory animals. Other responsibilities included supervision of other lab-assistants in microbiology prep room and assisting in laboratory instruction.

SEMINARS CONDUCTED:

Industrial Sterilization and Microbiological Quality Control-1983
Limulus Amebocyte Lysate Workshop on Testing and Regulation-1984
Statistical Process Control Methods Workshop-1985
Quality Control In The Microbiology Laboratory-1985.

PUBLICATIONS:

APPENDIX C

Current Medical Support Team

Bibliography

ABSTRACT: None

Naturwissenschaften. 73:0001-0455. 1986.

ABSTRACT: None


ABSTRACT: This manual describes methods for measuring the acute toxicity of effluents to freshwater and marine macroinvertebrates and fish. The methods include a preliminary range-finding test, a screening test, and multi-concentration (definitive) static and flow-through toxicity tests. Also included are guidelines on laboratory safety, quality assurance, facilities and equipment, effluent sampling and holding, dilution water, test species selection and handling, data interpretation and utilization, report preparation, organism culturing, and dilutor and mobile bioassay laboratory design.

Streptomyces DD-Carboxypeptidase-Transpeptidases. Exopeptidases, Chapter 51; 0611-0636.

ABSTRACT: None


ABSTRACT: In addition to microbial monitoring of the crewmembers as detailed in JSC-16888, attention must be given to the reusable spacecraft and its associated hardware. This monitoring will provide a basis for implementation of appropriate prophylaxis, treatment, or replacement procedures for insuring the maximum safety of crew members. The increased crew size may result in an increased microbial load within the Shuttle orbiter and thereby provide a potential for microbial contamination and buildup. Microbiological sampling and monitoring of selected sites and components within the confines of the spacecraft will be used for evaluation actual or potential microbial contamination. The comparison of pre- and postflight data will as a monitor of the effectiveness of cleanup procedures in preparation for a subsequent mission.


ABSTRACT: None

Space Lab 3 Microbial Contamination Control Plan In Support Of DSO 0437. NASA JSC2 0381.

ABSTRACT: This document will encompass specific guidelines and
procedures for the monitoring of crewmembers, animals, spacecraft, Spacelab, animals housing, Hangar L, and the Research Animal Holding Facility (RAHF), and animal food and water for the Spacelab 3 (SL-3) mission. The microbial sampling schedule is given in Table 1.

Test Results Operational Ninety-Day Manned Test Of A Regenerative Life Support System. Advance Biotechnology And Power Department, McDonnell Douglas Astronautics Company For Langley Research Center, NASA. NASA CR-111881, MDC G2282.

ABSTRACT: None


ABSTRACT: The KDI QUIK TEST Drug Screens are the first practical approach to drug testing in the workplace. Rapid, economical, accurate and simple-to-use, the screening procedures will detect drugs of abuse in urine samples.


ABSTRACT: This report discusses some of the inherent limitations of cancer studies in animals and humans and presents a qualitative carcinogen risk assessment of a number of pesticides based on the judgment of national and international authorities who have reviewed the available experimental and epidemiologic evidence. A large number of pesticidal compounds have shown evidence of genotoxicity or carcinogenicity in animal and in vitro screening tests, but no pesticides—except arsenic and vinyl chloride (once used as an aerosol propellant)—definitely have been proved to be carcinogenic in man. Resolution 94 (1-86), which was referred to the Board of Trustees, calls for the American Medical Association, through its scientific journals and publications, to alert physicians to the potential hazards of agricultural pesticides, to provide physicians with advice on such hazards for their patients, and to urge that these substances be appropriately labeled. This report addresses the potential carcinogenicity of pesticides by review of the available literature.


ABSTRACT: None


ABSTRACT: None


ABSTRACT: When you discover that the very water you drink is deadly, you don't just sit back and take it. Four communities
tell their stories.


ABSTRACT: This Atlas is a collection of differential scattering patterns, i.e. the relative intensity of scattered light as a function of the angle of scattering. It has been prepared for use with the Differential 1 and Differential 11 light scattering photometers manufactured by Science Spectrum, Inc., Santa Barbara, California. Most of the data are presented to correspond to the use of plane-polarized green laser light of wavelength 514.5nm.


ABSTRACT: Although piped water is available to at least 75 percent of the nation's population, the production and sale of bottled water has become an established and growing industry. In some parts of the country, particularly in those areas where the only available natural water is heavily mineralized, bottled water has always been an important source of drinking water. Since the recently aroused interest in our environment, the use of bottled water has rapidly increased. Fears regarding the pollution of city water supplies, whether or not founded on fact, have caused people to distrust the quality of the product issuing from the faucet. In addition, a dissatisfaction by the public with the taste and odor of their drinking waters has influenced the increase in the use of bottled waters. Rising affluence has also had a part, since people could now afford to purchase a deluxe product, supposedly much superior to the every day waters that the city water system provided. When, in 1970, a study of Community Water Supplies was published by the Water Supply Division, Environmental Protection Agency (then the Bueau of Water Hygiene, United States Public Health Service), the bottled water industry received an unexpected (and unintentional) boost. The study revealed shortcomings and potential hazards in many community water supplies, and the immediate reaction of the public was distrust of piped water and an increase in sales of bottled water. The Water Supply Division recognized the importance of this increase in the use of bottled waters by the public and was interested in determining the quality and health surveillance being provided by the manufacturers. To determine existing conditions a small pilot survey was undertaken.

Bottled Water. Published by the Office of the Federal Register National Archives and Records Administration (21 Parts 100 to 169), 1986.

ABSTRACT: Bottled water sold in interstate commerce is under the jurisdiction of the Food and Drug Administration, DHEW. FDA has established quality standards for bottled water which are essentially equivalent to the EPA standards in effect for tap water. However, there is no monitoring program for bottled water as there is for tap water, so compliance with FDA's standards
cannot be determined for a particular brand of bottled water without actually having an analysis performed. Most states also have regulations pertaining to bottled water, but few states have programs for monitoring the quality of bottled water available within their jurisdictions. Bottled water may be distilled and reconstituted to a particular formula, may be carbon filtered, ozonated, or may receive various other kinds of treatment. These processes are intended to produce a bottled water which is pleasing to the taste and is consistent in aesthetic characteristics. While some of the types of treatment can be expected to remove contaminants, no information is available on the contaminants, no information is available on the contaminant content of any of the many brands of bottled water. Since bottled water is most frequently sold on the basis of its aesthetic characteristics, the consumer's choice is usually based on his personal taste preference. No comparison of bottled waters on the basis of purity or freedom from contaminants has been made. If a consumer is interested in the quality of a particular brand (or lot) of bottled water, he should contact the Bureau of Foods, Food and Drug Administration, DHW, Washington, D.C. 20204; or the State agency responsible for regulation of bottled water. The latter may be the health department, the department of the environment, or the agriculture department depending on the individual state. If these agencies do not have the desired information, the consumer may wish to have a sample analyzed by a private water testing laboratory. It would be advisable to specify which contaminants the analyst is to look for in such cases, since the cost of the analysis is dependent on the number and nature of contaminants investigated.

Monoclonal-Based Tests for Respiratory Syncytial Virus, Adenovirus and Influenza Virus A & B. Analytab Products, Division of Sherwood Medical, 200 Express Street, Plainview, NY 11803.

ABSTRACT: Accurate and reliable-Four times faster than indirect method, Rapid, one-step direct immunofluorescent technique

Underground Storage Tank Management. Weston-ATC Inc., 1635 Pumphrey Avenue, Auburn Al. 36830.

ABSTRACT: EPA estimates that there are approximately 2,000,000 underground storage tanks (UTS) in the U.S. Most of these tanks contain petroleum products, petrochemicals or other chemicals. It is estimated that approximately 16,000 of these tanks contain hazardous waste. Various trade organizations and regulatory agencies have estimated that from two to 25 percent of these USTs are leaking. Products leaking from USTs can cause a variety of problems with enormous financial liabilities for the UST owner. Some products may leak from the UST and contaminate the surrounding soil and groundwater. Other products may travel through the soil as a vapor, accumulate in basements of nearby structures and reach explosive or toxic concentrations. In many cases, migration of both liquid and vapor phases will occur, endangering human health and the environment. Abandoning a nonleaking UST can cost the owner $10,000-20,000 depending on tank contents and final disposition of the tank. Remediation of

ORIGINAL PAGE IS OF POOR QUALITY
damage caused by leaking USTs can easily exceed $25,000 considering long term monitoring under an approved restoration and closure program. There are certain cases involving extensive soil and groundwater contamination in which remediation costs have exceeded $3 million. Lawsuits in excess of $2 billion have been filed for damages due to leaking USTs at a single service station. Clearly the UST problem impacts anyone involved with property on which UST is sited. Parties to a lawsuit resulting from a leaking UST (LUST) can easily include the property owner, the tenant (if the property is leased), real estate firms, mortgage bankers and lenders and the tank installer.


ABSTRACT: Over the years microbial biochemists have been challenged by the diversity of the metabolic reactions catalysed by members of the genus Pseudomonas and consequently their investigation of members of this genus has played a vital part in building up our knowledge of bacterial intermediary metabolism, particularly with respect to possible degradative routes. Latterly, interest in the pseudomonads has become much wider. Not only has the relative eclipse of Gram-positive bacteria as human pathogens revealed the presence of the so-called opportunistic pathogens (of which Pseudomonas aeruginosa is a particularly vicious example), but also pseudomonads have assumed a steadily increasing importance in industrial microbiology. Much of our knowledge of modern molecular biology has come from studies on Escherichia coli, but this organism is far from universally representative. It is to try to define what is known of another group of bacterial species of potential practical importance that these contributions have been collected and published in this form.


ABSTRACT: High amounts of B-glucosidase (MW 74,000) and B-galactosidase (MW 122,000) were isolated from the periplasmic space of Rhizobium trifolii 4S (infectious strain), compared with the cell homogenated. The characterization of B-glucosidase and B-galactosidase was determined. Both enzymes were inhibited by the addition of Cu2+, Fe2+, Zn2+, Hg2+ and p-chloromercuribenzoic acid. The B-glucosidase exhibited a strong hydrolytic activity on cellobiose, sophorose and laminaribiose to glucose, and the B-galactosidase degraded lactose and O-B-D-galactosyl-1,3-D-arabinoside to their respective components. Both enzymes hydrolyzed polysaccharide only slightly.


ABSTRACT: The U.S. Space Station being planned for the 1990s will
accommodate six or more crew members on 90-d flights in low earth orbit. Adequate nutrition will be essential for maintaining crew health, effectiveness and morale. Although much is known from prior space experience about in-flight metabolism, nutrition and associated food technology, important gaps in knowledge exist that need additional research, development and analysis to meet Space Station requirements. This paper is a synopsis of a report prepared by the Life Sciences Research Office (LSRO), FASEB, from a study of the nutritional and metabolic aspects of spaceflight. It reviews available data on the metabolic responses to spaceflight including extravehicular activity, physiological responses to microgravity that influence metabolism and energy needs, in-flight nutritional experience, space menus, food packaging, in-flight food service methodology, water supply and disposal of food wastes. The LSRO ad hoc Working Group identified critical gaps in knowledge and suggested corresponding research approaches for acquiring essential new data. The 38 research suggestions detailed in the report address in-flight metabolic needs, nutrient requirements, for systems and nutritional countermeasures.


ABSTRACT: A past study showed that bacteria can penetrate 0.2 μm rated sterilizing grade filters during long-term water service. However, it was demonstrated that 0.1 μm rated filters can retain 100% of these bacteria. Thus, the question of growth-through or penetration during periods of long-term water service can be resolved if a 0.1 rated (or finer) filter is used and properly maintained. Growth-through will not then occur. Concern over the breakdown of Gram negative bacteria collected on the filter surface, to give cell fragments which then may penetrate the filter, has been studied. These bacterial cell wall fragments, which contain endotoxins, have a negative charge in water and can be removed by a positively charged matrix.


ABSTRACT: Dynamica posture testing was conducted on the science crew of the Spacelab-1 mission on a single axis linear motion platform. Tests took place in pre- and post-flight sessions lasting approximately 20 min each. The pre-flight tests were widely spaced over the several months prior to the mission while the post-flight tests were conducted over the first, second, fourth, and sixth days after landing. Two of the crew members were also tested on the day of landing. Consistent with previous postural testing conducted on flight crews, these crew members were able to complete simple postural tasks to an acceptable level even in the first few hours after landing. Our test were designed to induce dynamic postural responses using a variety of stimuli and from these responses, evaluate subtle changes in the postural control system which had occurred over the duration of
the flight. Periodic sampling post-flight allowed us to observe the time course of readaptation to terrestrial life. Our observations of hip and shoulder position, when subjected to careful analysis, indicated modification of the postural response from pre- to post-flight and that demonstratable adjustments in the dynamic control of their postural systems were taking place in the first few days after flight. For transient stimuli where the platform on which they were asked to stand quickly moved a few centimeters fore or aft then stopped, ballistic or open loop 'programs' would closely characterize the response. During these responses the desired target position was not always achieved and of equal importance not always properly corrected some 15 seconds after the platform ceased to move. The persistent observation was that the subjects had a much stronger dependence on visual stabilization post-flight than pre-flight. This was best illustrated by a slow or only partial recovery to an upward posture after a transient base-of-support movement with eyes open. Postural responses to persistent wideband pseudorandom base-of-support translation stimuli were modeled as time invariant linear systems arrived at by Kalman adaptive filter techniques. Derived model parameters such as damping factor and fundamental frequency of the closed loop system showed significant modification between pre- and post-flight. This phenomenon is best characterized by movement of the poles toward increasing stability. While pre-flight data tended to show shoulders and hips moving in phase with each other, post-flight data showed a more disjoint behavior. One can speculate that this change illustrates a shattered postural organization or an acquired strategy not designed to stabilize terrestrial posture but as a carry over from optimum inflight postural control. Given our observations one can never be certain if these changes represent modifications in the physiology of posture or purposeful changes in strategy. As in other examples of motion behavior, the time domain analysis as represented by the step changes in position is not always reconcilable with the system modeling of pseudorandom responses and subsequent frequency domain analysis as represented by the pseudorandom noise stimuli. We present the observed data with arguments and some contradictions as to the nature of the adaptive changes which occur in the postural control system.


ABSTRACT: Acetivibrio cellulolyticus converts cellulose directly to ethanol, acetate, H2, and CO2. The effects of various physical and chemical parameters, and their interdependence, including pH, temperature, redox, and ethanol toxicity on this fermentation, were studied. Controlling pH at 6.8 favored a predominance of ethanol over acetate. Supplementation of the medium with additional reductant, concomitant with a lower redox potential, increased ethanol formation. Results from ethanol-challenged cultures indicated that cell lysis occurs with growing but not with nongrowing cells. A stable strain was adapted for growth in ethanol concentrations almost sevenfold
greater than the parent organism.


ABSTRACT: None


ABSTRACT: Quantification of body fluid redistribution and loss during space flight and observation of the effects on the heart were the aims of this experiment. The impedance of two body segments (Z-torso and Z-body) to a 100 kHz 1mA constant current, the first derivative of the torso segment and the ECG were recorded with a 24-hs personal recorder. Data were obtained from two astronauts during launch and reentry and inflight from another two. The recumbent period prior to launch is decisive for fluid redistribution in the compartments covered by this method. The amount of fluid shifted is comparable to that produced by daily positional changes. A fluid loss of about 2.51 can be inferred through the values of Z-body and anthropometric factors. Cardiac output, as assessed by dZ/dt, was increased more than 30% of control even of the 2nd inflight day; on the 4th day its values were however lower than pre-flight. It was not possible to demonstrate deconditioning effects on the heart of the payload specialists during this multidisciplinary Spacelab Mission. Heart rate and its variability strongly suggest increased cardiac parasympathetic activity.


ABSTRACT: It has been well documented that the presence of trace quantities of materials in ultrapure water can have a devastating effect on the yield percentage of semiconductor manufacturing operations. In the past ten years, this problem has been a major focal point for both manufacturers of water-purifying equipment and the analytical laboratories that test the water. The results of their combined efforts have led to a severe tightening of pure-water specifications. In spite of the tremendous improvements that have been made in the quality of pure water, however, it has become apparent that water specifications need to be tightened even more because of the reduced linewidths and film thicknesses of today's ICs. In order to tighten the specifications, it must be possible to measure smaller quantities of material in pure water—something it is not always possible to do using current methods of analysis.


ABSTRACT: During the next five years, we'll see much more widespread use of ozone in the semiconductor industry. More than 95% of all contamination problems that affect
semiconductor-device yields are caused by organic compounds. Specification for purified water will continue to tighten as further improvements occur in our ability to detect lower and lower levels of contaminants.


ABSTRACT: Reaching the mid-way point in the International Drinking Water Supply and Sanitation Decade is a fitting occasion to review the progress to date in achieving the Decade's goals. There is still time to benefit from both successful case histories and failures by learning how to overcome certain difficulties, modify approaches or redesign strategies. This article will review an international programme which monitors water quality, from the perspectives of the safety of drinking-water supplies and the protection of water resources on which such supplies depend. The significance of this activity will be only too apparent if one bears in mind that contaminated natural waters are the predominant cause of the most widespread diseases on earth today. The available statistics are alarming. It is reported (1) that over one-half of the world's population, or more than 2 billion men, women and children, at one time or another, suffer from infectious diseases due to exposure to polluted waters. Approximately 250 million new cases of waterborne or water-related diseases are reported each year, from which about 10 million die. The article will first outline the nature of waterborne diseases and the consideration of fresh water as a finite resource. The objectives, organisation and operation of the Global Environmental Monitoring System for Water (GEMS/Water) will then be presented. Finally, the water quality data that have been gathered over the years by the GEMS/Water programme will be critically reviewed.


ABSTRACT: A protocol for sampling environmental sites was developed and used to identify possible sources of Legionella species in support of epidemiologic investigations at two hospitals. In hospital A, legionellae were isolated from 43 of 106 (40%) different sites. Three separate Legionella pneumophila serotypes and a previously unrecognized species were present in different combinations in the positive samples. Two of five cooling towers contained the same L. pneumophila serogroup 1 monoclonal type (1,2,4,5) as was isolated from patients. The same monoclonal type was also isolated from make-up water for the two cooling towers, a hot water tank, water separators in four main air compressor systems for respiratory therapy, and cold and hot water faucets. In hospital B, 13 of 37 (38%) sample sites contained legionellae, all of which were L. pneumophila serogroup 1. The monoclonal type matching isolates from patients (1,2,4,5) was found at the highest concentration in a hot water tank, but it was also present at four other sample sites. Since legionellae not related to disease may be found in many of the
sites sampled, an epidemiologic association with the probable source should be established before intervention methods, such as disinfection, are undertaken.


ABSTRACT: The recent application of resazurin as a fluorogenic electron acceptor in the enzymatic analysis of bile acids has provided a simple and specific method for serum bile acid quantitation in clinical analysis [1,2]. The absence of blank sample fluorescence, which complicated previous enzymatic methods, has eliminated the need for preliminary solvent or resin extraction of serum [3,4] and has facilitated the application of automated methods [5]. Our studies, reported here, indicate that (a) the sensitivity can be enhanced by conducting the indicator step at pH 6.5, and (b) the assay can be quantitated by measuring changes of either absorbance or fluorescence.


ABSTRACT: The effects of three widely spaced levels of bacterial contamination of reagent water on several chemistry, radioimmunoassay, and coagulation procedures were studied. These included determinations of lactate dehydrogenase, creatin kinase, aspartate transaminase, alkaline phosphatase, blood urea nitrogen, total protein, thyroid-stimulating hormone, digoxin, thrombin time, activated partial thromboplastin time, and prothrombin time. Statistical analyses included calculations of means and coefficients of variation, and analysis of variance, as well as correlation coefficients for test results versus logarithm of bacterial contamination. Statistically and clinically significant differences occurred together only for an elevated level of creatine kinase.


ABSTRACT: We conclude from our results that the direct fluorometric procedure for serum quinidine no longer has a place in the management of quinidine therapy. The discrepancies that may arise with this method between the measured serum concentration and the actual clinical condition are simply unacceptable in view of the current availability of more specific methods.

Baugh P.J. Photodegradation and Photooxidation of Cellulose. Department of Chemistry and Applied Chemistry, University of Salford, UK.

ABSTRACT: Progress in the study of the photodegradation and photooxidation of cellulose and to some extent cellulose
derivatives in the last decade is reviewed with those aspects in which there have been significant recent advances receiving most attention. Direct and sensitized photooxidation of cellulose are discussed and model system work is treated in a parallel fashion. In relation to both, particular attention is paid to the recent flourish in activity in the study of the nature of free radicals generated in photoirradiated celluloses. This decade has seen a decline in activity of certain aspects of the photosensitized degradation of cellulose, particularly that concerning dye sensitzers, although the controversy over the involvement of singlet oxygen in relation to the validity of the activated oxygen theory in phototendering has continued during this period. Photoinitiated grafting is given some scope from the standpoint of the nature of the free radicals active in initiating the polymerization of added monomer, generated in cellulose by direct photolysis and via metal ion photosensitization. Work on the photostabilization and destabilization of cellulose derivatives is also summarized.


ABSTRACT: During the flight of Spacelab-1 a series of vestibular experiments was performed on the crew by a group of European investigators. Control experiments were carried out on the same subjects pre- and postflight. The tests included caloric stimulation of the ears, threshold measurements of response to linear acceleration, motion sickness provocative stimuli, vestibulo-ocular reflexes during linear and angular stimulation, estimation of the subjective vertical (luminous line measurements) and static ocular counterrotation at various tilt angles. The caloric experiment proved the existence of a nonthermoconvective mechanism of caloric nystagmus in space. Most of the other test results point to a greater dependence on visual and somatosensory than on otolith cues in the microgravity environment. Some results, in particular the raised threshold to perception of linear acceleration in flight and the temporary reduction of ocular counterrotation at lateral tilts postflight, suggest a decreased gain of the otolith system as a possible effect of space vestibular adaptation.


ABSTRACT: Enzymatically small quantities of native DNA and RNA in crude tissue homogenates can readily be specifically determined using ethidium bromide as a fluorescent indicator. The ethidium bromide-polynucleotide complexes of DNA and RNA serve as effective substrates for deoxyribonuclease and ribonuclease, respectively. Optimal divalent metal cation requirements were determined for a common reaction medium that is compatible for both the DNase and RNase reactions. To a single reaction mixture, that contains a biological sample, sequential addition of DNase and RNase produces a specific and rapid decrease in fluorescence that is proportional to the respective amounts of
DNA and RNA present. Levels of DNA and RNA found in six different tissues of the rat were determined enzymatically by this method and compared to that obtained by alternate techniques. Enzymatically determined values were highly reproducible and correlate well with those values obtained by more time-consuming, conventional methods. Most enzymatically determined RNA levels in tissues, however, were significantly greater than those levels obtained spectrophotometrically. Advantages of the enzymatic procedure for analysis of tissue polynucleotide content are: (1) rapid determination of both DNA and RNA within a single sample aliquot allowing maximum use of available sample; (2) extensive fractionation and extraction of the tissue are not required; (3) it is especially useful when quantities of tissue are limited; and (4) sensitivity to 0.05 and 0.25 ug of DNA and RNA, respectively. Reaction conditions developed for the assay also provide for a highly sensitive means to continuously monitor DNA hydrolysis; DNase activity is directly proportional to the amount of enzyme added.


ABSTRACT: In highly humic water, acridine orange precipitated with dissolved humic matter, resulting in such bright background fluorescence that no bacteria could be seen. With bisbenzimide staining, a similar precipitate was nonfluorescent but obscured many cells. An acriflavine staining method proved useful and reproducible both in clear and in humic waters. Fading of fluorescence was not a problem, and stained samples could be stored after preparation. The fluorescence of cells stained with acriflavine was weaker than that with acridine orange, making counting extremely small cells slightly more difficult with the former stain.


ABSTRACT: The purpose of these summary remarks is to put into proper focus the magnificent achievement created by the Skylab Medical Team in concert with their engineering colleagues and most importantly, the astronauts who had to serve as both investigators and subjects. Indeed, by their ingenuity and capability of handling the numerous problems encountered due to engineering deficiencies, they have shown man to be indispensable in long-duration space flight.


ABSTRACT: To study the value of phage sensitivity tests for the identification of phytopathogenic pseudomonanda, 284 isolates from various sources were examined for their sensitivity to 9
Phages. Phages came from infected plants (4), meat (2), manure (2) and from a culture of Ps. mors-prunorum, P27 (1). The main part of the study was concerned with isolates of Ps. syringae from lilac (6), stone fruits (22), pear (46), Ps. mors-prunorum (17), Ps. phaseolicola (16) and Ps. lachrymans (11), but single isolates of other phytopathogenic Pseudomonas spp. (30) were also examined. Strains of Ps. aeruginosa (5) and pseudomonads from soil, water and chicken meat (151) were included for comparison. Three of the phages 2, 12B and 33 from plant sources showed a high degree of specificity for Ps. phaseolicola, Ps. syringae (pear isolates) and Ps. syringae (lilac isolates), respectively, but in no case was this absolute. Most isolates of the 4 species studied in detail showed characteristic but not specific patterns with phages 12S, 15 and 21. Many of the phytopathogens were sensitive to phage 12S, but pseudomonads from soil, water and chicken meat were not lyzed by this phage. Of this latter group 44% were lysed by one or more of the phages from meat or manure (14, 15, 20 and 21). Ps. aeruginosa was not lysed by any of the phages. The ninth phage, P27, lysed a proportion of Ps. syringae isolates from pear but none of the other pseudomonads tested. Tests for oxidase, sucrose oxidation, gelatinase and lecithinase activity were found useful in conjunction with lesion tests for screening purposes. Many of the phytopathogens, especially those having affinities with Ps. syringae, were oxidase negative. From these results and those of other workers it is concluded that phage sensitivity tests can play a useful part in the identification of phytopathogenic pseudomonads, if used in conjunction with other tests. The importance of the host in connection with phage sensitivity patterns is emphasized; also the fact that isolates from a wide geographical area and saprophytes from the vicinity of the host plant need to be examined if an adequate assessment of the value of phage is to be obtained.


ABSTRACT: An interim determinative scheme for phytopathogenic Pseudomonas spp. by a variety of cultural and biochemical tests was suggested by Lelliott, Billing & Hayward (1966) following the study of 156 green fluorescent phytopathogenic pseudomonads. The phage sensitivity of these and 80 additional cultures to 20 phages from a variety of sources are described. Information on the morphology of these phages is now available (Bradley, 1963a). A few nutritional tests which seem to be of diagnostic value at the species level are also included and a relationship between the presence of a heat stable antigen (Lovrekovich et al., 1963) and phage sensitivity patterns is discussed.

Blumer M. Polycyclic Aromatic Compounds In Nature. :0035-0045.

ABSTRACT: These multiple-ring hydrocarbon molecules have been found in soils and sediments around the world. They are unusually stable, and their origins presented an intriguing puzzle.

ABSTRACT: The research components at the Camden Composting Project reflect each operation - dewatering, mixing, aeration, screening, curing, use - as sludge is processed into compost.


ABSTRACT: The emetic chemoreceptor trigger zone (CTZ), located in the area postrema of the medulla oblongata, is generally believed to be indispensable for the vomiting in motion sickness and by extrapolation, also in space sickness. Accordingly, it has been postulated that a "motion vomiting substance" is secreted into the cerebrospinal fluid in the emetic process. Furthermore, certain therapeutic measures against motion sickness are aimed at preventing the presumed chemical stimulation of the CTZ. This concept originated from laboratory experiments in which ablation of the area postrema protected some dogs and monkeys against motion-induced vomiting. More recent experiments, however, showed that verified lesions of the area postrema were not effective in preventing motion sickness in cats. It appears that an indispensable unidentified element close to but separate experiments. The overall evidence leads to the conclusion that the area postrema is not essential for motion-induced vomiting. Therefore, no functional basis exists for the postulation of a motion vomiting substance, and it is irrational for the treatment of motion sickness to seek pharmacologic blocking agents that act at the CTZ.


ABSTRACT: Seventeen officer aircrew, wearing soft contact lenses, were subjected to adverse conditions likely to be encountered in military aviation. The stresses included hypoxia, rapid decompression, pressure breathing, vibration, climatic extremes, G forces, and the prolonged wearing of an aircrew respirator. Their visual performance wearing contact lenses under stress did not differ significantly from the control values; either when wearing corrective flying spectacles or contact lenses when not under stress. It is considered that from the environmental standpoint soft contact lenses are suitable for aircrew. As contact lenses may not be tolerated by all, and may cause undesirable side-effects in some, their use should be restricted to the aircrew to whom they offer the maximum advantages. The group most likely to benefit are young, well motivated myopes flying fast jets.

Brorstrom E., Grennfelt P., Lindskog A. The Effect Of Nitrogen Dioxide And Ozone On The Decomposition Of Particle-Associated...
BIBLIOGRAPHY LISTING


ABSTRACT: The effects of NO2 and O3 exposure on the degradation of polycyclic aromatic hydrocarbons (PAH) during high-volume sampling of airborne particulate matter were studied. Addition of 1 ppm NO2 during ambient air sampling caused degradation of pyrene, benz(a)anthracene and benzo(a)pyrene, most probably due to nitration. Acid particles seem to enhance the reaction. The results indicate that NO2 concentrations within the range normally formed in urban air may cause degradation of some reactive PAH. Addition of 200 ppb O3 caused degradation in one of the three experiments only.


ABSTRACT: The effects of NO2 and O3 exposure on the degradation of polycyclic aromatic hydrocarbons (PAH) during high-volume sampling of airborne particulate matter were studied. Addition of 1 ppm NO2 during ambient air sampling caused degradation of pyrene, benz(a)anthracene and benzo(a)pyrene, most probably due to nitration. Acid particles seem to enhance the reaction. The results indicate that NO2 concentrations within the range normally formed in urban air may cause degradation of some reactive PAH. Addition of 200 ppb O3 caused degradation in one of the three experiments only.


ABSTRACT: Airborne transmission of infectious agents and associations of indoor air pollutants with respiratory illnesses are well documented. We hypothesized that energy conservation measures that tighten buildings also increase risks of respiratory infection among building occupants. At four Army training centers during a 47 month period, incidence rates of febrile acute respiratory disease were compared between basic trainees in modern (energy-efficient design and construction) and old barracks. Rates of febrile acute respiratory disease were significantly higher among trainees in modern barracks (adjusted relative risk estimate, 1.51; 95% confidence interval, 1.46 to 1.56), and relative risks were consistent at the four centers. These results support the hypothesis that tight buildings with closed ventilation systems significantly increase risks of respiratory-transmitted infection among congregated, immunologically susceptible occupants.


ABSTRACT: None

ABSTRACT: None


ABSTRACT: Alterations in the physiology of the cardiovascular system have been noted during all exposures to the microgravity experienced in space flight. Of most importance to the operational function of Space Shuttle crewmembers in orthostatic intolerance. Although complex changes occur as a result of adaptation to weightlessness, the redistribution and loss of body fluid apparently plays a substantial role. Utilizing ground-based bed rest data as an analog to the absence of gravitational force encountered in orbital flight, a saline loading countermeasure was developed. In this study, 17 crewmembers consumed various amounts of salt and fluid prior to the reentry phase of Space Shuttle flights; 9 other astronauts served as control subjects. The countermeasure reduced the heart rate response to orthostatic stress 29% and reversed the fall in mean blood pressure. A Cardiovascular Index of Deconditioning (defined as CID=delta HR - delta SBP+delta DBP) equaled 21 in those who utilized the countermeasure, a significant improvement toward baseline (p<0.003) when compared to the control group CID=49. The encouraging results of these investigations have led to the adoption of the countermeasure as an operational procedure by Shuttle crewmembers.


ABSTRACT: Echocardiographic measurements were obtained before and after space flight from 17 members of four shuttle crews. Measurements obtained 1 h after landing (L+0) compared with preflight values (n=7) demonstrated an increase in heart rate (HR) (16 beats/min, 30.5%, P < 0.05), mean arterial pressure (12%, P < 0.05), and systemic vascular resistance (34% P < 0.05). End-diasolic volume index (EDVI) fell 17 ml/m2 (-23%, P < 0.005) and stroke volume index (SVI) fell 15 ml/m2 (-28%, P < 0.05). Repeat measurements taken 1-2 wk later (n=17) demonstrated that HR had returned to normal (4 beats/min, P < 0.05); however, EVDVI remained significantly below preflight levels (-11%, P < 0.005). End-systolic volume index (ESVI) was also still significantly lower (-23%, P < 0.01). This delayed recovery occurred despite ability of the subjects to fully ambulate and exercise during the postflight period. These results indicate that spaceflight induces significant changes in heart volume affecting left ventricular function. The exact reasons for these specific
changes remain unknown and will require additional measurements before, during, and after flight. The prolonged recovery period for the present subject group probably relates to their high level of aerobic conditioning.


ABSTRACT: None


ABSTRACT: The evolutive characteristics as well as the qualification criteria applied in 21 cases of bifascicular blocks detected in a presumably healthy population consisting of 6,915 male individuals engaged in civilian flying activities (prevalence: 0.3%) were studied. The cases were divided in four groups according to the type and severity of the conduction disturbance. The sequence of conduction disturbances, ages and electrical axis rotation velocity are assessed. Bifascicular blocks may be complete or incomplete. The progression towards advanced conduction disturbances may affect the involved fascicles independently. Cases with incomplete bifascicular block have better prognosis, followed by those with primary conduction system disease. The mean time between the development of first and second conduction disturbance was 3.5 years. On an individual basis, once those etiologies which by themselves imply a future risk are ruled out, and provided they do not show evolutive features in frequent repeat evaluations, they may be waived for flying activities with a proposed maximum age of 60 years.


ABSTRACT: Ultraviolet radiation of the operating room was assessed bacteriologically in an open randomized study of 30 total hip procedures. Volumetric air-sampling demonstrated that the number of colony forming units (cfu m⁻³) were significantly reduced (P<0.001) by uv light, both close to the wound and in the periphery of the operating room. No adverse effects of uv-irradiation were observed either in the patients or the staff. In operating rooms fitted with a 'zonal ventilation' system and with an air change rate of about 70 h⁻¹, the addition of uv irradiation during surgery may achieve 'ultra clean' air. However, in conventionally ventilated operating rooms uv-irradiation alone is probably not sufficient to do so.

ABSTRACT: Cellulase yields of 250 to 430 IU/G of cellulose were recorded in a new approach to solid-state fermentation of wheat straw with Trichoderma reesei QMY-1. This is an increase of CA. 72% compared with the yields (160 to 250 IU/G of cellulose) in liquid-state fermentation reported in the literature. High cellulase activity 16-17 IU/ML) per unit volume of enzyme broth and high yields of cellulases were attributed to the growth of T. reesei on a hemicellulose fraction during its first phase and then on a cellulose fraction of wheat straw during its later phase for cellulase production, as well as to the close contact of hyphae with the substrate in solid-state fermentation, the cellulase system obtained by the solid-state fermentation of wheat straw contained cellulases (17.2 IU/ML), B-glucosidase (21.2 IU/ML), and xylanases (540 IU/ML). This cellulase system was capable of hydrolyzing 78 to 90% of delignified wheat straw (10% concentration) in 96 H, without the addition of complementary enzymes, B-glucosidase, and xylanases.


ABSTRACT: None


ABSTRACT: None


ABSTRACT: Two holding media were compared for their effects of total coliform recovery by the delayed-incubation membrane filter procedure. LES-MF holding medium contains tryptone, m-Endo broth, dipotassium hydrogen phosphate, sodium benzoate, sulfanilamide, para-aminobenzoic acid, and cycloheximide (pH 7.0). m-ST holding medium contains ethanol, sodium monophosphate, dipotassium hydrogen phosphate, sulfanilamide, and Tris (pH 8.6). In test with natural water and wastewater samples from various sources recovery with LES-MF and m-ST were similar after a 1-day holding period. With LES-MF, however, after a 2 or 3 day holding period, coliform bacteria frequently were partially or totally overgrown by noncoliforms, causing significant reductions in coliform counts. No significant overgrowth was observed with m-ST. We propose that m-ST be used for all holding periods longer than 1 day.


ABSTRACT: Instances of overt, serious functional impairment of space crews caused by adverse psychologic responses have not been scientifically documented. However, transient disorientation, spatial illusions, and visual disturbances as well as anomalous myopias, sleep disturbance, and instances of substandard
performance have been described. Moreover, anecdotal information describes significant psychologic aberrations in space flight. Adequate scientific data are lacking for optimal psychological and psychophysiological methods for crew selection, training, and performance evaluation, for identifying key psychosocial factors for crew compatibility, cohesiveness, and productivity, and for determining the effects of space flight on perceptual, intellectual, and motor skills. The ad hoc Working Group, converted to review psychological aspects of space flight, favored establishment of a comprehensive research and development program to address the deficiencies identified in the study.


ABSTRACT: The control of goal-directed arm movement and of body stability before, during, and 3 d after a 7-d spaceflight has been investigated. The findings show that the anticipatory and compensatory activities of the postural muscles were highly reproducible during the first days of the space mission. The sequence of these activities, studied in two situations- in which the platform either was fixed of could rotate about near the rotation axis of the ankle- was similar to a ground-based situation. The trajectory of various body segments demonstrated that a 7-d exposure to microgravity did not result in major changes in posture. Furthermore, vision seemed to play an important role in the control of standing posture at the beginning of the flight. Postural perturbations, elicited by unexpected displacements of the foot support, involved leg muscle reflexes whose amplitudes were greatly reduced compared to those on earth.


ABSTRACT: Radon-222 Levels in homes are known to undergo short-term fluctuations over times ranging from less than an hour to a few days, as well as long-term seasonal variations. Since we are usually interested in time-averaged 222RN Levels, it is important to know how well a measurement device determines this average. Clearly the average over a full year as can be done with a Beta track detector, and that is therefore unquestionable the most meaningful measurement. However, regardless of the desires of scientists, the great majority of measurements are made for 1 MO Or less during which seasonal variations are of negligible importance. For these, it is important to know how well they average over short-term fluctuations. In this paper, we consider that question, in particular, we determine the average deviation of a single measurement from the 1-MO Average.

Collins M.D., Jones D. Distribution of Isoprenoid Quinone Structural Types in Bacteria and Their Taxonomic Implications. Micro. Reviews, 45/2:0316-0354. 1981.
ABSTRACT: Chemotaxonomic methods, such as cell wall analyses and deoxyribonucleic acid base ratio and homology determinations, now figure prominently in microbial systematics. To date, the use of lipids as chemical characters has generally received less attention by bacterial taxonomists. However, studies involving fatty acid and polar lipid analyses have yielded encouraging results. A class of terpenoid lipids with a similar inherent potential in chemotaxonomy are the isoprenoid or respiratory quinones. Isoprenoid quinones are constituents of bacterial plasma membranes and play important roles in electron transport, oxidative phosphorylation, and, possibly, active transport. The results of the early studies indicated that the inherent structural variation exhibited by isoprenoid quinones might be of value in microbial systematics. The majority of subsequent studies on the isoprenoid quinones of bacteria have been preformed by biochemists, whose primary interest is in the function of these compounds in bacterial cells and not in their value as taxonomic markers. Over the last decade, however there have been a number of comparative studies designed to assess the value of these compounds in microbial taxonomy. Thus, there is now a comparable body of material on isoprenoid quinone structural types and their distribution in a large number of bacterial genera. However a great deal of this information is fragmentary and scattered through the literature in papers not necessarily concerned with taxonomy. Therefore seemed opportune to review the literature in this field and where possible, to attempt to evaluate the data in the context of taxonomic groupings based on other criteria.

Collins M.D., Jones D. Distribution of Isoprenoid Quinone Structural Types in Bacteria and Their Taxonomic Implications. Micro Reviews, 45/2:316-354. 1981.

ABSTRACT: Chemotaxonomic methods, such as cell wall analyses and deoxyribonucleic acid base ratio and homology determinations, now figure prominently in microbial systematics. To date, the use of lipids as chemical characters has generally received less attention by bacterial taxonomists. However, studies involving fatty acid and polar lipid analyses have yielded encouraging results. A class of terpenoid lipids with a similar inherent potential in chemotaxonomy are the isoprenoid or respiratory quinones.


ABSTRACT: A set of E. coli transformants (2,500) containing plasmid pBR322 with Thermomonospora YX DNA inserts larger than 3 kb was prepared. The transformants were screened directly for the ability to hydrolyze carboxymethyl cellulose. Two colonies exhibiting cellulase activity were found. One colony contains a plasmid (pD365) that contains a 7.6 kb insert, including the entire gene coding for the major endoglucanase activity of Thermomonospora YX. The other colony (D315) had two plasmids in it: pD316 contains a 8.5 kb insert which includes at least 80% of the major endoglucanase gene; pD315 contains a 6.6 kb insert and
does not express cellulase activity. Restriction maps were prepared for each plasmid and the endoglucanase gene was localized to a 2.3 kb SalI fragment in pD316 and to a 3.7 kb EcoRI fragment in pD365. These fragments were subcloned into plasmids containing active promoters regulated by the lactose repressor. The new strains each made 50 times more cellulase than the original strains. E. coli transformants containing plasmids pD316, pD365 and their derivatives secrete about 30% of their endoglucanase activity into the medium, 30% into the periplasmic space, while 40% remains in the cytoplasm.

Thermomonospora YX DNA restriction digests were fractionated by agarose gel electrophoresis and the fragments which hybridized to pD315 and pD316 were detected by nitrocellulose blotting techniques. The results indicated that each plasmid contains a single contiguous segment of Thermomonospora YX DNA and that the pD315 and pD316 inserts are linked in the Thermomonospora YX genome.


ABSTRACT: The Microbial Check Valve (MCV) is a flight qualified assembly that provides bacteriologically safe drinking water for the Space Shuttle. The 1-lb unit is basically a canister packed with an iodinated ion-exchange resin. The device is used to destroy organisms in a water stream as the water passes through it. It is equally effective for fluid flow in either direction and its primary method of disinfection is killing rather than filtering. The MCV was developed to disinfect the fuel cell water and to prevent back contamination of stored potable water on the Space Shuttle. This paper reports its potential for space applications beyond the basic shuttle mission. Data are presented that indicat the MCV is suitable for use in advanced systems that NASA has under development for the reclamation of humidity condensate, wash water and human urine.


ABSTRACT: The use of a mid-infrared transmitting fiber to carry the infrared beam of an FT-IR spectrometer outside of the optical bench is reported. In addition it is demonstrated that it is possible to analyze samples using the fiber as an Internal Reflection Element. The fiber is covered with a protective coating which can be removed for a short region, to allow contact with the sample over a controlled length. Two examples of the use of an optical fiber for remote sampling are discussed. The first shows that a spectrum of a liquid sample (2-butanone) may be easily measured, and the second shows how a fiber may be used to monitor the progress of a curing reactions in thermoset composite materials. The spectrum of a resin was recorded before
the cure by embedding the optical fiber in the graphite fiber/polyimide matrix resin prepreg, and then the progress of the cure monitored during the curing process. This type of remote sampling shows tremendous potential for opening totally new areas of usage for FT-IR spectrometry, including the studies of hazardous materials, enclosed reactions, and processes that do not allow samples to be taken inside the spectrometer.


ABSTRACT: None


ABSTRACT: Purified cell walls from Streptococcus mutans strain BHT were prepared without the use of proteolytic enzymes in order to retain all cell wall constituents for chemical analysis. Of four methods employed, the Ribi cell fractionator produced disrupted cell suspensions which could be most thoroughly purified on sucrose gradients. Results of chemical analyses on purified cell walls prepared in this manner represented 99.2% recovery. They indicated the presence of 6.8% protein, 8.9% glycerol teichoic acid, 33.6% non-peptidoglycan polysaccharide, and 49.9% peptidoglycan.

Cornet P., Millet J., Beguin P., Aubert J.P. Characterization Of Two (Cellulose Degradation) Genes Of Clostridium thermocellum Coding For Endoglucanases. Biotechnology, 1983.

ABSTRACT: Two structural genes, celA and celB, coding respectively for the endoglucanases A and B of Clostridium thermocellum, were subcloned from cosmids of a gene bank into plasmid pBR322. Both genes are carried in a DNA sequence of about 2.7 kb. They share no homology and are not contiguous on the C. thermocellum chromosome. They are expressed in E. coli independently of their orientation in the colonizing vector.


ABSTRACT: In many aspects, an Antarctic Station provides parallels to the environments encountered in space exploration, particularly with reference to infectious disease. In both instances, small groups of people live in isolation for long periods of time in a functionally sterile atmosphere. Therefore, studies of infectious disease in Antarctica should provide important insights into the experiences to be expected in spaceflight. This paper presents a summary of the information on the infectious and immunologic aspects of isolation derived over the years from research in Antarctica.

ABSTRACT: This report discusses one of the inherent limitations of cancer studies in animals and humans and presents a qualitative carcinogen risk assessment of a number of pesticides based on the judgement of national and international authorities who have reviewed the available experimental and epidemiologic evidence. A large number of pesticidal compounds have shown evidence of genotoxicity or carcinogenicity in animal and in vitro screening tests, but no pesticides except arsenic and vinyl chloride (once used as an aerosol propellant)- definitely have been proved to be carcinogenic in man. Resolution 94 (1-86), which was referred to the Board of Trustees, calls for the American Medical Association, through its scientific journals and publications, to alert physicians to the potential hazards of agricultural pesticides, to provide physicians with advice on such hazards for their patients, and to urge that these substances be appropriately labeled. This report addresses the potential carcinogenicity of pesticides by review of the available literature.


ABSTRACT: A group of 23 phages, mainly isolated with Pseudomonas mors-prunorum and Ps. syringae as the propagating strains, was tested against more than 200 pseudomonads including named plant pathogens and a variety of saprophytes. The majority of the phages had a wide host range, and did not distinguish between plant pathogens and saprophytes, thus confirming the close relationship between these two groups. The most reactive bacteria were 60 English isolates of Ps. mors-prunorum, 48 from cherry and 12 from plum, and 28 isolates of Ps. syringae from pear. Patterns of reaction within these 3 groups were relatively homogeneous and each group was distinct and differed from all other isolates tested. Ps. syringae isolates from other hosts were less uniform and occasionally shared reaction patterns with other species, e.g. Ps. cannabina and Ps. glycinea. Similar relationships were observed with phages at both high titre and at routine test dilution including the difference in phage sensitivity between the cherry and plum strains of Ps. mors-prunorum. On the basis of 7 biochemical tests the plum and cherry strains were indistinguishable but they differed from all Ps. syringae isolates tested by giving white growth in 5% sucrose broth and in failing to liquefy gelatin. Furthermore, unlike most Ps. syringae isolates they were also unable to hydrolyze aesculin and were tyrosinase positive. There was no clear evidence in this investigation of correlation between phage sensitivity and biochemical activity. Eleven isolates from various European countries, designated Ps. mors-prunorum, differed widely both in phage sensitivity and biochemical activity and some of them may be more appropriately called Ps. syringae. Others may be intermediate forms between these species. The relationship between Ps. mors-prunorum and Ps. syringae and the nomenclature of these organisms are discussed and a concept of ecotypes suggested as a substitute for species.

ABSTRACT: "Simulator sickness" describes a symptom complex frequently reported by pilots during or after flight simulator training. There were 112 helicopter pilots at a U.S. Army AH-1 Cobra Flight Weapons Simulator (FWS) who completed a symptom-oriented objective questionnaire. Of these, 40% reported symptoms of dysequilibrium; pilots developing simulator sickness had significantly more total and AH-1 flight time. Adaptation of the syndrome occurred with increasing FWS experience. The history and aeromedical significance of simulator sickness are briefly reviewed, and a case report presented. A mandatory grounding policy in use locally is described. Potential treatment strategies are briefly discussed.


ABSTRACT: Strains of Zymomonas mobilis were examined for their ability to act as recipients of plasmid DNA and for the relatedness of native plasmids which these strains harbor. We conclude that the high ethanol producing strains CP3 and CP4 are identical.


ABSTRACT: We describe a patient who presented with renal failure after a one-year period of unprotected heavy occupational exposure to organic solvents. Renal biopsy results and serological findings were diagnostic of anti-glomerular basement membrane antibody-mediated glomerulonephritis. An analytic review of the literature revealed substantial evidence linking solvent exposure to the development of glomerulonephritis (GN), with seven of nine case-control studies demonstrating a statistically significant association. Odds ratios were reported by or could be calculated for six of these studies, and the five positive studies detected a 2.8 to 2.9 fold increased risk for GN among solvent-exposed individuals. The findings in several of these studies of dose-response relationships, the reports of variations in disease severity in relation to exposure intensity, and the absence of alternative explanations for the association provide additional supportive evidence for a solvent effect. In the majority of cases of anti-glomerular basement membrane antibody-mediated GN and other types of GN, there is no remarkable preceding exposure to organic solvents. However, we conclude that in the case presented herein and in cases of GN with similar exposure histories, solvent exposure may play a significant contributing role in the development of GN.

ABSTRACT: The period of development of a new drug averages 10-15 years from initial invention of the chemical structure to approval for general use. In the US, the current cost can approach 100 million dollars, while elsewhere it can be approximately 15-20 million pounds sterling. Two main stages are involved in drug development: the preclinical stage comprises chemistry (synthesis, purification, patenting), pharmacology, pharmacokinetics and toxicology in animals and pharmaceutical development of dosage forms; the clinical stage includes four phases which embrace all studies done in man. The major aim of drug development is a safe and effective product. If a drug causes many minor side effects, or one serious one, development will probably be stopped unless the drug is of unique clinical benefit. However, for some drugs unusual serious adverse drug reactions (ADR) have been identified for the first time after marketing, benoxaprofen (Opren), indomethacin slow release, and zimeldine. In these cases the incidence of the ADR was so low, about 1:10,000-1:100,000 patients treated, that it was impossible to identify even in the large-scale clinical trials done before marketing; it follows that this type of rare ADR cannot be avoided even with extensive testing before marketing, and this must be accepted if development of new drugs is to continue.

This paper reviews the development programme of new drug (new chemical entity, NCE) taking approximately 5-7 years form initial administration to man to the point of approval for marketing by the various European and North American regulatory authorities.


ABSTRACT: Sixteen cultures of lactic acid bacteria were freeze-dried in 10% nonfat skim milk plus 0.75 M adonitol and rehydrated by using different rehydration media. Marked variations in their capacity to repair cellular damage after freeze-drying were observed among the species and strains under consideration.


ABSTRACT: In the present study, mPA-D and mPA-E agar, modifications of mPA-C agar that reduce background fecal streptococci that interfere with the differentiation and enumeration of the Pseudomonas aeruginosa colonies grown in other mPA media, are proposed for use in analyzing natural water samples. In addition, the efficiencies of several culture media for the recovery of P. aeruginosa in water after membrane filtration and multiple-tube techniques are compared. The degree of selectivity, precision, efficiency, and sensitivity achieved with the proposed media exceeded that achieved by current methods. Furthermore, they yielded equal rates of accuracy and specificity. Incubation at 36 C resulted in an improved recovery
of stressed P. aeruginosa. In conclusion, we propose the use of mPA-D and mPA-E agar, both incubated at 36 C for 24-48 h, for analyzing river water and seawater, respectively.


ABSTRACT: In this study, 20 human volunteers received a placebo and atropine doses of 0.5, 1.0, 2.0, and 4.0, mg 75 kg-1 in a Latin Square double blind design, and effects were monitored for 3 h postinjection. The 2.0 mg and the 4.0 mg doses resulted in significant flight simulator performance decrements beginning at 1 h postinjection with only minimal recovery by 3 h postinjection. Electrocardiogram data were used to estimate the amplitude of respiratory sinus arrhythmia (RSA) which was more sensitive than mean heart period or mean heart period variance to the effects of atropine. These parasympathetic effects were relatively rapid in onset and peaked within the first 40-min period for the 2.0 and 4.0 mg doses. The onset of performance effects were delayed 1 h 40 min for the 2.0 mg and 1 h 00 min for the 4.0 mg treatments.


ABSTRACT: Aircrew were studied before and after flying one of two routes: San Francisco (SFO) to London (LHR) or SFO to Tokyo (NRT). After an adaptation night, sleep and daytime sleepiness were objectively measured in SFO and during the first layover (L/O) of the target trip. Baseline sleep was slightly shorter than normally reported for similar age subjects and, for several reasons, is not an ideal basis for subsequent comparison. Nevertheless, L/O sleep periods tended to provide either less total sleep or less efficient sleep. Crewmember's estimates of their sleep duration correlated well with objective measures, but estimates of daytime sleepiness correlated poorly with objectively measured sleepiness. During baseline there was a significant midday sleep tendency as measured by the Multiple Sleep Latency Test. This tendency occurred at almost the same time (GMT) on the second L/O day in LHR. Since sleepiness has a persistent rhythm which is maximal twice per day, it is suggested that L/O sleep periods be taken at these times of maximal sleepiness and that peak workload should coincide with the subsequent periods of maximal alertness. Although the overall quality of sleep diminished only slightly on this L/O, it is possible that if this relatively small loss accumulated over successive L/Os, the effects on daytime sleepiness could be measurable.


ABSTRACT: Providing the different kinds of water used in health
care institutions is a formidable challenge. Water is used in the cleaning of equipment, in medical support equipment such as artificial kidney machines and respirators, in the preparation of infant formulas and injectable solutions, and so on. As steam, water is used in heating equipment, in autoclaves, in steam cookers, and in steam sanitizers. The water needed may be ordinary municipal tap water, or it may be high-purity water. This article discusses the uses of high-purity water, some considerations for determining the type of water required, and different methods for providing these special types of water.


ABSTRACT: Chemical and biological methods for delignification coupled to enzymatic hydrolysis of freed cellulose are being studied at the Northern Regional Research Center, Peoria, Ill. The immediate objective is enhanced production of alcohol from biomass. The oyster mushroom, Pleurotus ostreatus, NRRL 2366, was grown on native wheat straw (WS) amended with ammonium sulfate, urea, or oatmeal. The fungus degraded the lignocellulose in WS, as evidenced by 10 to 45% and 15 to 55% decreased in lignin and cellulose, respectively, after 36 days. The initial lignin and cellulose utilization was also greater with oatmeal amendment. Soluble reducing sugars in WS remained constant during the first 15 days of incubation; however, free reducing sugars increased twofold to threefold the remainder of the fermentation period regardless of nitrogen amendment. The in vitro digestibility of WS as measured by release of reducing sugar after cellulase treatment increased twofold to threefold after a 90 day fermentation period. Fermented WS thus would have improved digestibility in animal diets and the mycelium should contribute increased nutritional value.


ABSTRACT: None


ABSTRACT: The purpose of this study was to determine the minimum space-suit pressure required to prevent decompression sickness (DCS) during operational conditions in a 50% oxygen/50% nitrogen environment. In this study, 30 male volunteer subjects were exposed in groups of three, to three consecutive daily extravehicular activity (EVA) simulations at 7.8 psia (5,031 m altitude equivalent) for a continuous period of 6 h. During each altitude exposure, the subjects participated in similar exercise workloads expected to be experienced by astronauts during a
typical EVA scenario. Precordial Doppler monitoring revealed that 73.3% of the subjects had intravenous bubbling during at least 1 d of the 3 h of exposure, with 26.7% remaining bubble-free during the entire study. No correlation was found between either body fat or age and incidence of bubble formation. One case of DCS occurred during the study indicating that 7.8 psia is not sufficient pressure to preclude DCS in a 50% oxygen/50% nitrogen environment. The necessary pressure awaits further study.


ABSTRACT: Three enzymes in single cells were assayed dynamically by flow cytometry using four fluorogenic substrates. Acid phosphatase was determined with 7-bromo-3-hydroxy-2-naphtho-o-anisidine (naphthol AS-BI) phosphate and 4 methylumbelliferone (MU) phosphate, neutral esterase with fluorescein diacetate, and lactic dehydrogenase with NAD-sodium lactate. Fluorescence measurements obtained with the flow cytometer were converted into relative specific enzyme activities for single cells with molar fluorescence coefficients determined with a spectrofluorometer. Specific activities obtained from spectrofluorometric data were compared with activities for 4-methylumbelliferone phosphate hydrolysis and for lactic dehydrogenase than did similar assays by standard spectrofluorometry. Product diffusion may be the greatest cause for this discrepancy.


ABSTRACT: We measured endotoxin and bacterial levels in tap water, in water purified by reverse osmosis, and in dialysate samples over a 4-month period in a new 10-bed renal dialysis unit. Water treated by reverse osmosis is conducted to 10 stations through 111 m of piping composed of acrylonitrile butadiene styrene (ABS). All determinations were made prior to the opening of the unit and after the system was purged for 35 h with all bedside station taps open. Formaldehyde disinfection of the piping system was attempted with a recommended protocol after 11 weeks by feeding 2.5 liters of 37% formaldehyde (0.85%, vol/vol) into the delivery system. Prior to water purging, 24 ng of endotoxin per ml was detected. This level decreased to 2.0 ng of endotoxin after the purging. Levels of endotoxin remained below 1.0 ng of endotoxin per ml throughout the duration of the study. In contrast, the level of viable microorganisms recovered from the treated water was approximately 3.5 times 10,000 CFU/100 ml. Even after disinfection of the system, there was no significant decrease in culturable bacteria from the water even though endotoxin levels were lower. Species isolated from the renal dialysis system were predominately pseudomonads, whereas species isolated from the tap water were Bacillus and Flavobacterium species. ABS provides a surface suitable for
long-term colonization and growth of bacteria. Currently recommended decontamination protocols are ineffective in removing potentially pathogenic bacteria from ABS pipes and thus constitute an increased risk to patients undergoing dialysis.


ABSTRACT: High-resolution solid-state 13C NMR spectra of cellulose II samples and of the complete series of solid cellulose oligomers up to cellohexaose have been obtained by using cross-polarization/magic-angle spinning (CP/MAS) techniques. Comparison of the spectra of the solid oligomers with those of cellulose II preparations indicates that the characteristic features of cellulose II structure appear in the cellotetraose spectrum and are fully developed in those of cellopentaose and of the higher oligomers. Thus a single-crystal X-ray structure determination on one of the higher oligomers should reveal the details of the cellulose II structure that the 13C NMR data suggest is made up of two independent chins. A comparison of the chemical shifts for samples of cellulose I, II and IV shows characteristic displacements of C-4 and C-6 carbons for each polymorph.


ABSTRACT: A large proportion of drinking water is abstracted for treatment from lowland rivers—about 30% in the UK—and this water is at particular risk from sudden and poisonous industrial or agricultural pollution. To cover the range of potential pollutants it may be possible to use biosensors as broadband monitors for toxins. The underlying assumption is that some biological processes, when challenged with a toxin, will be affected in a way analogous to that of man, and that therefore on-line scrutiny of such processes will provide early warning of substances liable to be detrimental to human health. Suitable processes for study might involve multi-cellular organisms, whole cells or enzymes. To date, most practical work has concentrated on fish, but enzymes and single cells hold out the promise of quicker response and, possible, easier maintenance.


ABSTRACT: None


ABSTRACT: A comprehensive mechanistic kinetic model for enzymatic hydrolysis of insoluble cellulose has been synthesized by combining models for several key aspects which have been derived
independent of each other. The model takes into account the major contributing factors: the nature of the enzyme system, the structure of cellulose, and the mode of interaction between the enzyme and cellulose molecules. It consists of set of simultaneously occurring ordinary-differential equations with ten kinetic constants. All of the kinetic constants have been determined independently by carrying out critically designed experiments, and they appear in the comprehensive model without any arbitrary manipulations. The governing equations of the model have been numerically simulated by means of the computer subroutine CSMP III. The model predicts the progress of hydrolysis of cellulose over a wide range of experimental conditions and hydrolysis times reasonably well. The model can even be applied to predict the progress of hydrolysis for intensively pretreated cellulose with a minor adjustment. The applicability of the model for the actual process development is also discussed.


ABSTRACT: This review emphasizes the structure and morphology of cellulose, which are pertinent to understanding the enzymatic hydrolysis of cellulose. Physical and chemical constraints on the susceptibility of cellulose to hydrolysis will be examined. In addition, the relationship between the capillary structure of cellulose fiber and enzymatic hydrolysis will be discussed.


ABSTRACT: The effect of the application of the compartmentalization/airlock on accidental decompression was studied in conscious rats, mice, and guinea pigs. It was observed that in unprotected rats and mice, 78 of 102 middle ears (76.5%) exhibited hemorrhages with their eardrums intact; and in unprotected guinea pigs, 37 of 50 eardrums (74%) revealed rupture associated with hemorrhages of all middle ears (100%). Seven cases of malleus fractures (14%) were also found in unprotected guinea pigs. On the other hand, none of the protected animals showed signs of middle ear barotrauma. The protective effects of the tolerance of middle ears in the present study showed the same tendency as that on the tolerance of lungs in our previous study. These findings indicate that the application of the compartmentalization/airlock would be of great value in protection against accidental rapid decompression of pressurized aircraft and space craft.


ABSTRACT: It has been shown that, although iodinated
swimming-pool waters are usually free from coliform bacteria and enterococci, the total counts frequently become relatively high. Pseudomonas alcaligenes and Alcaligenes faecalis have been shown to account for most of these high counts. It was of interest, therefore, to compare the microbial flora of four alternately chlorinated and iodinated swimming pools. By means of the membrane filter method and suitable selective media, examinations were made for total viable counts, coliform bacteria, enterococci, staphylococci, Streptococcus salivarius, and P. aeruginosa. Colonies also were picked from membrane filters incubated on standard plate count agar and identified. The results showed that, although viable counts were significantly higher during the iodinated periods, the specific types of bacteria determined were either fewer than or the same as in chlorinated periods. During chlorination, the predominant microbial flora consisted of staphylococci and members of the genus Bacillus. During iodination, however, the P. alcaligenes-A. faecalis group accounted for 92 to 99% of the microbial flora. The accumulation of high numbers of these bacteria was shown to be due to their iodine resistance and their ability to grow rapidly in pool water in the absence of free iodine.


ABSTRACT: None


ABSTRACT: The cell-associated b-glucosidase activity of Thermomonospora fusca, strain YX, showed both PNPGase and cellobiase activities. The cellobiase activity was found by HPLC assay to have very low product inhibition, whereas the PNPGase activity was more significantly inhibited. Of the various sugars and sugar analogs tested for inhibition of the PNPGase activity, gluconolactone had the greatest effect. The low product inhibition of the cellobiase activity was further demonstrated by the production of glucose syrups to 20% concentration from both cellobiose and swollen cellulose (Avicel). This characteristic is of practical importance in the development of a commercial process for the production of glucose syrups from cellulose. Growth experiments gave further evidence for the probability of separate enzymes for the PNPGase and cellobiase activities.


ABSTRACT: None

Fishman N. Patient Smart. Miles Inc. Diagnostics Division,
Elkhart, In. 46515.

ABSTRACT: Months of data are stored in the patient's Glucometer M Blood Glucose Meter, then reported through my office computer or the Glucofacts Data Printer. Seeing all that information at once lets me make faster, better decisions about treatment regimens.


ABSTRACT: Psychophysical matching techniques were employed to equate the subjective experience of motion in two roll-axis motion simulation devices: the RATS, a whole-body motion environment, and the dynamic seat sub-system of the ASCOGS, presenting motion cues through a moving seat pan. Two psychophysical techniques, cross-modality matching and magnitude estimation, yielded similar results. These results indicated that motion sensitivity increased with roll angular frequency for both simulators. However, the rate of increase at high frequencies was greater for the RATS than for the dynamic seat. These results were used to design a filter for the dynamic seat which enhanced high-frequency signal components. Tests in a roll-axis tracking task showed that performance in the dynamic seat using this filter was both quantitatively (in terms of r.m.s. error) and qualitatively (in terms of frequency characteristics) similar to performance in the whole-body motion environment.


ABSTRACT: Cellulase production by Trichoderma reesei mutant RUT-C30, immobilized on 4% k-carrageenan beads, was monitored in continuous culture for 13 days. Cellulase production averaged 26.0 Filter Paper Units (FPU)/L/hr; carbon and nitrogen requirements per FPU produced were reduced to 1/4-1/2 those of conventional continuous culture.


ABSTRACT: None


ABSTRACT: Activated carbon was used for the treatment of waste water, and a study made of the fixing-properties of the adsorbent and the part played by micro-organisms. The process of "fixing" remains to be demonstrated because it has not yet been proved that bacteria are fixed on carbon. Study of the biological mechanism of activated carbon was carried out in three stages. The first was a survey of the adsorption on this material of various products present in waste water (amino-acids, enzymes,
total organic matter (COD)). In the course of these tests, the part played by the micro-porosity of activated carbon in regard to such molecules was observed. In the second stage, by using various techniques (electron microscope, scanning and transmission, X-ray fluorescence, Castaing micro-gauge), we determined the part played by fixation-spots initially present on carbon (surface functions, heavy metals) during bacterial development. In the third stage, we correlated the eliminated organic pollution with the bacterial mass present on the adsorbing material. The conclusions drawn were that the micro-porosity of carbon does not play a fundamental part in the adsorption of organic matter in sewage, but it does come into play in the adsorption of certain molecules taken separately (amino-acids, enzymes), and that the presence of fixation-spots (metals, surface functions) can have some influence during bacterial development. Experiments are in progress to determine the part played by the specific surface in regard to the adsorbable molecules and its correlation with the bacterial mass and also, to observe the part played the adsorbing material and the bacteria in regard to the non-adsorbable molecules (ethanol, methanol).


ABSTRACT: The use of digital computers in fermentation processes has increased in recent years. There have been several works dealing with data acquisition, parameter and state estimation, optimization, and control of such processes. There is considerable activity both in industry and research institutions in the use of digital computers for optimal control of fermentation systems. However, there still remains some unsolved problems. This article presents some results obtained when modern control techniques are applied to these processes. The article is organized as follows. A discussion about the main problems of computer control of fermentation processes is first presented. The objectives of computer-aided fermentations are mentioned. Then, a simple process model of a continuous culture fermentation process is described. This process model will be used throughout the work to test some control laws designed for a certain class of nonlinear multivariable systems. The synthesis of these control laws is detailed later. One of the main problems in the implementation of a control law is accessibility to the state vector. This problem is discussed and some methods to overcome the problem, in a fermentation process, are also presented. In particular, the design and realization of observers for the substrate concentration are described. The designed observers are included in a feedback control structure for nonlinear systems and the obtained simulation results are presented.


ABSTRACT: In 1985, the Man-Systems Division at the Johnson Space
Center initiated a program for the development of a whole body shower suitable for operation in a microgravity environment. Supporting this development effort has been a systematic research program focused on four critical aspects of the design (i.e., human factors engineering, biomedical, mechanical, and electrical) and on the interfaces between the whole body shower system and the other systems to be aboard the Space Station (e.g., the water reclamation and air revitalization systems). A series of tests has been conducted to help define the design requirements for the whole body shower. Crew interface research has identified major design parameters related to enclosure configurations, consumable quantities, operation timelines, displays and controls, and shower and cleanup protocols. Mechanical research has provided data on relative humidity, air and water temperatures and flow rates, liquid and gas separation, and system efficiency. Electrical research has characterized and quantified the power requirements for an optimized system. Biomedical research not only has provided data relevant to the identification and control of microorganisms introduced into the system by human usage but also has led to a new area of research; that is, a study of the effects of biofilm within the shower system. Defining the interfaces between the whole body shower system and the other Space Station systems and determining the impact of the whole body shower system on the performance of those systems are of paramount importance in this development program. In order to define these interfaces, a closed-loop test was conducted with the water reclamation system to evaluate the effects of the shower waste water on the design of the water reclamation system.


ABSTRACT: A whole body shower (WBS) can be designed and fabricated to include the human engineering concepts necessary to satisfy the hygienic, physiological, and social needs of crewmembers engaged in long-duration space missions while being compatible with the Space Station mechanical systems (e.g., the water reclamation system). Moreover, the microbial buildup in the shower system can be maintained at a safe level by selecting components that do not harbor microorganisms and by establishing appropriate cleaning procedures.


ABSTRACT: None


ABSTRACT: It is known that the early period of adaptation to weightlessness occupies the first 5-7 days of space flight.
During this time period many physiological changes that constitute the so-called space adaptation syndrome develop. A comprehensive study of this syndrome was the primary goal of physiological investigations of four monkeys flown onboard Cosmos-1514 and Cosmos-1667 in 1983 and 1985. The flight duration was 5 and 7 days, respectively.


ABSTRACT: In prolonged space flights, the cardiovascular function was examined at rest and during provocative tests. As compared to the preflight data the following changes were seen: higher heart rate at rest and during LBNP test, decrease of stroke volume at rest and during LBNP test and a less marked increase (or decrease) during exercise test, symptoms of a greater heart load which transformed to the syndrome of myocardial hypodynamics (preload) during LBNP test or to the syndrome of myocardial hyperdynamics (afterload) during exercise test (with other than preflight ratios of systolic and diastolic time intervals). The above cardiovascular changes did not, as a rule, aggravate with flight time and can be viewed as adaptive reactions to microgravity.

The above cardiovascular changes were primarily produced by fluid redistribution in the cranial direction, diminished participation of the muscle system in circulation, and involvement of unloading reflexes from the cardiopulmonary receptor zones.


ABSTRACT: None


ABSTRACT: More recent problems associated with cellulase production, pretreatment of cellulosic substance and their accessibility to enzymatic hydrolysis are discussed. Important aspects of mathematical models based on the kinetics of cellulose-cellulase system are briefly reviewed.


ABSTRACT: The development and performance of a novel solid-bed two-phase anaerobic digestion system are described. The system consists of a bed of organic feed operated in tandem with an acid-phase slurry digester and a methane-phase upflow anaerobic filter. The bed and the acid-phase digesters liquefy and convert the organics to volatile fatty acids (VFA) without gas production, while a high methane-content product gas is collected
from the methane-phase filter. With municipal refuse feeds, VFA and ethanol were the major products from acid-phase digestion. A high methane content (up to 88 mol %) gas was the major product from the methane phase filter.


ABSTRACT: A coupled-enzyme assay for the specific and sensitive fluorometric determination of S-aminolevulinic acid (ALA) dehydratase has been developed. This assay is at least 10 times more sensitive than the existing colorimetric methods for porphobilinogen (PBG) quantitation using p-dimethylaminobenzaldehyde. The coupled-enzyme assay for ALA dehydratase is similar to the second stage of the ALA synthase fluorometric assay detailed by Bishop et al.


ABSTRACT: Although wood hydrolysis has been practiced on a commercial scale during wartime conditions and is still practiced in the USSR, renewed interest and development work has been generated by the energy crisis, with ethanol from glucose fermentation assuming the role of a leading potential liquid fuel extender for gasoline. Recent developments in both enzymatic and acidic hydrolysis of wood are reviewed.


ABSTRACT: The influences of alginate on the attachment of Vibrio alginolyticus and Vibrio pelagius biovar II to stainless steel was investigated. When the bacteria were in stationary phase, alginate decreased the number of attached bacteria in the case of each Vibrio sp. In contrast, when V. pelagius biovar II was grown on alginate and harvested in log phase, attachment was increased. This effect may be due to nutrient availability at the surface or to receptors on the bacterial surface which interact with alginate adsorbed to the metal.


ABSTRACT: Approximately one-half of the lignin and most of the hemicellulose present in agricultural residues such as wheat straw and corn stover are solubilized when the residue is treated at 25 C in an alkaline solution of hydrogen peroxide. The delignification reaction is most efficient when the ratio of hydrogen peroxide to substrate is at least 0.25 (w/w) and the pH is 11.5. The supernatant fraction from a given pretreatment, after addition of makeup peroxide and readjustment of the pH, can be recycled to treat at least six additional batches of
substrate, resulting in a substantial concentration of hemicellulose and soluble lignin degradation products. Hydrolysis of the insoluble fraction with Trichoderma reesei cellulase after alkaline peroxide treatment yields glucose with almost 100% efficiency, based upon the cellulose content of the residue before treatment is a simple and efficient method for enhancing the enzymatic digestibility of lignocellulosic crop residues to levels approaching the theoretical maximum.


ABSTRACT: An international research team has carried out an electroencephalographic study of sleep and wakefulness in flight crews operating long-haul routes across seven or eight time zones. Following baseline recordings, volunteer crews (n=56) from four airlings spent their first outbound layover at a sleep laboratory. This paper provides an overview of the project's history, its research design, and the standardization of procedures. The overall results are remarkably consistent among the four participating laboratories and strongly support the feasibility of cooperative international sleep research in the operational arena.


ABSTRACT: An international research team has carried out an electroencephalographic study of sleep and wakefulness in flight crews operating long-haul routes across seven or eight time zones. Following baseline recordings, volunteer crews (n=56) from four airlings spent their first outbound layover at a sleep laboratory. This paper provides an overview of the project's history, its research design, and the standardization of procedures. The overall results are remarkably consistent among the four participating laboratories and strongly support the feasibility of cooperative international sleep research in the operational arena.


ABSTRACT: None


ABSTRACT: This report concerns the use of intramuscular injections of scopolamine, promethazine, and dramamine to treat severely motion sick individuals participation in parabolic flight experiments. The findings indicate that a majority of individuals received benefit from 50 mg injections of promethazine or 0.5 ml injections of scopolamine. By contrast, 50-mg injections of dramamine and 25-mg injections of promethazine were nonbeneficial. The use of antimotion drug injections for treating space motion sickness is discussed.


ABSTRACT: Ample literature and symposia now exist which examine questions of enzymatic degradation of cellulose. The intent of this work is to describe the isolation of a factor from a commercial Trichoderma reesei preparation and to demonstrate that this factor interacts with filter paper cellulose to generate microfibrils without causing release of water-soluble carbohydrates, and synergistically interacts with chromatographed
cellulase protein peaks such that the amount of substrate solubilized by a specific amount of protein fraction is increased. Visual evidence of microfibril generation is demonstrated by scanning electron-micrographs (SEM).


ABSTRACT: Anterior pituitaries from "small" (250 g) and "large" (400 g) rats flown on the 7 day Spacelab 3 mission were pooled and trypsinized into two single-cell suspensions. Compared with ground-based controls, flight cells appeared to contain more intracellular growth hormone (GH) but release less GH over a 6 day culture period. After implantation into hypophysectomized rats, both sets of flight cells released only 50% of the GH compared with the control cells. Glands from large flight rats contained 44% somatotrophs compared with 37% for controls; small animals showed no difference. There were no striking differences in somatotroph ultrastructure between cells in the four groups. Western blot analysis indicated that there were no major differences in immunoactive GH variants. High-performance liquid chromatography fractionation of culture media indicated that small flight cells released much less of a high-molecular weight variant rich in GH bioactivity. The results suggest that GH cells from rats exposed to microgravity may experience secretory dysfunction. The possibility that this occurs directly at the pituitary cell level is discussed.


ABSTRACT: None


ABSTRACT: For many years, membranes were confined to specialty applications, usually as delicate, often expensive, and frequently low-volume separation devices. With a few exceptions, industrial membranes were feeble imitations of the biological masterpieces found in living organisms. However, in the mid-1970s this picture changed abruptly. New membrane materials began to appear, the technique of making composite membranes was developed, and the integration of membrane separators into chemical processing technology accelerated. Today, membranes have found wide acceptance in the traditional chemical and petroleum refining industries, as well as a new role in the rapidly developing specialty chemicals industries, where highly selective catalysis is essential and where catalyst use must be intimately combined with pre- or postreaction preparation and separation. This article focuses on efforts to develop and expand applications for some of the more conventional operations employing membranes in high-volume industrial operations. A future article will look at some of the more exotic developments.
making use of membranes.


ABSTRACT: With industrial demands growing for better separation and/or purification in chemical, petroleum, pharmaceutical, biotechnology, and other areas, membrane technology has been attracting more and more attention. This article examines many of the smaller scale operations that are now using membrane technology or are seen as potential application areas. An earlier C&EN article focused on efforts to develop and expand applications for some of the more conventional operations employing membranes in high-volume industrial separations.


ABSTRACT: Although vast amounts of cellulosic materials are synthesised annually the absence of mountaious regions for the polymer testify to the efficacy of cellulolytic microbes in its removal to cell protein and related products. Unfortunately, man has so far been unable to emulate in the laboratory this remarkable ability of certain bacteria and fungi and has turned to pretreatment of cellulosic matter. Such procedures cover four main areas, chemical, physical, enzymic and a combination of these. Native cellulose, the form most resistant to biological degradation is ready swollen at low temperature in as little as two hours in certain acids and becomes 10-20 times more susceptible to hydrolysis, even by enzyme preparations from microorganisms not normally considered cellulolytic. Susceptibility to enzyme hydrolysis can be increased even further by extending acid treatment to dissolve cellulose thence to be followed by its reprecipitation in a very finely divided form (regenerated cellulose). Enzyme preparations from either Myrothecium verrucaria or Trichoderma spp readily achieve complete dissolution of regergerated cellulose within 24 hr. Unfortunately chemical treatment like the use of alkalis provides swollen material of relatively low density. An alternative procedure that might prove useful here since it provides large surface areas and is applicable not only to purer forms of cellulose but also to naturally occurring cellulosic material such as grass, straw, hay and sawdust utilises the ability of dilute peroxide and iron salts to disintergrate the substrate to very short fibers. Physical treatments including ball-milling offer considerable promises since they can increase susceptibility and yield products of high bulk density. Finally, the use of cellulase preparations themselves to provide increased contact surface by comminution natural fibers should be considered. This reaction constitutes and early stage through which crystalline cellulose passed before solubilisation is extensive and can be expedited considerably by agitation. Non-cellulolytic enzyme preparations from such microbes as M. verricaaroa can also accomplish this stage. It is a property freely available in crude enzyme extracts of such
microbes as well as in filtrates from the cellulolytic varieties. As such it would appear to offer some advantages and interesting possibilities in view of the wider range of microbes available and recent proposals for improving the economy of enzymic saccharification by recovering cellulase with fresh inputs of substrate.


ABSTRACT: None


ABSTRACT: Angiotensin-converting enzyme (ACE) is a dipeptidyl carboxypeptidase which hydrolyzes angiotensin II to produce the vasopressor angiotensin II and degrades the vasodepressor bradykinin (1,2). The enzyme is a vascular endothelial cell ectoenzyme (3,4) and is widely distributed in various mammalian tissues (4-7), but it is also present in parenchymal cells of kidney, where it plays a role in regulation of aldosterone formation and renal function (2,4,8). Recently, ACE was detected in epitheloid and giant cells in vivo (9), and in monocytes and macrophages in vitro (10,11). The assay of ACE in tissues usually is done spectrophotometrically as ethyl-acetate-extractable hippuric acid released from the synthetic substrate, hippuryl-L-histidyl-L-leucine (hip-His-Leu) (12). However, insensitivity of the method limits ACE measurement in some tissues (6). Roth and his co-workers (13,14) first designed a more sensitive fluorometric method using o-phthaldialdehyde-coupled L-histidyl-L-leucine (His-Leu) produced from N-benzyloxycarbonyl-L-phenylalanyl-His-Leu (15). The substrate was subsequently changed to hip-His-Leu by Yang and Neff for assay of ACE in rat brain (16). Although the assay method was further modified by Friedland and Silverstein (17), it still had a drawback. Since most animal tissues contain His-Leu peptidase (18), the apparent value obtained by fluorometric ACE assay required an adjustment for His-Leu peptidase activity. Silverstein and co-workers used a mathematical correction for measuring ACE in tissues and macrophages in man (10,11,19,20) and animals (21). We measured levels of both ACE and His-Leu peptidase in murine tissues by fluorometric assay and sought an inhibitor of His-Leu peptidase activity. Among various alcohols tested, n-butanol was found to selectively inhibit His-Leu peptidase, but not ACE. ACE levels were then established in 12 tissues and in subcellular fractions of lung, kidney, and liver by inhibiting His-Leu peptidase with n-butanol.

Harris M.I. Classification And Diagnostic Criteria For Diabetes And Other Categories Of Glucose Intolerance. Chapter II, Attachment J.8.1.

ABSTRACT: Diabetes mellitus comprises a heterogeneous group of
disorders characterized by high blood glucose levels. Four major types of diabetes have been defined by the National Diabetes Data Group: insulin-dependent diabetes (IDDM), noninsulin-dependent diabetes (NIDDM), gestational diabetes (GDM), and diabetes secondary to other conditions. In addition, impaired glucose tolerance (IGT) is a class that encompasses persons whose glucose tolerance is intermediate between normal and diabetic. Diabetes can be diagnosed by the presence of classical signs and symptoms of diabetes and unequivocally elevated blood glucose levels; by a fasting plasma glucose greater than or equal to 140 mg/dl; or by an abnormal oral glucose tolerance test, with a venous plasma glucose value greater than or equal to 200 mg/dl at 2 hours after 75 grams oral glucose being a hallmark criterion for diabetes.


ABSTRACT: Specific alterations in autonomic functions induced by endurance training may lead to a reduced ability to withstand orthostatic stress. This possibility has caused some authorities to suggest that, because of potentially greater pooling of blood in the lower extremities during gravitational loading, endurance-trained athletes may make poor astronauts. Although results from spaceflight studies have provided little evidence to support this suggestion, data from water-immersion studies indicate that endurance-trained athletes do become more orthostatically intolerant following a few hours of simulated weightlessness. Unfortunately, other evidence supporting the hypothesis that endurance training reduces orthostatic tolerance has not received adequate publication in the open scientific literature.

On the other hand, a number of studies which have been openly reported clearly refute this hypothesis. Nevertheless, the established physiological differences between endurance athletes and non-athletes are themselves sufficient to suggest that the hypothesis could be tenable. Consequently, it has to be concluded that the presently available information is both qualitatively and quantitatively inadequate to permit any definitive statement regarding a possible relationship between aerobic power and orthostatic tolerance.


ABSTRACT: More and more mission specialists are being trained to operate in the Space Shuttle and to eventually maintain a permanent station in space. Since up to 48% of the general population wears a visual correction of some sort, it is logical to assume that this percentage will also be found in the astronaut population. This paper proposes that the soft contact lens can be worn successfully in the space environment. The contact lens of choice is the continuous-wear soft contact which is proving to be quite successful for the general public. These lenses must be fitted at least 6 months before space flight in order to make sure they can be worn successfully.
ABSTRACT: A fluorometric system to determine the kind and amount of substances derived from a biological fluid (e.g., serum or urine) or tissue in which the substances to be detected (e.g., antigen, antibody, hormone or enzyme) are coated onto a substrate surface in fluorescent form. Multiple coating areas of different samples may be employed. The fluorometric system includes a source of filtered light to excite fluorescence, optical systems for conducting the excitation light to such coating, and optical systems for receiving emitted fluorescence and for detecting the same. The system efficiency and optical characteristics disclosed avoid photobleaching; limit fading; and are especially adapted to provide accurate surface reading fluorometry.


ABSTRACT: A fluorometric system to determine the kind and amount of substances derived from a biological fluid (e.g., serum or urine) or tissue in which the substances to be detected (e.g., antigen, antibody, hormone or enzyme) are coated onto a substrate surface in fluorescent form. Multiple coating areas of different samples may be employed. The fluorometric system includes a source of filtered light to excite fluorescence, optical systems for conducting the excitation light to such coating, and optical systems for receiving emitted fluorescence and for detecting the same. The system efficiency and optical characteristics disclosed avoid photobleaching; limit fading; and are especially adapted to provide accurate surface reading fluorometry.

Henney M.R., Knopp K.D. Shuttle Air Monitoring. NIS/LSL Test Plan Number 79-875.

ABSTRACT: None


ABSTRACT: The supply of pure water through a piping network can best be assured by following a number of validation procedures during installation.


ABSTRACT: Enterobacter cloacae attached to drinking water distribution particles was subjected to chlorination. Attachment resulted in the protection of these organisms from disinfection. This effect was found to be dependent upon both the level of chlorine in the system and attachment time. The results obtained in this study indicate that attached organisms may play an important role in coliform outbreaks.

ABSTRACT: Fundamental physiological principles have been invoked to design compatible environments for a space suit, space station, and the space craft used to transport the astronauts from Earth. These principles include the long-term memory of tissues for a bubble-provoking decompression, the intermittent nature of blood flow in the tight connective tissues responsible for the bends whose incidence in aviators have been shown to be related to bubble volume by the Weibull distribution. In the overall design an astronaut breathing a mixture of 30% oxygen in nitrogen for 4-5 h in a space craft at 11.9 psia can transfer to a space station filled with the same mix at 8.7 psia and, after a further 4-5 h, go EVA at any time without any oxygen prebreathing at any stage. The probable incidence of decompression sickness has been estimated as less that 0.5% using the present suit operating at 4.3 psia but the risk could be reduced to zero if the suit pressure were increased to 6.5 psia.


ABSTRACT: The need to monitor certain key biochemical parameters in hospitalized patients is driving the development of biosensors, a new class of medical device for real-time, on-line quantitative analysis. A biosensor is a microelectronic device that utilizes a biological molecule (e.g., antibody, enzyme, or receptor) as the sensing or signal-transducing element. Biosensors can be configured into simple, rapid, and cost-effective laboratory devices that will allow the clinical pathologist to become even more responsive to the primary care physician. In those instances where measurements on discrete samples do not provide the required information, continuous monitoring with implantable biosensors could provide real-time data on levels of critical endogenous or exogenous substances. By hybridizing recent advances in transdermal substance collection with the analytical capabilities of biosensors, devices for continuous noninvasive monitoring at the bedside can be envisioned. The clinical pathologist can and should play a key role in the clinical evaluation and implementation of such technological advances.

Igarashi M., Kobayashi K. Space Motion Sickness and Space Vestibulology. Department of Otorhinolaryngology and Communicative Sciences, Baylor College of Medicine, Houston, Texas, U.S.A., :0228-0236. .

ABSTRACT: Given the relatively short period of the space flight missions and more inexperienced personnel expected to be aloft, if the time in space should be optimized, the critical processes which occur in the body equilibrium system during the period of initial exposure to space environment must be thoroughly investigated. It is most important that improved management of space motion sickness (including the prediction, prevention and
countermeasures) is properly developed. The improvement will fully depend on advances in our research on the etiology and pathology of this debilitating condition.

Inman F.N. Filtration And Separation In Antibiotic Manufacture.

ABSTRACT: The manufacture of a typical semi-synthetic antibiotic is described in detail. The preparation of the initial culture, the fermentation stage, the extraction and preparation of bulk sterile product and the final filling of vials with sterile powder or solution for injection together use many forms of filtration and separation. In this respect, antibiotic manufacture is similar to other large-scale fine chemical manufacturing processes, but there is the additional and essential requirement for contamination control as extraneous micro-organisms can adversely affect antibiotic production in many ways, and some stages have to be operated aseptically for reasons that are self-evident. The high demands made upon the equipment are discussed and practical applications described.


ABSTRACT: A system of tangential-flow filtration was evaluated for use in the detection of Giardia cysts in drinking water. This method was more sensitive in recovering cysts than a frequently used wound-orlon system of throughfiltration


ABSTRACT: Water used during current and previous space missions has been either carried or made aloft. Future human space endeavors will require some form of water reclamation and recycling. There is little experience in the U.S. space program with this technology. Water reclamation and recycling constitute engineering challenges of the broadest nature that will require an intensive research and development effort if this technology is to mature in time for practical use of the proposed U.S. Space Station. In order for this to happen, reclaimed/recycled water specifications will need to be devised to guide engineering development. Present NASA Potable Water Specifications are not applicable to reclaimed or recycled water. Adequate specifications for ensuring the quality of the reclaimed of recycled potable water do not exist either within or outside of NASA. NASA experience with potable water systems is reviewed, limitations of present water specifications are examined, world experience with potable water reclamation/recycling systems and system analogs is reviewed, and an approach to developing pertinent biomedical water specifications for spacecraft is presented. Space Station water specifications should be designed to ensure the health of all likely spacecraft inhabitants.
including man, animals, and plants, both separately and collectively.


ABSTRACT: A study was performed to evaluate decompression procedures suggested for use prior to Space Shuttle extravehicular activity. Hematological parameters were measured in 12 male human subjects before and after exposure in an altitude chamber to a 3-day staged decompression schedule, with simulated extravehicular activity. Following the exposure, significant increases occurred in white blood cell count and activated partial thromboplastin time, and platelet aggregate ratio was significantly decreased. Pre-exposure samples from subjects who were susceptible to formation of venous gas emboli (VGE) exhibited a significantly lower degree of ADP-induced platelet aggregation and a significantly higher amount of lymphocyte blastogenic transformation in response to the mitogen phytohemagglutinin than samples from VGE-resistant subjects. The results indicate that, following this decompression profile, small but significant changes occur in several hematological parameters, and that levels of certain parameters may be related to susceptibility to VCGE formation during decompression.


ABSTRACT: Women are now being exposed in increasing numbers to environmental hazards. Normal operations in that environment plus accidents of training procedures may result in conditions such as decompression sickness, air embolus, hyperoxia, or carbon monoxide poisoning occurring in a woman who also happens to be pregnant. This article examines the animal data and human experience in these conditions in both early and late gestation. The risk of these conditions to the mother and fetus is assessed compared to the problems associated with hyperbaric oxygen therapy (HBO) in pregnancy. Suggestions are made regarding the appropriate use of HBO therapy in pregnancy. Further medical investigation is requested.


ABSTRACT: None


ABSTRACT: None

Johnson P. Saliva: A Way To Obtain Specimens In An Operational
ABSTRACT: None


ABSTRACT: As space missions become longer and broader in scope, and as crews become more heterogeneous, psychological and interpersonal factors will take on increasing importance. In order to isolate instructive psychosocial issues and trends, a review was made of over 60 American and Russian simulation and spaceflight studies and reports. Although the missions accomplished most of their goals, psychological and social stresses were evident in the crew members. Psychosocial problems tended to relate to mission length. There was evidence that the use of appropriate psychological testing and interpersonal sensitivity training could improve crew selection and ameliorate problems in the simulation studies. It is time to apply this knowledge to actual spaceflight conditions.


ABSTRACT: As future manned space missions become longer, and as crews become more heterogeneous, psychological and interpersonal factors will take on increasing importance in assuring mission success. On the basis of a review of more than 60 American and Soviet space simulation studies on Earth, along with reports from U.S. and Soviet space missions, the author identifies nine psychological and seven interpersonal issues, which are discussed along with pertinent research findings and examples from manned spaceflights. He concludes that more psychological and interpersonal research should be done under actual spaceflight conditions and offers suggestions.


ABSTRACT: A series of vestibular experiments were performed in conjunction with the first Spacelab mission, consisting of sets of pre-, in- and postflight tests. A multipurpose experimental apparatus used for the diverse flight and ground test is presented. Additional apparatus together with the multi-purpose package were used in the baseline data collection facility at the landing site at NASA Dryden Flight Research Facility for the ground tests. The tests involved optokinetic, caloric and mechanical (whole-body of head alone) stimulation. The latter included linear acceleration in the subjects' xyz axes, static roll and yaw about an earth-vertical axis. Physiological parameters such as electro-oculogram (EOG), blood-volume-pulse (BVP), respiration, as well as the stimulus variables such as acceleration and caloric temperature were transmitted to the

ORIGINAL PAGE IS OF POOR QUALITY
ground and recorded there. The flight and ground testing schedules are outlined. Problems arising from this complex venture are discussed, and some suggestions are made for future improvement.


ABSTRACT: Vibrio vulnificus was isolated from United States West Coast estuaries at a low frequency (5.9%) from 529 samples of water, shellfish, and sediment. Four strains tested with iron-treated mice had 50% lethal dose values ranging from 7.6 to 360 CFU, compared with a 50% lethal dose of 4.9 CFU for a clinical isolate that caused the death of a septicemic patient. The presence of this pathogen may be a hazard to users of marine beaches and consumers of raw shellfish on the West Coast, especially to persons most susceptible to V. vulnificus septicemia. Species-specific antiflagellar serum and a gene probe for cytotoxin-hemolysin production were useful for screening these environmental isolates.


ABSTRACT: The incidence of Vibrio cholerae in shellfish, sediment, and waters of California, Oregon, and Washington was determined during the summer of 1984. Samples from 24 distinct estuaries were analyzed qualitatively. V. cholerae non-01 was found in 23 estuaries and in 44.6% of the 529 samples examined. V. cholerae 01 Inaba was isolated from water samples from water samples in Morro Bay, Calif. Vibrio mimicus was found in 2.3% of the samples. Cholera enterotoxin was not found in cell-free filtrates of the 100 isolates tested in the Y-1 mouse adrenal cell assay, but heat-labile cytotoxic activity was observed with 3% of the isolates.


ABSTRACT: The use of screens to detect "significant levels" of pathogenic microorganisms in urine specimens offers the advantages of both rapidly reporting results and controlling costs. Many of these screens, however, are insensitive at microbial counts below (10)5 colony-forming units (CFU)/ml of urine. It is increasingly apparent that patients with almost any type of urinary tract infection (except for most patients who are asymptomatic or who have pyelonephritis) may have urine concentrations of pathogens as low as (10)2 to (10)3 CFU/ml. This review documents factors that can contribute to diminished concentrations of microorganisms in urine, lists patient population in whose urine microorganisms in concentrations well
below (10)5 CFU/ml have been associated with infection, and makes recommendations for selection of laboratory tests, including rapid screens, for the diagnosis and management of urinary tract infections.


ABSTRACT: None


ABSTRACT: The type stain Fontaine of Clostridium thermoacetemicum proliferated on H2/CO2 as energy source and was culturally adapted to grow on 100% CO in the headspace. The doubling times at 55°C on CO of H2/CO2 were 16 and 18 h, respectively. Under these conditions, the substrate-product transformation stoichiometries observed were: 4H2 + 2.1 CO2 = 0.9 acetate and 4 CO = 2CO2 + 1.1 acetate. It is concluded that C. thermoacetemicum has a single carbon growth physiology.


ABSTRACT: None


ABSTRACT: In microgravity (micro-g) when the hydrostatic component of the intravascular pressure is eliminated, a redistribution of body fluids occurs leading to a fluid shift towards the cephalic parts of the body. Therefore, elevated venous pressures should be expected in the vein of the upper part of the body as compared to the values on ground. However, our measurements during the Spacelab 1 Mission failed to show this. It was thought that 22 h after entry into the micro-g environment, when we had the first chance to measure, adaptive mechanisms had already counteracted this pressure increase. Therefore, the attempt was made to measure venous pressure as early as possible during the D1 Mission.


ABSTRACT: None


ABSTRACT: The influence of several operating variables on the
productivity and nutritional quality of Candida utilis under carbon-limited growth conditions was studied. Four responses were analyzed: biomass yield (Y), in vitro dry matter digestibility (d), nucleic acid content, and protein content (F). Three operating variables were studied: dilution rate, temperature, and carbon-nitrogen ratio in the growth medium. Correlation describing the influence of operating variables on the studied response parameters were developed. From these correlations response surfaces were drawn. A new function, alpha-PdY, is proposed as a more comprehensive criterion for selecting the optimal conditions under the constraint of satisfying multiple objectives. It is demonstrated to be superior to the yield coefficient alone in this respect, since it accounts for factors that are important to the nutritional aspects of the process.


ABSTRACT: None


ABSTRACT: A rapid high performance liquid chromatographic (HPLC) method is described which offers a fast quantitative procedure for determining the percentage of guanine (G) plus cytosine (C) in DNA preparations after acid hydrolysis in 83% formic acid. As little as 10 µg of DNA is amenable to this analysis. Although thymine is sometimes poorly resolved from impurities at the solvent front, the percentage of G+C was found to be accurately determined using adenine (A) simply from the ratio of concentration from C/(A+C) or (G+C)/(2A+G+C). The HPLC method gave values for the percentage of G+C in close agreement with thermal melting point and buoyant density values determined for the DNA of ten bacterial species and two fungi.


ABSTRACT: Existing methods for quantitating yeasts in beverages include time-consuming plate counts that detect only living cells and hemacytometer counts that are reliable only at very high concentrations (e.g., 10^6 to 20 x 10^6 cells per ml). The new method described here involves the use of fluorescence microscopy with the fluorescent stain aniline blue to differentiate yeasts (and other fungi) from backgrounds for easy counting and also may be used in conjunction with membrane filtration to concentrate yeasts from liquids before cell enumeration. Recoveries averaged 91.5% for beverages spiked with levels of 500 to 600,000 organisms per ml. The correlation coefficient of count to spike levels was 0.996%.

ORIGINAL PAGE IS
OF POOR QUALITY

ABSTRACT: Orally administered metoclopramide (REGLAN) at doses of 10 or 20 mg, 75 min prior to either stressful linear acceleration (parabolic flight) of cross-coupled accelerative semicircular canal stimulation in a rotating chair was evaluated for its ability to prevent emesis or nausea 11, respectively. Although metoclopramide is an effective antiemetic agent that enhances gastric emptying and prevents cancer chemotherapy-induced emesis, we were unable to demonstrate any significant (p<0.05) effects of this drug on motion sickness.


ABSTRACT: Sympathomimetic agents are frequent components in antimotion-sickness drug combinations because of their usefulness in counteracting the sedation caused by stressful motion or resulting from the administration of other antimotion-sickness drugs. The noradrenergic neurochemistry of the brain's arousal-attentional systems prompted us to evaluate the efficacy of five new sympathomimetic drugs and to further define the role of arousal in susceptibility to motion. Subjects were orally administered methamphetamine (20 mg), phenmetrazine (25 mg), phentermine (37.5), methylphenidate (20 mg), or pemoline (75 mg) 2 h prior to taking a Staircase Profile Test. All of the drugs increased resistance to stressful Coriolis stimulation by 80-120%. Methylphenidate and pemoline showed fewer side effects. These findings, interpreted in conjunction with the documented inefficacy of most anticholinergic and antihistaminergic drugs tested to date, suggest that sympathomimetic drugs of a generalized state of arousal can inhibit the development of motion sickness.


ABSTRACT: This study will be initiated in order to assay preflight and postflight samples from the Shuttle crewmembers for medically important aerobic bacteria and to determine the microbial load of the inner surfaces of the Orbiter before and after flight.


ABSTRACT: Aniline, a toxic organic pollutant, occurs in a number of industrial effluents. Apart from carbonaceous oxygen demand, aniline imposes a nitrogenous oxygen demand, due to its nitrogen content, in excess of that required for cell growth. Incomplete
biodegradation will result in ammonia production; this also exerts toxicity. Hence, nitrification of aniline should be ensured in the biological treatment before discharge into receiving streams. Aniline, however, is reported to inhibit the nitrification process. Aniline degradation was studied in laboratory continuous activated sludge with an acclimated culture developed in synthetic feed to determine the extent of complete biological degradation. Aniline-N (even at 400 mg/L aniline concentration) could be converted to nitrate-N with ammonium-N and nitrite-N formed as intermediates at a detention time of 24 h. The nitrification, however, was suppressed by aniline. The degradation of aniline to ammonia releases the suppression and the nitrification proceeds rapidly.

Kutch J.M. Letters To The Editor. Pride And Professionalism, .

ABSTRACT: None


ABSTRACT: Episodes of emesis unaccompanied by the usual prodromal signs of motion sickness have been reported by astronauts in the space shuttle program. Such reports have raised the issue whether space motion sickness has different characteristics from terrestrial motion sickness. We present evidence here from parabolic flight experiments that sudden vomiting can occur in response to a provocative vestibular stimulus even when no premonitory exposure conditions, the absence of prominent signs of symptoms of motion sickness does not necessarily mean an absence of sensitization.


ABSTRACT: Space motion sickness has become an operational concern in manned space flight. Considerable evidence exists that head movements in free fall, especially pitch movements, are provocative until adaptation occurs. The question arises whether space motion sickness is an unique nosological entity of is due to body movements in a non terrestrial force environment, a force environment for which the body's dynamic sensory-motor adaptions to 1 G are no longer appropriate. To evaluate this issue, we had subjects make controlled head movements during exposure to high gravito inertial force levels, 1.8-2.0 G, in parabolic flight maneuvers. Head movements in pitch with eyes open were most evocative of motion sickness, yaw movements with eyes covered were least provocative. This pattern is identical to that which occurs when the same types of head movements are made in the free fall phase of parabolic maneuvers. It appears that space motion sickness is the consequence of prolonged exposure to a non-terrestrial force background rather than of exposure to free fall per se.

ABSTRACT: Coriolis, cross-coupled angular acceleration stimulation readily induces motion sickness under terrestrial conditions. Nevertheless, the Skylab astronauts, when tested with such stimulation in-flight, sure insusceptible event though each had been susceptible preflight. It is unclear whether this decreased susceptibility was the consequence of in-flight adaptation of in part the result of immediate changes in sensory-motor and vestibulo-motor function that occur during exposure to microgravity conditions. To evaluate this issue, we have tested individuals both in the high and low force phases of parabolic flight maneuvers using constant levels 1) subjects are less susceptible when tested in 0 G than +2 Gz 2) the perceived intensity and provocativeness of Coriolis stimulation decreases in 0 G and increases in +2 Gz relative to +1 Gx baseline values; and 3) changes in the apparent intensity of Coriolis stimulation occur virtually immediately when background gravitoinertial force level is varied. These findings explain in large part why the Skylab astronauts were refractory to motion sickness during Coriolis stimulation in-flight. The general implication for space motion sickness are discussed.


ABSTRACT: The investigation was carried out in cooperation with the helicopter school AF 1 in Boden. Measurements were made in two different types of helicopter, Hkp 3 and Hkp 6. Three different parameters were recorded during the flights: noise, vibration, and wakefulness. Noise and vibration exposures were mainly correlated to the main rotor energy and frequency. Both types of exposure were dominated by lower frequencies, below 10 Hz. Analyses of wakefulness during long-distance flights, about 4 h, and short-distance flights, less than 2 h, were based on EEG and EKG recordings. As expected the level of wakefulness was influenced by the stress upon the pilots. Take-offs and landings, as well as unexpected events during the flight, were correlated to an increased level of wakefulness. In some cases flying was correlated to a gradual increase of weariness. The correlation between weariness, types of flying, and the external environmental factors of noise and vibration, is also discussed.


ABSTRACT: Previous studies have shown that a decrease in red cell mass occurs in astronauts, and some studies indicate a leukocytosis occurs. A life science module housing young and
mature rats was flown on shuttle mission Spacelab 3 (SL-3), and the results of hematology studies of flight and control rats are presented. Statistically significant increases in the hematocrit, red blood cell counts, and hemoglobin determinations, together with a mild neutrophilia and lymphopenia were found in flight animals. No significant changes were found in bone marrow and spleen cell differentials of erythropoietin determinations. Clonal assays demonstrated an increased erythroid colony formation of flight animal bone marrow cells at erythropoietin doses of 0.02 and 1.0 U/ml but not 0.20 U/ml. These results agree with some but vary from other previously published studies. Erythropoietin assays and clonal studies were performed for the first time.


ABSTRACT: Injection of Iodine (I2) into water is widely used to control microbial growth. An advanced, entirely automated Device for I2 injection has been developed for spacecraft application. Transfer of I2 into the water from a concentrated form is controlled electrochemically via feedback from an integrated photometric I2 Level Detector. All components are contained within a package weighing only 1.23 kg dry, occupying only 1213 cm³ of space, and having the capacity to iodinate 10,900 kg of water to 5 ppm. These features exceed design specifications. The device performed satisfactorily during extended testing at variable water flow rates and temperatures. Designed to meet specification of the Shuttle Orbiter, the device will find application in the regenerative water systems of advanced spacecraft.


ABSTRACT: Two systems that effectively convert the cellulose in municipal solid waste (MSW) to fuel-grade ethanol have been evaluated. These systems yield about 40 gallons per ton of MSW. Our economic analyses indicate that these systems would be cost effective at a 500-1500 MSW ton/day scale.


ABSTRACT: The pressurized Spacelab module was designed and built to allow investigators to conduct research in space in an environment approximating that of a ground-based laboratory. It is configured to allow multiple investigations employing both human and non-human subjects. This flexibility is exemplified by the SLS-1, SLS-2, and SLS-3 experiment complement. Twenty-one experiments will be performed on these missions; the areas to be investigated are renal-endocrine function, cardiovascular-cardiopulmonary function, hematology, immunology,
metabolic activity of muscle, calcium metabolism, the vestibular system, and general biology. A plan for integration of measurements will allow each investigation to use data from other experiments. The experiments make up a scientifically balanced payload that addresses fundamental biomedical problems associated with space flight and provides the first opportunity to study the acute effects of weightlessness in a comprehensive, interrelated fashion.


ABSTRACT: None


ABSTRACT: This chapter reviews the different uses of a physical method, electron probe microanalysis, for the analysis of chemical elements in very small volumes of biological material. A technique is outlined for scaling down a chemical and physical method, fluorescence spectrometry, for this analysis of organic compounds in fluid volumes in the picoliter range. The examples given illustrate the different possibilities of applications as they have been used in renal, reproductive, or developmental physiology and as they could apply to renal developmental biology.


ABSTRACT: The invasion of epithelial cells in vitro and in vivo by chlorine-injured Yersinia enterocolitica was assessed by direct microscopic observations. These experiments showed that injury by chlorin inhibited invasiveness of virulent Y. enterocolitica. Two requirements appeared to be necessary for invasiveness: (i) the organism must be viable and metabolically active, and (ii) the organism must have certain surface components to initiate engulfment. Inhibition of RNA synthesis by rifampin and protein synthesis by chloramphenicol, tetracycline, and spectinomycin inhibited the invasiveness but not the attachment of Y. enterocolitica to epithelial cells. Membrane preparations from untreated and antimicrobial-agents treated Y. enterocolitica blocked the invasiveness. Chlorine did not change the hydrophobicity of surface charge of unjured Y. enterocolitica. The results indicate that invaslon was more than simple association of the bacterium with the epithelial cell and involved a specific trigger to stimulate engulfment.


ABSTRACT: The enzyme b-d-glucosidase has been immobilized on
concanavalin A-Sepharose to give a maximum loading of 2050 units/g dry weight of support material. The immobilized b-d-glucosidase was also entrapped within calcium alginate gel spheres with apparently only 35% retention of activity when assayed with 10mM cellobiose. However, it was discovered that, unlike the immobilized enzyme, the entrapped immobilized enzyme was not subject to substrate inhibition up to 100mM cellobiose, suggesting that a concentration gradient of cellobiose existed between the bulk solution and the interior of the gel sphere. Thus, the activity of the entrapped immobilized enzyme was almost twice as high as that of the immobilized enzyme when assayed with 100mM cellobiose. Concanavalin A-Sepharose-immobilized b-d-glucosidase and the bacterium Zymomonas mobilis coimmobilized in calcium alginate gel spheres converted cellobiose to ethanol in both batch and continuous-flow fermentation systems.


ABSTRACT: The kinetics of enzymatic hydrolysis of pure insoluble cellulose by means of unpurified culture filtrate of Trichoderma reesei was studied, emphasizing the kinetic characteristics associated with the extended hydrolysis times. The changes in the hydrolysis rate and extent of soluble protein adsorption during the progress of reaction, either apparent or intrinsic, were investigated. The hydrolysis rate declined drastically during the initial hours of hydrolysis. The factors causing the reduction in the hydrolysis was examined; these include the transformation of cellulose into a less digestible form and product inhibition. The structural transformation can be partially explained by changes in the crystallinity index and surface area. The product inhibition was caused by the deactivation of the adsorbed soluble protein by the products, which essentially represents the so-called "un-competitive" inhibition. The kinetics of B-glucosidase were also studied. The result has shown that the action of B-glucosidase is competitively inhibited by glucose. It has been found that the integrated form of the initial rate expression cannot be used in predicting the progress of reaction because the digestibility of cellulose changes drastically as the hydrolysis proceeds, and that the rate expression for enzymatic hydrolysis of cellulose cannot be simplified or approximated by restoration to the pseudo-steady-state assumption. A mechanistic kinetic model of cellulose hydrolysis should include the following major influencing factors: 1) mode of action of enzyme, 2) structure of cellulose, and 3) mode of interaction between the enzyme and cellulose molecules.


ABSTRACT: The general notion that space motion sickness (SMS) is due to a "conflict" between vestibular, visual, and other sensory inputs has gained popular acceptance. We have reviewed three
specific hypotheses for SMS and identified characteristic disorders of ocular motility that each hypothesis would predict. Accurate recording of horizontal and vertical eye movements during free head movements in spacecraft presents technical difficulties. We suggest that careful clinical examination may be useful, provided the examination is directed towards detection of those specific abnormalities predicted by each hypothesis.

Linko M. An Evaluation of Enzymatic Hydrolysis of Cellulosic Materials. Technical Research Center of Finland, Biotechnical Laboratory, Box 192, SF-00121 Helsinki 12, Finland.

ABSTRACT: The diminishing one-way resources must be replaced by renewable, plentiful organic materials such as cellulose. Enzymatic hydrolysis of cellulose has been intensively studied in recent years, since acid hydrolysis of cellulose has not proved to be economically feasible. In spite of the abundance of cellulose, it is not very easy to find suitable cellulosic materials that could be collected from a limited area and would be cheap enough, taking into account collecting, transport, handling, and storage costs. The correct choice of material depends on local conditions. For example, sugarcane bagasse would be useful in certain areas. An enzyme preparation capable of completely breaking down cellulose is needed for the hydrolysis. Trichoderma viride is the most efficient producer of extracellular cellulases known at present. Since several types of cellulases are needed, it is possible that two or more organisms will be used in the future. Pretreatment of cellulosic materials prior to hydrolysis is inevitable, but all the known methods, such as alkali treatment or ball-milling, are rather costly. The product of complete hydrolysis is glucose, which can be used as such for various purposes or as raw material for other products. The economic feasibility of processes based on enzymatic hydrolysis of cellulosic materials is uncertain so far, but the potential of these processes encourages further developmental work.


ABSTRACT: The evolution of terrestrial life has taken place under the constant influence of gravity, but in all fields of life sciences there is a lack of knowledge about the importance and nature of the influence of gravity on life processes. This is true also for the area of human physiology. A new exciting tool for experimentation became available with the onset of the manned exploration of space. The men and women who were exposed to microgravity could be observed as experimental subjects. Areas where new insights could be gained were in the control of balance and locomotion, in cardiovascular dynamics, in fluid balance and in bone mineralization.

ABSTRACT: Pretazettine is an alkaloid from Narcissus tazetta having therapeutic activity in mice against Rauscher erythrocytic leukemia (1) and spontaneous AKR lymphocytic leukemia (2). This activity may be due partly to reverse transcriptase inhibition ('antiviral effect') and partly to protein biosynthesis inhibition ('cytostatic effect') (3). We now report an investigation of toxicity and associated pharmacological effects of PTZ in rats and cats.


ABSTRACT: The purpose of this paper is to present a detailed description of the effects of hypergravity on the mitogenic response of human lymphocytes to concanavalin A. The effect of cultures of lymphocytes isolated from peripheral blood are compared with those on whole-blood cultures obtained by diluting fresh blood with culture medium 1:10. Whole-blood cultures of lymphocytes from crew members will be investigated inflight on the Spacelab missions D1 in 1985 and SLS1 in 1987. In hypergravity there is an increase in lymphocyte activation of up to 500%. A similar increase can be induced by pre-incubating the cultures in hypergravity prior to exposure to concanavalin A at 1G. The effect is less evident in cultures of isolated lymphocytes. The influence of autologous plasma and erythrocytes has also been investigated. Plasma and hypergravity have a synergistic and positive effect of lymphocyte activation, i.e. cultures of separated lymphocytes show the highest activations when incubated at G and supplemented with autologous plasma. Conversely, erythrocytes depress lymphocyte activation.

Lum M. A Family Physician's Guide to Toxnet. Center for Disease Control, Agency for Toxic Substances and Disease Registry, Chambless, 28 South, F38, 1600 Clifton Road, NE, Atlanta, GA 30333.

ABSTRACT: Toxnet is a computerized system of toxicologically oriented data banks operated by the National Library of Medicine (NLM). This minicomputer-based system permits efficient access to valuable data on potentially toxic or otherwise hazardous chemicals.


ABSTRACT: Several processes have been developed for the enzymic conversion of lignocellulose to fermentable sugars. Most of these processes have employed the cellulolytic enzyme system from Trichoderma reesei. The action of a commercial cellulase preparation, Celluclast, from T. reesei on microcrystalline cellulose is compared with that of cellulolytic enzymes from other microorganisms. It is concluded that the Trichoderma system is not unique. More effective enzyme complexes can be
Produced from other microorganisms. In particular, systems from different Aspergillus species are shown to be more effective. The enzymic conversion of lignocellulose to fermentable sugar has not yet been scaled up, undoubtedly for technical and economic reasons. The cellulose substrate is very inaccessible, and furthermore the enzymic hydrolysis involves several consecutive reactions, each of which may be rate limiting. Enzyme costs have a great impact on process economy. The conversion of cellulose into fermentable sugar requires approximately 100 times more enzyme protein than the corresponding hydrolysis of gelatinized starch. Therefore, with today's enzyme technology, the use of cellulose as a raw material is not competitive with processes based on starch.


ABSTRACT: None


ABSTRACT: A method has been described for the isolation of DNA from micro-organisms which yields stable, biologically active, highly polymerized preparations relatively free from protein and RNA. Alternative methods of cell disruption and DNA isolation have been described and compared. DNA capable of transforming homologous stains has been used to test various steps in the procedure and preparations have been obtained possessing high specific activities. Representative samples have been characterized for their thermal stability and sedimentation behaviour.


ABSTRACT: The conditions that produce the optimal re-formation of the native DNA conformation from denatured DNA have been examined. The restoration of the native conformation, called thermal renaturation, has been found to depend markedly on the source of the DNA; mammalian DNA coming from cells with very large DNA content renatures only slightly, bacterial DNA with greatly reduced DNA content per cell undergoes extensive renaturation, and the very smallest bacteria together with bacteriophage, having the lowest DNA contents, show nearly complete renaturation. With a given DNA, the optimal renaturation was found to occur at about 25 degrees below the denaturation temperature, Tm. The extent of renaturation was optimal above 0.4 m-Na+ and increased with molecular weight. The identity of the renatured DNA and the native material can be shown in two ways: the similarity of the absorbance-temperature curves and the similarity of the rate of thermal inactivation of biological markers at temperatures somewhat above Tm. This reproducibility of the helix-coil transition and the course of thermal inactivation demonstrates that the same secondary
structure has reformed and that non-specific hydrogen bonding is not involved.


ABSTRACT: The previously discovered linear relation between the base composition of DNA, expressed in terms of percentage of guanine plus cytosine bases, and the denaturation temperature, Tm, has been further investigated. By means of measurements on 41 samples of known base composition the previously observed relation has been confirmed. It can be summarized thus: for a solvent containing 0.2m-Na+, Tm=69.3+0.41(G-C where Tm is in degrees Centigrade and G-C refers to the mole percentage of guanine plus cytosine. The deviations of experimental points from this relation are no more than that expected from the uncertainties of base analysis and the variations of a half degree in the reproducibility of determining the Tm. Consequently it appears that the measurement of the Tm is a satisfactory means of determining base composition in DNA. The Tm values are most simply measured by following the absorbance at 260 mu as a function of temperature of the DNA solution and noting the midpoint of the hyperchromic rise. Only 10-50 ug of DNA are required. A number of other DNA samples of unknown base composition have been examined in this manner and their base compositions recorded.


ABSTRACT: This paper describes a research program conducted to determine the feasibility of providing useful angular onset-motion information via a broad-area tactual seat-pan display. The experiment was designed to evaluate the utility of the display as a training device as well as its efficacy for imparting motion information. The results indicate that, with proper attention given the drive law, the tactual display can elicit both performance and control behavior indistinguishable from that observed in a whole-body motion environment. Unfortunately, the training transfer results were not as encouraging. These results indicated that the seat-pan display as used in this study was not adequate for training naive subjects to properly interpret and use the motion information available in a whole-body motion environment.


ABSTRACT: None


ABSTRACT: The detailed procedure for a new fluorometric assay for total diamines in human urine is described. The diamines were purified from the urine by cation-exchange chromatography and incubated with human placental diamine oxidase. Hydrogen peroxide formed in the diamine oxidase reaction was measured fluorometrically by converting homovanillic acid to a highly fluorescent compound in the presence of peroxidase. Because of its simplicity and high sensitivity, our present method seems useful for routine clinical investigation. The data obtained from normal subjects and patients suffering from various forms of cancer are also presented.


ABSTRACT: A bacterial mass (ca. 1 mg) was placed directly on a thin-layer chromatography plate and developed shortly in chloroform-methanol (2:1 vol/vol). After being dried, the bacterial mass was developed in chloroform-methanol-5 M ammonia (80:25:4 vol/vol). The obtained chromatogram indicated the characteristic lipid compositions of the bacteria. So, it became possible to examine bacterial colonies at once for the identification of mutants defective in the production of specific lipids.


ABSTRACT: A medium was developed for the differential enumeration of homofermentative and heterofermentative lactic acid bacteria. Essential components of the medium included fructose (14mM), KH2PO4 (18mM), bromcresol green (as a pH indicator), and other nutrients to support growth. In agar medium, homofermentative colonies were blue to green, while heterofermentative colonies remained white. A total of 21 Lactobacillus, Pediococcus, Leuconostoc, and Streptococcus species were correctly classified with the medium.


ABSTRACT: Coliforms were enumerated by using m-Endo agar LES and m-T7 agar in 102 routine samples of drinking water from three New England community water systems to investigate the occurrence and significance of injured coliforms. Samples included water collected immediately after conventional treatment, during the backwash cycle, at various points in the distribution system, and 1 week after the break and subsequent repair of a distribution main. Injured coliforms in these samples average >95%. m-T7
agar yielded 8-38 fold more coliforms than did m-ENdo agar LES. The geometric mean of coliforms recovered by m-ENdo agar LES was <1 confirmed coliform per 100 ml, although m-T7 agar yielded 5.7 to 67.5 confirmed coliforms per 100 ml. In addition, the majority of these samples giving positive results on m-T7 agar produced no detectable counts on m-ENdo agar LES. These findings indicated that coliforms were injured and largely undetected by use of accepted analytical media in the system examined.


ABSTRACT: The thermophilic fungus Talaromyces emersonii when grown on cellulose-containing medium produces three extracellular forms of B-glucosidase, I(Mr 135000), II (Mr, 100000), III (Mr, 457000), and one intracellular form, B-glucosidase IV (Mr, 57600). With the exception of B-glucosidase II which has yet to be isolated in quantities for characterization each has been shown to be a glycoprotein and to exist as a single polypeptide. Each of the purified enzyme preparations catalysed cellobiose hydrolysis but only B-glucosidase IV, at the concentrations of substrates used, also catalysed glucosyl transfer to cellobiose.


ABSTRACT: None


ABSTRACT: Environmental stimuli influencing catecholamine levels induce changes in cyclic AMP-dependent reactions and cell morphology in the rat parotid. Responses of salivary glands to spaceflight were determined by measurement of cyclic AMP-mediated reactions in fresh-frozen salivary glands and by microscopic evaluation of ultrastructure in fixed parotid glands. Decreased cell-free protein phosphorylation occurred in parotid glands in three of five flight animals. Protein kinase activity ratios were decreased in the soluble and increased in the particulate fractions of Appcelab 3 (SL-3) rat sublingual glands, compared with ground controls. Biochemical analyses show that effects of space flight on salivary glands are similar to those induced experimentally by physiological manipulation of alteration of catecholamine levels. Morphological evaluation of three SL-3 rat parotid glands showed increased numbers of lysosomes, autophagic vacuoles containing degenerating secretory product, and accumulation of lipid droplets. Since these animals lost weight, consistent with disruption of food and water consumption, morphological changes may in part be due to decreased masticatory stimulation, as occurs with reduced food intake of a liquid diet.
The observed changes may reflect physiological responses of the gastrointestinal and autonomic systems to effects of spaceflight.


ABSTRACT: The inclusion of rats aboard Spacelab 3 (SL-3) allowed analyses of liver lipids, glycogen, hepatic enzymes of cholesterol, glycerolipid and sphingolipid biosynthesis, and other enzyme activities. Glycogen content was markedly elevated in livers from the flight animals compared with controls. Cholesterol was 24% (P < 0.04) lower in livers from the experimental groups, whereas blood cholesterol was 19% higher (P < 0.05). The activity of 3-hydroxy-3-methylglutaryl-CoA reductase, the rate-limiting enzyme of steroid biosynthesis, was 80% lower (P < 0.01). Total phospholipids and sphingolipid levels did not differ significantly. The specific activity of fatty acyl-CoA synthetase, which is responsible for activation of fatty acids, was 37% (P < 0.02) there was no difference per gram of liver. The initial enzymes of sphingolipid and glycerolipid biosynthesis were assayed; serine palmitoyltransferase was 40% lower (P < 0.01), and glycerol 3-phosphate acyltransferase did not differ. Hepatic cytochrome P-450 content decreased by 50% after spaceflight. Enzymes that did not differ significantly between the two groups include cytochrome b5, glutathione S-transferase, tyrosine aminotransferase, aspartate aminotransferase, and cystathionase. These findings suggest that space flight alters hepatic metabolism of several classes of compounds.


ABSTRACT: Information of the distributions of pulmonary ventilation and perfusion was obtained from four subjects on board a Learjet during 112 weightless periods lasting up to 27 s each. Zero gravity (G) was obtained during all or part of each test by varying the aircraft flight profile. Single-breath N2 washouts were performed with the test inspiration containing an initial bolus of argon at residual volume (RV). When the test inspiration was at 0 G with the washout at 0 G or greater, the terminal rises and the cardiogenic oscillations in both N2 and argon were small and often absent. If instead the test inspiration was at 1 G with the washout at 0 G, the terminal rises were again small or absent but the cardiogenic oscillations remained. The terminal rise and the cardiogenic oscillations for N2 but not argon, were also nearly eliminated by performing just the preliminary exhalation to RV at 0 G with the test inspiration and washout following at 1 G. Alveolar plateaus for N2 sloped upward at 0 G apparently due to nontopographical inequalities of ventilation. In further tests during air breathing, recordings were made of expired partial pressure of oxygen (PO2) and carbon dioxide (PCO2) following a brief hyperventilation and a 15 s
breath hold. These recordings revealed marked cardiogenic oscillations in PO2 and PCO2 at 1 G that were enhanced at 2 G but almost eliminated at 0 G. The results suggest that virtually all the topographical inequality of ventilation, blood flow, and lung volume seen under 1 G conditions are abolished during short periods of 0 G.


ABSTRACT: None


ABSTRACT: None


ABSTRACT: This communication reports the studies on saccharification of lignocelluloses by P. funiculosum cellulase and certain studies on the kinetic aspects.


ABSTRACT: The efficiency of many industrial operations is often closely tied to the quality of purified water used. The tie is particularly strong in the microelectronics industry, where ultrapure water is essential to a number of manufacturing processes. Clearly, it is important that contaminants that may affect water quality—and, ultimately, product quality and systems operations—be identified and isolated from the water system.


ABSTRACT: The unique ability of microorganisms to adapt to their environment allows them to survive under extremely nutrient-limited conditions. This unusual physiology contributes to a number of difficulties associated with the analysis of these contaminants. This column will describe various microbiological testing methods designed for application to high-purity waters.


ABSTRACT: This column will provide insight into the factors involved in the selection of biofouling treatments. Biological fouling presents a number of special treatment problems. Purified-water systems contain both planktonic and adherent
bacterial populations; since the latter make up the bulk of the total bacteria present, the treatment used must be capable of killing the bacteria in biofilms as well as those in the overlying water. In addition, the attached biofilms must be removed from surfaces and flushed from the system in order to prevent organic or ionic contamination. Other essential factors in treatment selection are product, process, and system-component compatibility. Finally, since most treatments for biological fouling employ chemicals, safety and environmental considerations are of great importance.


ABSTRACT: None


ABSTRACT: An airline captain with a presenting sign of some premature ventricular contractions. The clinical presentation, evaluation, and diagnosis of the pilot are discussed. The aeromedical disposition and prognosis of this patient are provided.


ABSTRACT: Criteria for space flight crew and passenger selection should be based on the following three considerations: (1) freedom from impairing disease, (2) ability to perform mission requirements and (3) motivation to undertake the mission. Chronologic age of itself is not a valid criterion. Forecast life expectancy and vitality relative to mission duration are valid criteria and can be applied on an individual basis using modern assessment techniques. The good health and vitality characterizing the upper ages of today's population widens the opportunity to utilize increasingly broad fields of experience and skills in future space flights, further enhancing the odds for total mission accomplishment.


ABSTRACT: The sorption characteristics of the cellulase system of Talaromyces emersonii on various cellulosic substrates were examined. Analysis of reaction mixture supernatants by electrophoresis and enzyme assay showed that all components of the cellulase system were rapidly adsorbed by cellulose and then gradually returned to the liquid phase as the hydrolysis of the substrate progressed. The extent of adsorption in the rapid phase was influenced by pH, temperature, the nature of the substrate, and its concentration.

Moloney A.P., Considine P.J., Coughlan M.P. Cellulose Hydrolysis By
ABSTRACT: Pulp obtained from the processing of sugar beet at a local factory is mixed with molasses and sold as cattle food. However, the value of the pulp would be increased considerably if its constituent cellulose and hemicellulose fractions could be converted to fermentable sugars. To this end we are investigating the enzymic hydrolysis of beet pulp using the cellulase system produced by the termophilic fungus, Talaromyces emersonii. In this Communication, we report on the initial results of such studies.


ABSTRACT: By a combination of genetic mutation and modification of growth medium the cellulase activity of culture filtrates of Talaromyces emersonii CBS 814.70 has been increased four-fold to approximately 2 U ml-1 and a productivity of 20-25 U l-1 h-1. At 50 degrees C this system was completely stable for at least 24 hours. At 60 degrees C in static reaction mixtures 19% of the original activity was lost compared with 21% when mixtures were shaken. At 70 degrees C the loss of activity after 4 hours was 64% without shaking and 70% when shaken. The cellulase system from Trichoderma reesei was decidedly less than that of Talaromyces emersonii under each of the above conditions. The ability of each enzyme system, separately and together, to digest beet pulp was investigated.


ABSTRACT: The development of an agar plate screening technique has allowed the isolation of a range of mutants of Trichoderma reesei capable of synthesizing cellulase under conditions of high catabolite repression. The properties of one of these mutants (NG-14) is described to illustrate the use of this technique. NG-14 produced five times the filter paper-degrading activity per ml of culture medium and twice the specific activity per mg of excreted protein in submerged culture when compared with the best existing mutant, QM9414. NG-14 also showed enhanced endo-B-glucanase and B-glucosidase production. Although these mutants were isolated as cellulase producers in the presence of 5% glycerol on agar plates, in similar liquid medium, NG-14 exhibits only partial derepression of the cellulase complex. Since the proportions of filter paper activity, endo-B-glucanase, and cellobiase were not the same in mutants NG-14 and QM9414, and the yields of each enzyme under conditions repressive for cellulase synthesis were different, differential control of each enzyme of the cellulase complex is implied. These initial results suggest that the selective technique for isolating hyper-cellulase-producing mutants of Trichoderma will be of
considerable use in the development of commercially useful cellulolytic strains.

Montenecourt B.S., Evelelgh D.E. Production And Characterization Of High Yielding Cellulase Mutants Of Trichoderma reesei. Department of Biochemistry And Microbiology Cook College, Rutgers The Stat University of New Jersey, New Brunswick, New Jersey 08903.

ABSTRACT: Biological conversion of cellulosic materials to glucose by the use of microbial cellulase enzymes is an attractive alternative to chemical hydrolysis since enzymes generally are non-polluting, reusable, energy sparing and catalyze high conversion efficiencies without undesirable side products. Enzymatic conversions to date have not been economical due to the high production costs and low yield of the enzymes produced by the available microbial strains. In an effort to overcome these economic bottlenecks, improved strains of trichoderma reesei have been isolated by mutation and selection which are capable of overcoming some of the rigid controls on enzyme synthesis and activity. The selection techniques and the characteristics of several high yielding mutants are discussed. These mutants hyperproduce all of the enzymes in the cellulase complex. One mutant C-30 is resistant to catabolite repression and appears to have a partially end-product resistant B-glucosidase.


ABSTRACT: A plate clearing assay was devised to screen for high-producing cellulase mutants of Trichoderma viride. The method employs (i) the use of either rose bengal or oxgall to limit colony size and (ii) Phosfon D (tributyl-2,4-dichlorobenzylphosphonium chloride) to enhance cellulase detection, in combination with acid-swollen cellulose on agar plates. The method was used to isolate constitutive cellulase mutants of T. viride and should prove useful for isolation of high-producing mutants from a range of organisms. This technique has been also used to determine the concentration at which glucose and glycerol inhibit cellulase synthesis by catabolite repression in the wild-type strains.


ABSTRACT: The production of proteins, vaccines, antibodies, hormones vitamins and enzymes involves high technology processes which require aseptic and sterile supplies of gases or liquids throughout the manufacturing cycle. Recent advances in methods of filtration for compressed air, gases and liquids are leading to longer service life with higher retention efficiencies. This paper highlights the need for filtration in pharmaceuticals and describes test programmes designed to establish the value of hollow fibres as a superior filter medium.

ABSTRACT: Recent advance in preventive medicine offer practitioners exceptional opportunities to help patients and their families have longer, healthier, and more enjoyable lives. Those involved in aerospace medicine are uniquely qualified by their training and experience to apply this enhanced prevention armamentarium. The discussion considers a number of activities and techniques which can provide important patient benefits at acceptable costs.


ABSTRACT: Process liquid chromatography analyzes streams of reactants and products, permitting quick process changes when needed.

MSFC. Major Concerns For Microbial Contamination Of The ECLS.

ABSTRACT: None


ABSTRACT: Nosocomial Legionnaires disease can be acquired by exposure to the organism from the hospital water distribution system. As a result, many hospitals have instituted eradication procedures, including hyperchlorination and thermal eradication. We compared the efficacy of ozonation, UV light, hyperchlorination, and heat eradication using a model plumbing system constructed on copper piping, brass spigots, Plexiglas reservoir, electric hot water tank, and a pump. Legionella pneumophila was added to the system at 10^7 cfu/ml. Each method was tested under three conditions; (i) nonturbid water at 25 C, (ii) turbid water at 25 C, and (iii) maintenance. Both UV light and heat (60 C) produced a 5 log kill in less than 1 h. In contrast, both chlorine and ozone required 5 h of exposure to produce a 5 log decrease. Neither turbidity nor the higher temperature of 43 C impaired the efficacy of any of the disinfectant methods. Surprisingly, higher temperature enhanced the disinfecting efficacy of chlorine. However, higher temperature accelerated the decomposition of the chlorine residual such that an additional 120% volume of chlorine was required. All four methods proved efficacious in eradicating L. pneumophila from a model plumbing system.


ABSTRACT: Members of the genus Cryptosporidium are protozoan parasites that cause gastroenteritis in humans and animals and
appear to be spread largely by the fecal-oral route. A method was developed for the concentration and detection of Cryptosporidium oocysts in water to assess their occurrence in the environment and potential for waterborne disease transmission. This method was developed by using spun polypropylene cartridge filters. Optimal conditions for concentration, filter elution, filter porosity, and detection were determined. Fluoresceinated monoclonal antibodies were used for oocyst detection. Experiments also were conducted to study the effect of flow rate, low oocyst numbers, and the addition of detergents of recovery and retention of oocysts. The method that was developed was sensitive enough to detect oocysts at levels of less than 1 per liter. Using this method, we isolated Cryptosporidium oocysts from secondarily treated sewage.


ABSTRACT: The multitest V. cholerae medium (VC medium) for rapid presumptive identification of V. cholerae was evaluated. On the basis of reactions in the VC medium, 379 strains recovered during a yearlong ecological study in Calcutta were presumptively identified as V. cholerae. Further phenotypic characterization of these strains revealed that the reactions of 371 (97.9%) isolates were consistent with that of V. cholerae. False-positive reactions were exhibited by eight (2.1%) strains, three of which were identified as V. fluvialis biotype 1. By slightly varying the basic formulation of the VC medium, we could eliminate some false-positive reactions. On the basis of the present evaluation, we recommend the routine use of the VC medium.

NASA. Information Summaries: Space Station. 1986.

ABSTRACT: None


ABSTRACT: An amplified enzyme-linked immunosorbent assay (A-ELISA) for detecting and quantifying hepatitis A virus in estuarine water samples is described. The test was five times more sensitive than a standard ELISA and at least two times more sensitive than radioimmunoassay. Test sensitivity was unaffected by the procedures used to concentrate the virus in estuarine samples or by the presence of humic and tannic acids in test samples. Nonspecific reactions were not encountered with a number of enteroviruses or with a rotavirus. A high sensitivity and specificity combined with speed, low cost, and freedom from radiolabels made the A-ELISA useful for detecting hepatitis A virus in environmental samples. The virus was detected in 3 of 20 estuarine water samples examined by A-ELISA.

Natelson B.H., Goldwater D.J., De Roshia C., Levin B.E. Visceral

ABSTRACT: A major task for space biologist is to try to delineate methods which can be used to predict the degree of cardiovascular deconditioning that given individuals might develop while in space. Toward that end, we have studied a number of different visceral and behavioral variables in a group of late middle-aged men (55-65 years) on day 1 and day 5 of a bedrest regimen. During each 8-h study period, data were collected every 15 min. Mean arterial blood pressure and plasma cortisol and norepinephrine concentrations were significantly higher on the day 5 than on the day 1 of bedrest; heart rate, core temperature, plasma epinephrine and subjective arousal were unchanged. Pairwise correlations between each of these variables and the time to blackout on a +3-Gz test of acceleration tolerance administered on day 9 of bedrest (mean decrease in latencies from prebedrest was 52%) revealed a significant correlation for the mean arterial blood pressure variable. Thus, these data indicate that men in this age span with relatively low resting blood pressures are at greater risk for developing clinical signs relating to their cardiovascular deconditioning than other men with higher basal blood pressures.


ABSTRACT: Treatment of a wide variety of lignocellulosic biomass with gaseous ozone results in greatly enhanced susceptibility to cellulase enzyme hydrolysis and to digestion by rumen microorganisms so that it can be used as ruminant animal feed or for the production of glucose via enzymatic hydrolysis. By use of appropriate reaction conditions a useful degree of such pretreatment may be obtained in 1-2 h contact time with an ozone consumption of ca.4-6% of the dry weight of the biomass.


ABSTRACT: Effects of hyperbaric oxygen (HBO) on tumor growth and lung metastases were investigated using the Lewis lung squamous carcinoma in a mouse model. Ninety Swiss white mice were injected with 1 mm3 of the tumor in a standardized fashion and randomly assigned to a control or HBO group. Mice receiving HBO were treated at 2.5 ATA for 90 min twice a day for 7 d. Tumor volumes, tumor weights, and lung metastases were analyzed at specified times by a "blinded" researcher. Results indicated that there were no significant differences between HBO and control groups on any of the parameters measured. Results of the current study indicate that HBO does not enhance tumor growth or lung metastases.

ABSTRACT: None


ABSTRACT: There are two overriding concerns in the design of schedules for aircrew who have to cope with irregularity of their sleep due either to work at unusual times of the day or to time zone changes. The first is that aircrew must be able to achieve an acceptable sleep pattern, and this is likely to involve short periods of sleep and naps. These, in turn, depend on limits to duty hours. The second is that the arrangement of work must bear in mind that prolonged duty and duty at certain times of the day may both involve relatively low levels of performance, and modelling can identify the adverse interactions of these influences. It is also important that the quality of the sleep of the individual pilot is taken into consideration when there are undue difficulties in coping with irregularity of work.


ABSTRACT: The nocturnal sleep and daytime alertness of aircrew were studied by electroencephalography and the multiple sleep latency test. After a transmeridian flight from London to San Francisco, sleep onset was faster and, although there was increased wakefulness during the second half of the night, sleep duration and efficiency over the whole night were not changed. The progressive decrease in sleep latencies observed normally in the multiple sleep latency test during the morning continued throughout the day after arrival. Of the 13 subjects, 12 took a nap of around 1-h duration in the afternoon preceding the return flight. These naps would have been encouraged by the drowsiness at this time and facilitated by the departure of the aircraft being scheduled during the early evening. An early evening departure had the further advantage that the circadian increase in vigilance expected during the early part of the day would occur during the latter part of the return flight.


ABSTRACT: None


ABSTRACT: Sixty-eight halobacteria, including both culture collection strains and fresh isolates from widely differing geographical areas, were tested for susceptibility to arsenate, cadmium, chromium, cobalt, copper, lead, mercury, nickel, silver, and zinc ions by an agar dilution technique. The culture
collection strains showed different susceptibilities, clustering into five groups. Halobacterium mediterranei and Halobacterium volcanii were the most metal tolerant, whereas Haloarcula californiae and Haloarcula salinisolis had the highest susceptibilities of the culture collection strains. Different patterns of metal susceptibility were found for all the halobacteria tested, and there was a uniform susceptibility to mercury and silver. All strains tested were multiply metal tolerant.


ABSTRACT: Technology for a continuous alcohol fermentation process was developed by means of immobilized living cells using yeast cells and specially designed artificial resins. Yeast which has the ability to make alcohol was screened from Saccharomyces genus and mixed with prepolymer of photo-crosslinkable resin, then illuminated with an active ray (for example, chemical lamp) to change the prepolymer into three dimensional cross-linked polymers in which yeast was entrapped. Specially shaped immobilized yeast was packed in a fermentor and a diluted molasses solution fed to the fermentor. The fermentation temperature was kept at about 30-31 C and the pH at 4-5. As a result of a bench scale test (10 liters of ethanol a day) and pilot plant test (250 liters of ethanol a day), the constant activity of the yeast and high alcohol yield on sugar during long-term operation was confirmed and it was also established that the alcohol productivity was several times that of conventional suspended state batch system fermentation.


ABSTRACT: The concept of transforming municipal, agricultural, and industrial cellulosic wastes into usable resources has long excited the scientific community. Our new found awareness of our depleting resources has been responsible for the support, both scientific and political, given to the development of many cellulose utilising technologies. In a process conceived at the US Army Natick Research and Development Command, cellulose is hydrolysed to glucose via the action of a complex of enzymes known as 'cellulase'. A small pilot facility has been built and operated to develop an economic process technology for both the production of enzymes and the hydrolysis of various cellulosic materials. A highly instrumented concept with designed processing flexibility has greatly accelerated the development efforts. Improved processing techniques have led to both enhanced production of cellulase via submerged fermentation of Trichoderma viride and more optimum use of these biological catalysts in enzyme reactors.

ABSTRACT: The design of our initial study of gestational diabetes provided both an intervention trial and a longitudinal study. The results of the intervention trial, which concerned the effects of insulin treatment on the outcome of pregnancy, were summarized in the First Colloquium on Carbohydrate Metabolism in Pregnancy and the Newborn in 1973 (O'Sullivan, 1975). On the occasion of the Second Colloquium, my comments will be confined to data from the longitudinal study providing current information on the rates of subsequent diabetes from that initial study and to some of the factors that determine these rates.


ABSTRACT: None


ABSTRACT: Materially closed microbial ecosystems represent model life support systems for the future human habitation of space. These ecosystems when subjected to a constant energy flux seem to be reliable and self-sufficient systems for recycling of biologically produced carbon compounds.


ABSTRACT: Considering a controversy among those attempting to provide support for man in Space, three kinds of systems are contrasted: A. the conventional engineering approach with pipes, electrical circuits, fuel, and maintenance parts sent from earth; B. the physiological approach with a few biological species in culture to complement man in a simple ecosystem, which also requires heavy subsidies in energy materials, controls, and parts from earth; C. the ecological approach with a complex multispecies climax ecosystem self sufficient with all its maintenance and control functions in the form of many highly miniaturized and specialized biogeochemical circuits. Some fallacies in previous estimates of the amount of solar energy required to support man in space are described: A. the incorrect use of theoretical reversible high efficiencies for computing potentials in defiance of the great body of empirical data on the moderately low efficiency of successful self maintaining ecosystems; B. the omission of the energetic costs of the accompanying species necessary for stable chemical cycles and system maintenance; C. the neglect of the high trophic position of man and the necessity of heat losses during food chain transfers to him. The estimated minimum solar area for a closed and stable climax ecosystem supporting man without outside subsidies is estimated as 2 acres. To develop such a system including man for space encapsulation, the multiple seeding method is recommended.


ABSTRACT: Ten aviators with cardiac symptoms or electrocardiographic abnormalities underwent electrocardiographic testing. Four patients were studied because of symptoms including palpitations, near-syncope, and sudden cardiac death. Six patients were studied because of electrocardiographic abnormalities including AV block, right bundle branch block, sinus bradycardia, ventricular tachycardia, and questionable Wolff-Parkinson-White syndrome. Three patients with bradycardia and/or AV block were found to have increased vagal tone. A fourth patient had near-syncope and intra-Hisian block. Of four patients evaluated for palpitations and/or tachycardias; one had nonsustained ventricular tachycardia; one had easily inducible ventricular tachycardia and fibrillation; one had a normal study, and one had coronary artery disease with an unanticipated prolonged HV interval. The diagnosis of congenital right bundle branch block and Wolff-Parkinson-White syndrome were confirmed in the final two patients. Performance of electrophysiologic testing provided objective data to allow appropriate therapeutic and administrative decisions in these aviators.


ABSTRACT: Pure cellulose (Avicel) was hydrolyzed batchwise at 50 C and pH 4.8 by cellulase from Trichoderma viride (Meicelase CEP). Then the effects of the crystallinity of cellulose as well as the thermal deactivation and product (cellobiose and glucose) inhibition to cellulase on the hydrolysis rate were quantitatively investigated. While these factors had evidently retarded the enzymatic hydrolysis of cellulose to a significant extent, the hydrolysis rates observed could not be explained. For practical purposes, an empirical, simple rate expression was developed which included only one parameter: an overall rate retardation constant. This empirical rate expression held for the hydrolysis of at least two kinds of cellulosic materials: Avicel and tissue paper.


ABSTRACT: None


ABSTRACT: Space sickness symptoms were observed by 4 specially trained observers on Spacelab-1. Three reported persistent symptoms, and vomited repeatedly during the first and/or second day of flight. Head movements on all axes were provocative, particularly in pitch and roll. Head acceleration data recorded
from 2 symptomatic crewmen showed that after several hours of physical activity in orbit, symptoms appeared, and thereafter both crewmen were compelled to limit head movements. Firm body contact with motionless surfaces helped alleviate symptoms. When crewmembers floated into unfamiliar body orientations in the cabin, inherent ambiguities in static visual orientation cues sometimes produced spatial reorientation episodes which were also provocative. Symptoms largely resembled those of other forms of prolonged motion sickness, superimposed upon other symptoms attributable to fluid shift. All 4 eventually used anti-motion sickness drugs. When they did, vomiting frequency was reduced. By the 4th day, symptoms subsided, and head accelerations again increased in magnitude and variability. Sickness intensity in orbit was not predicted by statistically concordant results of 6 acute preflight susceptibility tests. However, results from a longer duration preflight prism goggles test showed an apparent correlation. All subjects were asymptomatic making head movements in parabolic flight 4 days after the mission, but not 1 year later. Overall, results support the view that space sickness is a motion sickness.


ABSTRACT: The adsorption of cellulase from trichoderma viride (Meicelase CEP) on the surface of pure cellulose was studied. The adsorption was found to obey apparently the Langmuir isotherm. From the data concerning the effects of temperature and the crystallinity of cellulose on the Langmuir adsorption parameters, the characteristics of the adsorption of the individual cellulase components, namely CMCase (endoglucanase) and Avicelase (exoglucanase), were discussed. While B-glucosidase also absorbed on the surface of cellulose at 5 degrees C, it did not at 50 degrees C.


ABSTRACT: The development of diode-array spectrophotometers was a major advancement in UV/Visible spectrophotometer technology. In 1979, Hewlett-Packard introduced the HP 8450A, the world's first commercially available diode-array spectrophotometer. It possessed a revolutionary new optical system and introduced the concept of total integration of spectrophotometer, microprocessor control and data processing. Compared to conventional, serial scanning spectrophotometers, a diode-array instrument acquires the spectral data simultaneously without mechanically moving parts. The most obvious benefit to the user is speed. However, the design differences result in a series of other advantages, which will be discussed in this booklet. As a result, diode-array spectrophotometers can not only replace conventional instruments in most applications, but their benefits clearly make them superior in most cases. Initially, because of the high price, the advantages of diode-array spectroscopy could
only be appreciated by a relatively small number of specialized laboratories. Now, the HP 8452A diode-array spectrophotometer is available at a price that is comparable to that of conventional instruments. This has been achieved through a combined effort in optimizing the design, developing new technologies and new manufacturing concepts.


ABSTRACT: In recent years several efforts have been made to investigate the sources of volatile organic chemicals (VOCs) in offices and residential buildings. However, the largest data base by far has been compiled by NASA (McDonnell Douglas, contractor), who have tested the VOC Emissions for over 5,000 Materials used in the space program. Many of these (paints, epoxies, pens, cosmetics, etc.) are available commercially and are used in homes and offices across the United States. By utilizing this unique data base, stored on a personal computer, we calculated emission rates of ten common VOCs using the test results from a large number of materials and household products found in most U.S. buildings. Ongoing analysis efforts using this important data set are also presented.


ABSTRACT: None


ABSTRACT: The analysis of a continuous aerobic, fixed-film bioreactor is performed by simulating the behavior of penicillin production in a three-phase fluidized bed. Rigorous mathematical models are developed for a fluidized-bed fermentor in which bioparticles are fluidized by the liquid medium and air. The steady-state performance of the fluidized-bed reactor is appraised in terms of penicillin productivity and outlet concentration by considering the two extremes in contacting patterns, complete back-mix and plug flow, in the absence of a growing biofilm. The results show that the complete back-mix contacting pattern is preferred over that of plug flow due to the nature of the penicillin kinetic relationships. It is also shown that for the dual-nutrient (glucose and oxygen) penicillin reaction system the optimum biofilm thickness does not equal the penetration depth of a limiting nutrient, but depends upon the total reactor configuration.


ABSTRACT: The dynamic analysis of a continuous,aerobic,
fixed-film bioreactor has been performed. Rigorous mathematical models have been developed for a fluidized-bed fermentor with biofilm growth. The transient performance of the reactor is appraised in terms of outlet penicillin concentration for constant, as well as variable carbon substrate feed rates. The effect of the reactor oxygen transfer capacity is elucidated for those cases employing substrate feeding strategies. The results show that penicillin production in a continuous, fixed-film bioreactor reaches a maximum with processing time, but subsequently decreases as cell mass accumulates and substrate deficiencies occur. The maximum production level can be maintained for increased operating times if the substrate supply is continuously increased. The duration of this prolonged production is a direct function of the rate of increase and the operating time at which the increase is initiated. The oxygen transfer capacity of the reactor was found to be important to the effectiveness of a feeding strategy.


ABSTRACT: Observations with three astronauts yielded two major findings. First, perceived self-motion during sinusoidal roll differed immediately postflight from preflight. Between 70 and 150 min after landing, roll was perceived primarily as linear translation. Secondly, more horizontal eye movement was elicited by roll stimulation immediately postflight relative to both preflight observations. These results support as "otolith tilt-translation reinterpretation" hypothesis, which has clear implications for understanding astronaut reports of space motion sickness during the early period of orbital flight. A proposal for "prophylactic adaptation training" which may provide preflight adaptation to weightlessness, derives from this research.


ABSTRACT: To gain some insight into the early effects of spaceflight on skeletal metabolism, we quantified the major chemical constituents and a noncollagenous protein, osteocalcin, in the third-lumbar vertebrae and humeri from 8-wk old rats that were part of the 7-day NASA Spacelab 3 flight experiments. The ratio of calcium to hydroxyproline in the humeral diaphysis increased from 8.5 in preflight to 9.8 in ground simulation control and only to 8.9 in flight bones. There was no demonstrable change in the fraction of nonmineralized collagen. Osteocalcin content was reduced in the humerus and vertebra. Reduced accumulation of mineral and osteocalcin with no associated decrease in collagen in flight animals suggests that both mineralization and collagen metabolism are impaired in growing animals during spaceflight within a few days after launch. Strength tests of the humeri of flight rats shoved
substantial deficits that appeared to be related, not only to the reduced bone mass, but also to the composition and quality of new bone formed.


ABSTRACT: The challenge is to have man living and working in a permanently based space station. Nursing is on the threshold of expanding the health care role to man's adaptation in outer space. Elements of man's physiologic and psychologic responses are involved in determining the most productive use of man and machines in the space environment. Curricular considerations for a career in space nursing can produce effective contributions toward health care maintenance of the space station personnel. The challenge for nursing is to become a collaboration team participant in the exploration of living and working in space.


ABSTRACT: Spacelab is a large, versatile laboratory carried in the bay of the Shuttle Orbiter. The first Spacelab mission dedicated entirely to life sciences is Spacelab-4. It is scheduled for launch in late 1985 and will remain aloft for 7 days. All of the investigations are currently classified as "tentatively selected," with "final selection" and confirmation planned for late 1983. The 24 tentatively selected investigation have been combined into a comprehensive, integrated exploration of the effects of acute weightlessness on living systems. An emphasis is placed on studying physiological changes previously observed in manned space flight. This payload has complementary designs in both human and animal investigations in order to validate animal models of human physiology in weightlessness. The experimental subjects include humans, squirrel monkeys, laboratory rats, two species of plants, and frog eggs. The primary scientific objectives include study of the acute cephalic fluid shift, cardiovascular adaptation to weightlessness (including postflight reductions in orthostatic tolerance and exercise capacity), and changes in vestibular function (including space motion sickness), associated with weightlessness. Secondary scientific objectives include the study of red cell mass reduction, negative nitrogen balance, altered calcium metabolism, suppressed in vitro lymphocyte reactivity, gravitropism and phototropism in plants, and fertilization and early development in frog eggs. The rationale behind this payload, the selection process, and details of the individual investigations are presented in this paper.


ABSTRACT: The effects of disturbances in carbohydrate metabolism
during gestation were studied in the offspring of 1049 Pima Indian women who had no previous diagnosis of diabetes. Rates of fetal and maternal complications of pregnancy among women with diabetes first diagnosed during the pregnancy were similar to those among women in whom diabetes was recognized before gestation. Offspring, aged 5-19 yr, of women with abnormal glucose tolerance during pregnancy had a higher mean percent desirable weight and a higher mean postchallenge plasma glucose concentration than did offspring of women with normal glucose tolerance. Percent desirable weight and glucose concentration, however, were both lower than found in offspring of women with diabetes diagnosed before the pregnancy. Thus, metabolic events during pregnancy, as indicated by the detection of abnormal glucose tolerance during gestation, appear to have long-term effects on obesity and glucose tolerance in the offspring.


ABSTRACT: None


ABSTRACT: None


ABSTRACT: A total of 2,601 water samples from six different water systems were tested for coliform bacteria by Clark's presence-absence (P-A) test and by the membrane filter (MF) method. There was no significant difference in the fraction of samples positive for coliform bacteria for any of the systems tested. It was concluded that the two tests are equivalent for monitoring purposes. However, 152 samples were positive for coliform bacteria by the MF method but negative by the P-A test, and 132 samples were positive by the P-A test but negative by the MF method. Many of these differences for individual samples can be explained by random dispersion of bacteria in subsamples when the coliform density is low. However, 15 samples had MF counts greater than 3 and gave negative P-A results. The only apparent explanation for most of these results is that coliform bacteria were present in the P-A test bottles but did not produce acid and gas. Two other studies have reported more samples positive by Clark's P-A test than by the MF method.


ABSTRACT: Recommendations were formulated on sampling strategies and characteristics of different sampling methods. Microbiological products, such as endotoxins and proteases were suggested to be included apart from traditional dust
measurements. It was recommended that priority should be given to establishing dose-response relationships and that the importance of anaerobic organisms be evaluated. A summary of components within organic dust suspected of contributing to respiratory disease was presented.


ABSTRACT: In the course of adaptation to space flight effects and subsequent readaptation to Earth gravity regulatory systems, develop significant changes. This gives an impetus to the study of changes in hormonal regulation as a function of flight time. In this context the key problem, which is the subject of the present report, is the blood content of hormones and responses to them of target organs.


ABSTRACT: Water management subsystem data are presented for a four-man 90-day test conducted in the Space Station Simulator with closed water and oxygen loops and no resupply. All expendables including food, urine pretreatment chemicals, filter beds, and machinery spare parts were stored onboard and no pass-ins were made during the test. Elements of the subsystem were: (1) isotope-heated VD-VF unit; (2) wick evaporator and humidity control unit; (3) detoxification-multifiltration unit; (4) potable water storage and distribution system; (5) backup potable water supply; and (6) wash water recovery unit. The performance data include mass and energy balances, water chemistry, and microbiological profiles. Pretest qualification procedures are covered as well as operating protocol used during the manned test.


ABSTRACT: In recent years, attention has been focused not only on re-cycling of waste paper but also on other indigenous sources of fibre. Studies have shown that cereal straw is the most promising such source and, supposing a system of collection can be contructed, the author considers an oblique approach to the still unsatisfactorily-solved question of how best to degrade the unwanted part of straw to retain suitable fiber. He proposed the use of enzymes-collectively cellulases-and explains how they act and considers the practicability of the idea.


ABSTRACT: This study was initiated to examine the sensitivity of Pseudomonas spp. to iodine and their ability to recover after
disinfection. It has been shown that the degree of bacterial resistance to disinfection may be related in part to the conditions under which the organisms had been growing before disinfection. In this investigation we have examined the sensitivity of two Pseudomonas spp. to iodine after growth in rich nutrient media (brain heart infusion and mineral salts supplemented with glutamate and glucose) and low nutrient conditions (phosphate buffered water and reverse osmosis water). The ability of these species to recover after iodination was also examined because this may be a significant factor in the detection of pseudomonads after disinfection.


ABSTRACT: The popular notion appears to be growing that the human is the limiting factor in aircraft performance. Proponents cite recent instances of pilot loss of consciousness during maneuvers. The aerospace medicine perspective differs, seeing the aircraft not as a vehicle in which to make hard turns, but as a mission-directed weapon system for which the pilot is the enabling factor. Various "human limitation factors" are described among requirements staffs, developers, researchers, trainers, and operators. A plea is made to pursue available avenues to improve manned weapon system performance and to see even our most sophisticated weapons as human instruments.


ABSTRACT: Production of cellulase from Pestalotiopsis versicolor was studied in a shake flask culture. The cellulase system was found to be rich in B-glucosidase. Kinetic parameters such as pH and temperature have been optimized for the various enzyme components.


ABSTRACT: This paper describes the continued development of a membrane-based subsystem designed to recover up to 99.5% of the water from various spacecraft waste waters. Specifically discussed are 1) the design and fabrication of an energy-efficient reverse osmosis (RO) breadboard subsystem; 2) data showing the performance of this subsystem when operated on a synthetic wash-water solution--including the results of a 92 day test; and 3) the results of pasteurization studies, including the design and operation of an in-line pasteurizer. Also included in this paper is a discussion of the design and performance of a second RO stage. This second stage results in higher-purity product water at a minimal energy requirement and provides a substantial redundancy factor to this subsystem.

ABSTRACT: The tools NASA is developing for the Health Maintenance Facility have some of the flavor of science fiction, because they will need to be adapted to the conditions of microgravity. The core diagnostic component of the facility will include capability to do a complete blood count, urinalysis, clinical chemistry and electrolyte measurements, basic microbiology, and diagnostic imaging.


ABSTRACT: The DNAs of four Mycoplasma and one Acholeplasma species were found to contain methylated bases. All of the five species contained 6-methyladenine (m6Ade), the methylated base characteristic of prokaryotic DNA. The extent of methylation of adenine residues in the mycoplasmal DNA ranged from 0.2% in mycoplasma capricolum to about 2% in Mycoplasma arginini and Acholeplasma laidlovii DNAs. About 5.8% of the cytosine residues in M. hyorhinis DNA were methylated also. Analysis of cell culture DNA for the presence of m6Ade as a means for detection of contamination by mycoplasmas, and the phylogenetic implications of the finding of methylated bases in mycoplasmal DNAs are discussed.


ABSTRACT: None


ABSTRACT: The hyperfiltration Wash Water Recovery Subsystem is considered the most promising water recovery process for the large quantities of wash water needed for a Space Station. A preprototype Hyperfiltration Subsystem has been developed by Lockheed Missiles and Space Corporation (LMSC) to satisfy projected wash water recovery requirements of 10.9 Kgms/hr (24 lbs/hr) utilizing a hyper filtration module consisting of cintered metal tubes having a polymeric filtration layer. Two hyperfiltration module designs, manufactured by Abcor, Inc. and Carre, Inc., are currently being evaluated at NASA JSC. This paper presents a description of the preprototype subsystem design and important design features, configuration, module test results comparisons and recommendations for future development and testing.


ABSTRACT: This study was undertaken to determine the feasibility
Initially, it was determined that there was no apparent difference in ozone resistance between spores of Bacillus subtilis and Clostridium sporogenes when they are suspended in water. Both species were inactivated by a 10-min exposure at ambient temperature. Resistance was increased when the spores were dried on AOAC carriers. Viable organisms were recovered after an exposure of 40 min at ambient temperature. An increase in the reactor water temperature to 60 °C did not improve the effectiveness of the ozone in sterilizing AOAC carriers. Dried spores of C. sporogenes were more resistant than B. subtilis spores because of a greater accumulation of organic matter on the carriers. No significant sporicidal activity was demonstrated after 40 min for spores of either species when they were inoculated on silk suture loops. The data suggest that organic loading and poor ozone penetrability are key factors in effecting the ability of ozone to sterilize surfaces rapidly.


ABSTRACT: A survey of water samples to determine the efficacy of standard procedures for the isolation of environmental legionellae was conducted. Marked variations in intraspecies resistance to selective agents and treatments were observed, and in experiments with one of the isolates, the response was modified by culture conditions. Five selective procedures incorporating acid (pH 2.2) and heat (50 °C, 30 min) treatments, with and without plating on buffered charcoal-yeast extract agar supplemented with vancomycin (5 ug/ml), polymyxin B (60 U/ml), and cycloheximide (80 ug/ml), caused 5 to 99% decreased in viable counts of pure cultures in water suspensions. The differences in the responses of the cultures to the five treatments were statistically significant. Cells in retained samples of naturally contaminated water from which the original cultures had been isolated were significantly less sensitive than artificially grown isolates. The sensitivities of the laboratory-grown cells to the treatments were affected by the length of incubation of buffered charcoal-yeast extract agar. Whereas acid resistance increased after 24 h of incubation, resistance to the antibiotic mixture decreased.


ABSTRACT: This appendix gives an approach to risk assessment that considers both the epidemiologic data and some measures of exposure to the constituents of ETS.

ABSTRACT: A novel method for rapid determination of total microbial cell numbers was investigated. The method involves the application of most-probable-number estimation statistics to direct microscopic counting of microbial cells by using a particle sizing graticule. Its accuracy and reliability were tested with computer simulations of bacterial cell distributions encountered in ecological studies. Good estimates of cell numbers were obtained when the cell density varied from 3-6000 cells per field, i.e., over 3 orders of magnitude. Low levels of contagion did not markedly influence cell estimates, although high levels, corresponding to discrete scattered microcolonies, did. However, these could be recognized visually. Estimates of cell numbers in Breed smears confirmed its speed and good correlation with the standard quadrat counting technique under real experimental conditions.


ABSTRACT: None


ABSTRACT: Ultrastructural study of utricular and saccular maculas demonstrates that their innervation patterns are complex. There is a clustering of type 1 and type 2 hair cells based upon a sharing of afferents, a system of efferent-type beaded fibers that is of intramacular (mostly calyceal) origin, and a plexus-like arrangement of afferents and efferents at many sites in the neuroepithelium. Results suggest that information concerning linear acceleration is processed peripherally, beginning at the hair cell level, before being sent to the central nervous system. The findings may supply a structural basis for peripheral adaptation to a constant stimulus, and for lateral inhibition to improve signal relative to noise.


ABSTRACT: The application of behavioral technology to the toxicity testing of pyrolysis/combustion (P/C) products is discussed and two categories of behavioral tests commonly employed in fire toxicology programs are reviewed. Data are presented from a comparison of carbon monoxide (CO) induced incapacitation in rats performing in a rotating wheel or under a Sidmon free-operant schedule of shock avoidance. Rats performing in the rotating wheel were behaviorally incapacitated at CO concentrations and carboxyhemoglobin levels significantly lower than those which incapacitated operant avoidance animals. It is concluded that different measures of behavioral incapacitation may vary since incapacitation is a function of the particular
ABSTRACT: During the past decade numerous behavioral end points have been used in toxicological evaluations of thermal decomposition products. However, little research has been conducted which allows a comparison of these different end points. Such comparisons should provide useful information about the susceptibility of different behaviors to toxic incapacitation, supply further knowledge about specific mechanisms of incapacitation, and ultimately provide a guideline by which appropriate behavioral end points may be chosen. The following two experiments were part of a preliminary assessment of the applicability of two different behavioral methodologies to the toxicological evaluation of pyrolysis and combustion products. The purpose of the experiments was to compare the course of changes in two behaviors in animals exposed to increasing concentrations of carbon monoxide (CO). Specifically, the experiments were designed to compare CO induced incapacitation of simple motor behavior in a rotating wheel with CO induced changes in a more complex operant avoidance behavior.


ABSTRACT: Thirty-six male Sprague-Dawley rats were exposed for 15 minutes to the decomposition products of either a polyurethane or polyimide foam while performing an unsignalled shock escape-avoidance task. These products were generated by placing 1g samples of the foams on a conductive plate heated to either 435, 605, or 775 degrees Celcius. The decomposition products and behavioral toxicity of the 2 foams varied differentially with test temperature. At the 2 lower temperatures, the decomposition products of polyurethane proved to be more behaviorally disruptive than those of polyimide, while at 775 degrees Celcius the reverse was true. These results indicate that operant behavior technology brings a sensitivity to material testing which may prove quite useful for future assessments of potential behavioral toxicity.


ABSTRACT: Some studies on the adsorption of cellulase on cellulose revealed part of the mechanisms involved in the enzymatic hydrolysis of cellulose and provided some clues to the synergistic mechanism of cellulase complex. The adsorption of cellulase was significantly affected by the reaction conditions and physical chemical characteristics of cellulose.
Endoglucanase consisted of adsorbable and nonadsorbable components. Celllobiohydrolase had the strongest adsorption affinity. Each cellulase component is postulated to have distinctly different adsorption sites on cellulose, corresponding to the active sites in the hydrolysis reaction. Competitive adsorption kinetics between cellulase components were also observed during the adsorption process. The degree of competitive adsorption was most remarkable when the composition of cellulase components was nearly the same as that in the crude cellulase complex. This seems to show the optimal relative composition of cellulase components. The synergism between celllobiohydrolase and endoglucanase could be elucidated more clearly by this competitive adsorption model of the reaction mechanism.


ABSTRACT: None

Safarik J., Rogers D.M., Ridgway H.F. Effects Of Biocidal Agents Of Bacterial Adhesion To Reverse Osmosis Membranes.

ABSTRACT: The flux and mineral rejection of reverse osmosis (RO) membranes are adversely affected by microbial surface fouling. Because fouling translates into increased operation costs, the Orange County Water District is conducting studies on the mechanism of biofouling in RO systems. Our experiments have focused on the use of chemical biocides to reduce biofilm formation. The effects of biocidal agents were quantified by measuring attachment of radiolabeled fouling microorganisms (Mycobacteria BT2-4) to RO membrane surfaces in response to biocide treatment. A variety of biocides including quaternary ammonium compounds and chlorine were tested. The effects of compounds on adhesion depended on their chemical structures and concentrations, as well as on the bacterial type and polymer structure of the RO membrane. Results will be used to formulate more effective membrane cleaners or inhibitors of biofilm development.


ABSTRACT: A theory of the origin of eukaryotic cells ("higher" cells which divide by classical mitosis) is presented. By hypothesis, three fundamental organelles: the mitochondria, the photosynthetic plastids and the (9+2) basal bodies of flagella were themselves once free-living (prokaryotic) cells. The evolution of photosynthesis under the anaerobic conditions of the early atmosphere to form anaerobic bacteria, photosynthetic bacteria and eventually blue-green algae (and plastids) is described. The subsequent evolution of aerobic metabolism in prokaryotes to form aerobic bacteria (protoflagella and protoflagella) presumably occurred during the transition to the oxidizing atmosphere. Classical mitosis evolved in protozoan-type cells millions of years after the evolution of
photosynthesis. A plausible scheme for the origin of classical mitosis in primitive amoeboflagellents is presented. During the course of the evolution of mitosis, photosynthetic plastids (themselves derived from prokaryotes) were symbiotically acquired by some of these protozoans to form the eukaryotic algae and the green plants. The cytological, biochemical and paleontological evidence for this theory is presented, along with suggestions for further possible experimental verification. The implications of this scheme for the systematics of the lower organisms is discussed.


ABSTRACT: Pressure and flow relationships to the head were measured before and during space flight by means of a chronically implanted cuff placed about the left common carotid artery in one of two rhesus monkeys flown aboard cosmos 1514. Measurements were obtained daily for 4 min every 2 h during the 5-d spaceflight and compared to identical recordings obtained during a 35 h pre-flight control period 9-d before flight and a 12 h period while on the launch pad. Mean arterial pressure demonstrated a 10% increase compared to control levels immediately on insertion into orbit and maintained a 16-27% increase over the first few hours of flight before returning to baseline levels. Blood flow velocity showed a marked increase (approximately 8 cm/s) compared to pre-flight control while on the launch pad which was maintained over the duration of the flight. Blood flow showed reciprocal changes to pressure on orbital insertion. Cardiovascular system changes persisted into the second day of flight and were most clearly indicated by a decrease in relative differences between blood flow to the head and total cardiac output as measured by impedance plethysmography. Signs of adaptation appeared on days 3-5 of flight.


ABSTRACT: In a diabetes detection survey carried out between 1962 and 1965, 2477 (1.1%) of 228,883 subjects had Clinistix-positive glucosuria after a carbohydrate-rich luncheon meal. Of these 2477, 578 displayed impaired tolerance to oral glucose without having manifest diabetes. From this group, 267 men were divided into five groups and subjected to the following treatments and controls: (a) diet regulation and 0.5 g tolbutamide t.i.d. (N=49), annual oral glucose tolerance test (OGTT); (b) diet regulation and one placebo tablet t.i.d. (N=48), annual OGTT; (c) diet regulation only (N=50), annual OGTT; (d) no treatment (N=61), annual OGTT; and (e) no treatment, OGTT at follow-up (N=59 at follow-up). In addition, a control group was included...
comprised of men with normal OGTT (N=52). At follow-up, 29% of these without diet regulation and medication (group e; N=59) had developed diabetes. Of those on diet regulation, but without active medication (group b plus group c, N=98), 13% had diabetes. No individual maintaining tolbutamide and diet regulation (N=23) had progressed to diabetes. In this group, 80% of those later examined (N=11) had serum tolbutamide concentrations in the therapeutic range. No individual with initially normal OGTT developed diabetes or impaired OGTT. The findings suggest that normal oral glucose tolerance signifies little risk of progress to impaired glucose tolerance and manifest diabetes, whereas impaired glucose tolerance is associated with a high risk of progression to diabetes. In addition, it seems possible that treatment with diet regulation, in combination with tolbutamide, may prevent or postpone progression from impaired glucose tolerance to manifest diabetes.


ABSTRACT: The study investigated changes in sleep-wake rhythms due to time zone changes. The subjects were 12 commercial airline cockpit crewmembers on active duty who spent their baseline nights in a sleep facility in Tokyo. After flying from Tokyo to San Francisco, they underwent two consecutive nights of sleep polysomnography and daytime sleep latency tests (MSLT1). During the San Francisco layover, slight changes in sleep quality were observed. REM sleep (%) was decreased, while slow wave sleep (%) tended to increase during the major sleeps. Subjective sleep quality assessments also exhibited a decrease in comparison to the baseline values. Daytime sleepiness as measured by MSLTs was generally greater in the latter half of the awake period during layover as compared with baseline. When the subjects were divided into "morning" or "evening" types, the daytime MSLTs of each type showed different patterns. The former displayed a decreasing L-shaped pattern. These results suggest that further investigation of the individual differences in circadian phase position may be important for understanding the effects of multiple time zone flights.


ABSTRACT: Crude cell-free extracts from Cellulomonas fimi contains cellobiose phosphorylase which cleaves cellobiose into glucose and glucose-1-phosphate in the presence of inorganic phosphate. With the aid of this enzyme, two samples of C14-cellobiose labeled in reducing or non-reducing glucosyl moiety were prepared from uniformly labeled C14-glucose or C14 glucose-1-phosphate as substrate, respectively. The labeled preparations have been shown to be radiochemically pure. Analyses of the anaerobic fermentation products from C14-cellobiose by resting cell suspensions showed that both glucose moieties were fermented almost equivalently. However,
relatively small difference in specific activities of the products revealed that significantly larger amounts of formic acid were produced form the reducing glucose moiety than from the other half of the molecule. Succinic and lactic acids appeared to be produced almost equally from both moieties.


ABSTRACT: The microporous polyethylene hollow-fiber membrane has a unique microfibrile structure throughout its depth and has been found to possess the functions of filtration and adsorption of endotoxin in water. The membrane has a maximum pore diameter of approximately 0.04 um, a diameter which is within the range of microfiltration. Approximately 10 and 20% of the endotoxin in tap water and subterranean water, respectively, polyethylene hollow-fiber membrane. Escherichia coli 0113 culture broth contained 26.4 % of endotoxin smaller than 0.025 um which was also removed. Endotoxin was leaked into the filtrate only when endotoxin samples were successively passed through the membrane. These results indicate that endotoxin smaller than the pore size of the membrane was adsorbed and then leaked into the filtrate because of a reduction in binding sites. Dissociation of 3H-labeled endotoxin from the membrane was performed, resulting in the removal of endotoxin associated with the membrane by alcoholic alkali at 78% efficiency.


ABSTRACT: A comprehensive study of the buoyant density of DNA as a function of composition has been made. The linear relation previously reported has been confirmed. Based on a value of 1.710 g cm -3 for DNA from Escherichia coli the following relation was obtained from the best fit of measurements on 51 different DNA samples: \( p=1.660 + 0.098 \times (GC) \) where \( p \) refers to buoyant density and \( (GC) \) to the mole fraction of guanine plus cytosine. On this basis the composition of DNA from 36 other sources, not previously reported, has been estimated. Several specific observations were made. Bimodal distributions in the density-gradient band patterns were found in DNA from calf thymus and salmon sperm. The DNA of the commonly studied T-even bacteriophages exhibits altered densities due to the presence of glucosylated hydroxymethylcytosine. The DNA of *X174* phage is abnormally heavier suggesting less base-pairing than normal denatured, single-stranded DNA.


ABSTRACT: None

Schroeder D.J., Collins W.E., Elam G.W. Effects of Some Motion
ABSTRACT: Two studies examined the influence of three established antimotion sickness drugs on tracking performance in static (stationary) and dynamic (angular acceleration) conditions and on visual fixation ability during motion. In Study 1, 40 young men were randomly assigned in equal numbers to either a control (lactose placebo), dimenhydrinate (50 mg), promethazine hydrochloride (25 mg), or mixture (25 mg promethazine plus 10 mg d-amphetamine) group. Study 2 used 30 new subjects equally divided into controls, dimenhydrinate (100 mg), and promethazine (50 mg) groups. Following practice, tests were conducted prior to, and 1, 2, and 4 h after drug ingestion. The depressant drugs had little effect of static tracking, but impaired dynamic tracking performance and reduced ability to maintain visual fixation on a localizer/glide slope instrument due to increased ocular nystagmus. The mixture of promethazine plus d-amphetamine produced none of these deleterious effects.


ABSTRACT: Rhodospirillum rubrum and Rhodopseudomonas capsulata were able to grow anaerobically in the dark either by a strict mixed-acid fermentation of sugars or, in the presence of an appropriate electron acceptor, by an energy-linked anaerobic respiration. Both species fermented fructose without the addition of accessory oxidants, but required the initial presence of bicarbonate before fermentative growth could begin. Major products of R. rubrum fermentation were succinate, acetate, propionate, formate, hydrogen, and carbon dioxide; R. capsulata produce major amounts of lactate, acetate, succinate, hydrogen, and carbon dioxide. R. rubrum and R. capsulata were also capable of growing strictly through anaerobic, respiratory mechanisms. Nonfermentable substrates, such as succinate, malate, or acetate, supported growth only in the presence of an electron acceptor such as dimethyl sulfoxide or trimethylamine oxide. Carbon dioxide and dimethyl sulfide were produced during growth of R. rubrum and R. capsulata on succinate plus dimethyl sulfoxide. Molar growth yields from cultures grown anaerobically in the dark on fructose plus dimethyl sulfoxide were 3.8 to 4.6 times higher than values obtained from growth on fructose alone and were 56 to 60% of the values obtained from aerobic, respiratory growth with fructose. Likewise, molar growth yields from anaerobic, respiratory growth conditions with succinate plus dimethyl sulfoxide were 51 to 54% of the value obtained from aerobic, respiratory growth with succinate. The data indicate that dimethyl sulfoxide or trimethylamine oxide as a terminal oxidant is approximately 33 to 41% as efficient as oxygen in conserving energy through electron transport-linked respiration.

ABSTRACT: This report describes the Space Station ECLSS Simplified Integrated Test (SIT) that was conducted at the Core Module Integration Facility (CMIF) located in building 4755 of the Marshall Space Flight Center (MSFC). The test, which began on June 9, 1987, was 52 hours in duration with approximately 42 hours of integrated system operation. The primary objectives of this test were to verify proper operation of ECLS subsystems functioning together in an integrated fashion as well to gather preliminary performance data for the partial ECLS system used in the test. The test was conducted inside of an open module simulator with nominal 3-man metabolic design loads imposed. In order to verify proper performance of the ECLS system, 250 measurements were monitored continuously by on-site personnel and archived for later recovery by an automated data acquisition system. Additionally, water and gas samples were taken during the test to aid in verifying proper subsystem performance. All 250 measurements were reviewed with analyses of over 60 of these measurements and the water and gas samples selected for inclusion into this report.


ABSTRACT: During the summers of 1984 and 1985, a total of 6680 samples of lake water were collected from 15 of the most popular beaches in Manitoba and tested for faecal coliforms, enterococci and Escherichia coli. The 30 day maximum geometric mean of 200 faecal coliforms per 100 mL of water recommended as the acceptable maximum limit in the 1983 Guidelines for Canadian Recreational Water for bather protection was achieved by beaches in all three geographic regions. The United States Environmental Protection Agency (USEPA) criterion of 126 Escherichia coli per 100 mL of water was satisfied by the beaches in the Whiteshell area and the east side of Lake Winnipeg, but not by beaches on the west side of Lake Winnipeg. The USEPA criterion of 33 enterococci per 100 mL, as well as the enterococcus criteria proposed for Manitoba were not met by most beaches in all three regions. Before recommending changes to the national guidelines for recreational water quality (i.e. adding enterococcus criteria), it is important to document an association between illness and counts of a specific indicator bacteria, standardize the test procedures for this bacteria and to agree on the bacterial counts that would relate to an acceptable risk to bathers.


ABSTRACT: The proposed revisions to the total coliform regulations under the National Primary Drinking Water Regulations may specify that a heterotrophic bacteria count must be taken and that the bacterial density must be below a specified value to avoid interference with the total coliform test. The Standard Plate count (PCA or TGE pour plate), has been used for years as a
useful procedure for determining the heterotrophic bacterial density of potable waters and for quality control studies of water treatment processes. It also has been used for monitoring changes in the bacteriological quality of finished water throughout a distribution system. (1) Standard Methods (16 ed. 2) states the problems in using the Standard Plate Count. All viable bacteria present in a water sample cannot be recovered with any single procedure growth medium, or set of physical conditions. Three alternative methods and two new media are presented in Standard Methods (2) to improve recovery of heterotrophic bacteria. The purpose of this evaluation was to compare the heterotrophic bacteria recoveries using these new media and methods with recoveries obtained using the previously accepted method in order to assess heterotrophic bacteria levels in various drinking water samples.


ABSTRACT: Bone marrow transplant recipients were found to have a 10-fold greater incidence of nosocomial Aspergillus infection that other immunocompromised patient population (p < 0.001) when housed outside of a high-efficiency particulate air (HEPA) filtered environment. Multivariate analysis demonstrated that number of infections, age, and graft-versus-host disease severe enough to require treatment were independent risk factors for development of nosocomial Aspergillus infection in this group. The use of whole-wall HEPA filtration units with horizontal laminar flow in patient rooms reduced the number of Aspergillus organisms in the air to 0.009 colony-forming units/m3, which was significantly lower than in all other areas of the hospital (p < 0.03). No cases of nosocomial Aspergillus infection developed in 39 bone marrow transplant recipients who resided in this environment throughout their transplantation period compared with 14 cases of nosocomial Aspergillus infection in 74 bone marrow transplant recipients who were housed elsewhere (p < 0.001). Thus, although bone marrow transplant recipients had an order-of-magnitude greater risk of nosocomial Aspergillus infection than other immunocompromised hosts, this risk could be eliminated by using HEPA filters with horizontal laminar airflow.


ABSTRACT: A biochemical scheme was developed for the separation of Streptococcus mutans into 5 biotypes, a-e, which correlated with the recognized serotypes a-e. The biotype identification of the Strep. mutans was based on the fermentation of mannitol (with and without bacitracin), sorbitol, raffinose, melibiose, and the production of ammonia from arginine. Of 194 naval recruits found harbouring Strep. mutans, 189 (97.4%) were carriers of biotype c alone, or in combination with other biotypes. Biotypes a, d, and e were infrequently isolated and biotype b was not isolated from any of the subjects.

ABSTRACT: As part of an ongoing effort to mimic the hypokinesia and hypogravity of spaceflight, the effects of 14 d immobilization and rotopositioning on mandibular bone osteon growth (radial rate of closure) was assessed in 12 juvenile Rhesus monkeys by tetracycline labeling. The monkeys had been restrained in a supine position and rotated 90° every 30 min through a full 360° arc for 14 d. Osteon growth was also assessed after the immobilized /rotopositioned animals had been permitted to recover in metabolism cages for periods of 28 and 56 d. The closure rates of osteons in the cortex of the inferior border of the mandible were not abnormal during immobilization/rotopositioning or during recovery. The regression line plots yielded slopes of: Controls=0.946-1.000; Immobilized/Rotopositioned= 1.045;28 d Recovery=0.833; 56 d Recovery= 0.829. Microradiographs indicated a normal distribution of osteons of different mineral density: lowly (28%), moderately (53%), and highly mineralized (18%). Bone porosity values also remain within the normal range (18.3,6,4.1%). These results suggested that 14 d immobilization/rotopositioning did not effect abnormal changes in the rates of bone formation and mineralization in the mandibular cortex of the juvenile Rhesus monkey.


ABSTRACT: A variety of different commercially available submicron-rated membrane filter cartridges were inoculated with a known number of viable cells and placed in service on a simulated D.I. water point of use. Pseudomonas diminuta was selected as the model organism. The effluent was monitored for cell count as a function of time under continuous as well as intermittent usage. Since the downstream bacterial counts varied considerably for the cartridges tested, laboratory experiments were conducted to obtain insight into the possible mechanisms which may be associated with the proliferation of bacteria through various types of membrane materials.


ABSTRACT: The influence of three different feeds, wheat straw, sorghum and berseem, on total and cellulolytic bacterial counts in the buffalo rumen at different time intervals from 0 to 8 hours after feeding was studied. Berseem feeding supported maximum growth of rumen bacteria in general and cellulolytic bacteria in particular. Wheat straw supported the poorest growth. The types of cellulolytic bacteria recovered from the rumen of adult buffaloes were Ruminococcus albus, R.
flavefaciens, Bactercides succinogenes, Butyribrio fibrisolvens, Clostridium lochheadii, Cl. longisporum and other Clostridium spp. Cellulolytic cocci were present in smaller numbers than rod forms in the rumen of wheat-straw-fed buffaloes, whereas the cocci outnumbered rod forms in sorghum and berseem-fed buffaloes.


ABSTRACT: Conjugal transfer of three IncP1 plasmids and one IncFII plasmid into strains of the ethanol-producing bacterium Zymomonas mobilis was obtained. These plasmids were transferred at high frequencies from E. coli and Ps aeruginosa into Z. mobilis and also between different Z. mobilis strains, using themembrane filter mating technique. Most of the plasmids were stably maintained in Z. mobilis, although there was some evidence of delayed marker expression. A low level of chromosomal gene transfer, mediated by plasmid R68.45, was detected between Z. mobilis strains. Genetic evidence suggesting that Z. mobilis may be more closely related to E. coli than to Pseudomonas or Rhizobium is discussed.


ABSTRACT: Many different types of engineering devices to produce water from human waste, chamber atmosphere and oxygen-hydrogen fuel cells have been developed over the past decade. Such diversified techniques have resulted in water varying greatly in quality from one technique to another, between units of the same process, and within the same unit from day to day. Thus, potable water standards were developed for guidance to (1) qualify all water producing techniques prior to evaluation for aerospace systems and (2) ascertain the safety of the water for human consumption. Development of these engineering guidelines has been based on several criteria, including the results of over 300 laboratory analyses of aerospace water systems. The recommended standards are divided into two parts. The first deals with qualification of the technique and is subdivided into general requirements (performance goals) and specific requirements (limits of acceptability). The second part consists of procedures for monitoring the water from qualified units for potability.

Smith H. The Determinants of Microbial Pathogenicity. Essays in Microbiology, Dept. of Microbiology, Univ. of Birmingham, P.O. Box 363, Birmingham B15 2TT,:0002-0032. .

ABSTRACT: None

Sneath P.H.A. Identification of Microorganisms. Essays In Microbiology, Department of Microbiology, Leicester University, Leicester,:0002-0032. 1978.

ABSTRACT: A spectrometric technique is presented that combines most of the important criteria necessary for efficient detection and identification of microorganisms. These criteria include simplicity of experimental design, various degrees of sensitivity and selectivity, convenience, and total reaction times of less than 15 min. The study takes advantage of the inherent extracellular enzymes present in living as opposed to dead, non-enzyme-producing organisms. Sequentially, these are harnessed in in vivo reactions with a substrate containing a select organic functional group that is known to be cleaved of hydrolyzed by a certain enzyme. The substrate is tailored so that one of the products can be induced to fluoresce, and by using a conventional spectrofluorimeter the rate at which the fluorescence appears can be recorded. By subjecting the same bacterial sample to a number of different enzyme substrates, a pattern of fluorescence response rates emerges from a 7 by 7 microorganism-substrate matrix. Detection limits ranged from 3.6 x 10^2 to 3.5 x 10^8 cells per ml for the Bacillus globigii -indoxyl acetate and Escherichia coli-deacetylfluorescein pairs, respectively. The specificity and versatility of the method for bacterial determination is demonstrated in probing different bacterial enzymes through their spectrally active metabolic products.


ABSTRACT: A total of nine chlorinated ethanes and ethenes were circulated over lithium hydroxide in a laboratory scale closed system simulator. System volume and lithium hydroxided temperature were varied from that intended to maximize possible reactions to conditions approximating those of a space cabin environment. Of the nine compounds tested, seven were found to be dehydrohalogenated (viz., loss of hydrogen chloride) in the course of one of more experimental treatments. Of particular significance was the conversion of 1,2-dichloroethane to chloroethene, a known carcinogen, and of trichloroethene to dichloroethyne, a highly toxic substance. It is therefore concluded that a potentially hazardous situation exists for the inhabitants of closed ecological systems such as spacecraft, one for which precautions must continue to be taken.


ABSTRACT: The literature on the effects of mixing and Volatile
Fatty Acid concentrations on anaerobic digestion is reviewed, and results of further experiments, carried out on laboratory scale digesters, reported. It is shown that mixing regimes for anaerobic digesters control the rate of biogas production. For impeller speeds of between 140 and 100 rpm, in a digester system treating sewage sludge, no improvement in gas yields was obtained. At the higher speeds, a slight reduction in gas production occurred, due possibly to shear forces separating the hydrolytic bacteria from their polymer substrates. Propionic acid concentrations, within digesters fed with sewage sludge, increased shortly after dosing and particularly when lactic acid was a feed additive. Acetate concentrations up to 4000 mg litre$^{-1}$ did not inhibit gas production within digesters and could be stimulatory. Digesters showing (propionic + butyric acids):(acetic acid) ratios of less than 80:1 produced good gas yields.


ABSTRACT: The use of anaerobic digestion for the biological breakdown of waste organic materials to produce methane is developing commercially. Together with technological improvements in the process an increase in our knowledge on the microbiology of these systems can be linked with chemical enginerring "knowhow" and newer designs can be implemented for specific applications. Design types and their advantages are discussed with presentations of practical data when operating pilot plant reactors. These studies indicate that scale-up applications produce similar results to the innovative laboratory systems.


ABSTRACT: None


ABSTRACT: The extraction and use of the cellulosic and protein fractions of sewage sludges has potential for animal feedstuffs. The technology to derive these useful materials commercially is discussed. High grade protein can be chemically extracted directly or microbes can be grown on the hydrolysed cellulose fraction to produce single cell protein.

Starr D. Fingerprinting Microbes. one page torn from unknown journal.

ABSTRACT: A computerized device that identifies bacteria and other microorganisms faster and more accurately than any previous method.

ABSTRACT: Exposure to conditions of weightlessness has been associated with decrements in muscle mass and strength. The present studies were undertaken to determine muscle response at the cellular level. Male Sprague-Dawley rats (360-410 g) were exposed to 7 days of weightlessness during the Spacelab 3 shuttle flight (May 1985). Animals were killed 12 h postflight, and soleus (S), gastrocnemius (G), and extensor digitorum longus (ECL) muscles were excised. Muscle protein, RNA, and CNA were extracted and quantified. Differential muscle atrophy was accompanied by a significant (P < 0.05) reduction in total protein only in S muscles. There were no significant changes in protein concentration (mg/g) in the muscles examined. In S muscles from flight animals, sarcoplasmic protein accounted for a significantly greater proportion of total protein than in ground controls (37.5 vs. 32.5%). Tissue concentration (nmol/g) of asparagine-aspartate, glutamine-glutamate, glycine, histidine, and lysine were significantly reduced (from 17 to 63%) in S muscles from flight animals, but only glutamine-glutamate levels were decreased in the G and ECL. Muscle DNA content (ug) was unchanged in the tissues examined, but S muscle DNA concentration (ug/mg) increased 27%. RNA content (ug) was significantly (P < 0.025) reduced in S (-28%) and G (-22%) muscles following spaceflight. These results identify specific alterations in rat skeletal muscle during short term (7-day) exposure to weightlessness and compare favorably with observations previously obtained from ground-based suspension simulations.


ABSTRACT: A progressive loss of bone mass is consistently reported in humans exposed to weightlessness during space flight. The mechanism of this metabolic alteration is unknown but may be due in part to the effects of disuse osteoporosis along with the influence of elevated corticosteroid levels. With a goal toward mankind's permanent presence in space, effective countermeasure against bone demineralization will be required. Synthetic anabolic steroids have been shown to prevent bone loss in ground-based immobilization studies and in excess corticosteroid states. These agents may offer a means of slowing or preventing bone loss thus facilitating long term space habitation.


ABSTRACT: None

Stokes H.W., Dally E.L., Yablonsky M.D., Eveleigh D.E. Comparison Of Plasmids In Strained Of Zymomonas mobilis. 1983.
ABSTRACT: Four strains of Zymomonas mobilis were examined for their resistance to antimicrobial agents and found to have similar resistance profiles. Plasmid DNA was extracted and purified by CsCl dye buoyant density centrifugation; molecular weights were determined by agarose gel electrophoresis and electron microscopy. All four strains harbored a large plasmid (46 x 10^6 Da) and a smaller plasmid (16-21 x 10^6 Da) whose molecular weight was strain dependent. Two strains, AgII and ATCC 10988, had smaller plasmids of unique molecular weight. Homology existed between the plasmids in the four stains as shown by cross-reaction in DNA-DNA blot hybridizations. Only one plasmid appeared unique to the host from which it was isolated.


ABSTRACT: To ascertain the feasibility of heat inactivation as an eradication method applicable to all members of the family Legionellaceae, we tested the heat resistance of 75 isolates which represented 19 members of this family of organisms. The range of thermal death times at 60, 70, and 80 °C were 1.3 to 10.6, 0.7 to 2.6, and 0.3 to 0.7 min, respectively. These data suggest that the method of heat eradication will be effective against all members of the family Legionellaceae.


ABSTRACT: Bacteria from soil and related environments were selected or adapted to metabolize phenol, hydroxy phenols, nitrophenols, chlorophenols, methylphenols, alkylphenols, and arylphenols when cultured in mineral salts media with the specific substrate as the sole source of carbon. A phenol-adapted culture (substrate-induced enzyme synthesis proven) was challenged in respirometric tests with 104 related compounds; probable significant oxidative activity occurred with 65. Dihydric phenols were generally oxidized; trihydric phenols were not. Cresols and dimethylphenols were oxidized; adding a chlorogroup increased resistance. Benzoic and hydroxybenzoic acids were oxidized; sulfonated, methoxylated, nitro, and chlorobenzoic acids were not; m-toluic acid was utilized but not the o- and p- isomers. Benzaldehyde and p-hydroxybenzaldehyde were oxidized. In general, nitro- and chloro-substituted compounds and the benzenes were difficult to oxidize.


ABSTRACT: This symposium was organized to bring together two complex groups: space biologists, who are attempting to develop closed ecological systems to sustain man during extended space missions, and ecologists, who for many years have been studying the ecological system on earth, man's normal life support system.
ABSTRACT: Several consistent medical problems have been encountered by astronauts during space flights. These include vestibular dysfunction, weight loss, increase in height, upward fluid shift, anemia, cardiovascular deconditioning, muscle atrophy, and bone loss. Almost all of these alterations can be attributed to the absence of gravitational force. Most are adaptive in nature and therefore reversible, but readaptation after returning to earth may cause further problems (e.g., in the case of vestibular dysfunction). The most recalcitrant and disturbing of all these problems is the relentless bone loss associated with negative calcium balance. This problem appears to be irreversible, and critical demineralization can occur after two years in a weightless state. Unless its mechanism is elucidated and preventive measures are taken, the bone loss may prove to be the medically limiting factor for the duration of space flight.

Taylor G.R., Graves R.C., Brockett R.M., Ferguson J.K., Mieszkuc B.J. Skylab Environmental And Crew Microbiology Studies. Biomedical Results From Skylab, Chapter 8, Chapter 8,:0053-0063.

ABSTRACT: The objectives of the Skylab microbiology studies were to detect the presence of potentially pathogenic micro-organisms on the crewmembers and their spacecraft and to obtain data which would contribute to an understanding of the response of the crew's microbial flora to the space flight environment. These data were interpreted in light of the theories of microbial simplification, intercrew transfer of medically important microorganisms, in-flight autoinfections, and postflight microbial shock, which have been proposed by various authors.


ABSTRACT: We have previously reported changes in the immunoresponsiveness of "T" lymphocytes following space flight. Additional data collected before and after 11 Shuttle space flights show that absolute lymphocyte numbers, lymphocyte blastogenic capability, and eosinophil percent in the peripheral blood of crewmembers are generally depressed postflight. These responses resemble those associated with physical and emotional stress and may not be related to flight per se. Additional data from Space Shuttle flights 41B and 41D, involving 11 crewmembers, indicate a postflight decrease in cells reacting with "B" lymphocyte and monocyte monoclonal antibody tags. Further, the loss of "T" lymphocyte blast capability interacts with the decreased monocyte count (correlation coefficient = 0.697). This finding implies that the previously reported loss of blastogenic capability may be a function of decreased monocyte control, as noted in several nonspaceflight related studies.
BIBLIOGRAPHY LISTING


ABSTRACT: The theoretical basis of a new technique for measuring equilibrium adsorption/desorption kinetics and surface diffusion of fluorescent-labeled solute molecules at solid surfaces has been developed. The technique combines total internal reflection fluorescence (TIR) with either fluorescence photobleaching recovery (FPR) or fluorescence correlation spectroscopy (FCS). A laser beam totally internally reflects at a solid/liquid interface; the shallow evanescent field in the liquid excites the fluorescence of surface adsorbed molecules. In TIR/FPR, adsorbed molecules are bleached by a flash of the focused laser beam; subsequent fluorescence recovery is monitored as bleached molecules exchange with unbleached ones from the solution or surrounding nonilluminated regions of the surface. In TIR/FCS, spontaneous fluorescence fluctuations due to individual molecules entering and leaving a well-defined portion of the evanescent field are autocorrelated. Under appropriate experimental conditions, the rate constants and surface diffusion coefficient can be readily obtained from the TIR/FPR and TIR/FCS curves. In general, the shape of the theoretical TIR/FPR and TIR/FCS curves depends in a complex manner upon the bulk and surface diffusion coefficients, the size of the illuminated or observed region, and the adsorption/desorption kinetic rate constants. The theory can be applied both to specific binding between immobilized receptors and soluble ligands, and to nonspecific adsorption processes. A discussion of experimental considerations and the application of this technique to the adsorption of serum proteins on quartz may be found in the accompanying paper (Burghardt and Axelrod. 1981. Biophys. J. 33:455).


ABSTRACT: The aim of the Cytos 2 experiment, carried out during the French-Soviet manned flight in July 1982, was to study the bacteria's sensitivity to antibiotics cultivated in vitro during the orbital flight, using the bacterial method of minimal inhibitory concentration (MIC). Two species of bacteria were tested with various antibiotics: Staphylococcus aureus with Oxacillin, Chloramphenicol and Erythromycin; Escherichia coli with Colistin and Kanamycin. The results show an increase in resistance to antibiotics particularly strong in E. coli and weaker in Staphylococcus aureus. Considering these results, we think that there might be a relationship between the increase in resistance to antibiotics and a stimulating effect on growth rate by the factors of environmental space.

ABSTRACT: The union of Soviet Socialist Republics and the United Stated of America operate major aerospace medicine programs; each country has taken specific measures to assure the development of an adequate number of trained aerospace medicine physicians. This jointly prepared paper emphasizes the training of aerospace medicine physicians related to civil aerospace activities. Those working in the field of aerospace medicine will find of interest the aerospace medical approaches taken by the U.S.S.R. and the U.S.A. in achieving their respective aerospace objectives.


ABSTRACT: None


ABSTRACT: None


ABSTRACT: An endo-B-1,4-GLUCANASE (EC 3.2.1.4) was obtained in high yields in purified form from a culture filtrate of Fisarium lini by an extremely simple method. The method consists of precipitation of the culture filtrate with ammonium sulphate (290 g/L), followed by chromatography of the precipitated fraction on Biogel P-150. The purification is based on the unusual property of the enzyme being eluted after cytochrome C, even though its molecular weight is 2.8 X 10 (4) (by SDS PAGE). The yield of pure enzyme was 6.8 mg/L culture broth. The homogeneity of the enzyme was established by ultracentrifugation, isoelectric focusing, and electrophoresis in polyacrylamide gels containing SDS. The enzyme was isoelectric at PH 8.3 and contained 2.9% carbohydrate. The Km value for carboxymethyl (CM) cellulose was 11.6 mg/mL. The enzyme showed high viscosity reducing activity towards CM cellulose but very low activity with Walseth cellulose and crystalline celluloses such as Avicel and cotton. The purified enzyme has activity towards xylan. The amino acid analysis showed a predominance of acidic and neutral amino acids and low contents of histidine, arginine, and methionine. One-half of the cysteine content was 1 residues/mol enzyme, and no free-SH group was detectable.


ABSTRACT: A microgravity whole body shower (WBS) and a waste water recovery system (WWRS) were used in a closed loop test at the Johnson Space Center. The WWRS process involved chemical pretreatment, phase change distillation and post-treatment. A preprototype Thermoelectric Integrated Hollow Fiber Membrane Evaporation Subsystem (TIMES) was used for distillation after
pretreatment and the post-treatment was accomplished with activated carbon, mixed ion exchange resin beds and bactericide dispensing units. The purposes of this test were to evaluate a NASA approved Shuttle soap for whole body showering comfort; evaluate the effects of the shower water on the WBS and the TIMES; and evaluate purification qualities of the recovered water in a closed loop operation. This paper describes the test hardware, the controls exercised for whole body showering, shower water collection and chemical pretreatment for microorganism control, TIMES operation and recovered water post-treatment. During the closed loop test, samples were taken to evaluate the water quality for both chemical and microbial impurities at selected locations in the water purification process. The water was recycled five times, thus demonstrating the feasibility of reusing reclaimed shower water in Space Station. Chemical pretreatment effectively controlled microorganism growth in the raw shower water and the TIMES with post-treatment effectively reduced the organic impurities and provided adequate and positive disinfectant.


ABSTRACT: A shower test was conducted recently at NASA-JSC in which waste water was reclaimed and reused. Test subjects showered in a prototype whole body shower following a protocol similar to that anticipated for Space Station. The waste water was purified using reverse osmosis followed by filtration through activated carbon and ion exchange resin beds. The reclaimed waste water was maintained free of microorganisms by using both heat and iodine. This paper discusses the test results, including the limited effectiveness of using iodine as a disinfectant and the evaluation of a Space Station candidate soap for showering. In addition, results are presented on chemical and microbial impurity content of water samples obtained from various locations in the water recovery process.


ABSTRACT: Previous 3-week COSMOS spaceflights indicated a significant reduction of bone mass in weight- and non-weight-bearing bones probably due to a decrease in bone formation activity. On COSMOS 1667, 7 flight and 7 control male rats were studied by bone histomorphometric methods. 1) Weight-bearing bones: in proximal tibial metaphysis, the trabecular bone volume was markedly declined in flight animals. Trabeculae were decreased in number and thickness; this probably leads to an alteration of bone mechanical properties. Formation activity (reflected by osteoid seam thickness and osteoid surface measurements) was decreased at the trabecular and endosteal levels. Resorption activity (osteoclast number and active resorption surfaces measured by a histoenzumologic method)
remained unchanged. The imbalance that appeared to occur between these cellular activities may be responsible for the loss of trabecular bone mass. In proximal femoral metaphysis, trabecular bone volume was measured in an area located under muscular insertions. Deleterious effects of weightlessness were not observed. Therefore, muscular tractory may have a protective effect on weight-bearing bones. 2) Non-weight-bearing bones: in thoracic and lumbar vertebrae, no change was found neither in bone mass nor in bone cellular parameters. The short flight appeared to confirm that non-weight-bearing bones are not as much at risk as weight-bearing bones during spaceflight. Furthermore, marked differences observed between areas with and without muscular insertions, emphasize the most important role of mechanical factors in trabecular bone mass preservation.


ABSTRACT: Five pregnant growing rats were orbited for 5 days aboard the Soviet COSMOS 1514 biologic satellite. The bone effects of weightlessness were studied and compared to those of five pregnant rats. Bone histomorphometric studies were performed to investigate the early effects of weightlessness in loaded (tibia-femur) and unloaded (thoracic and lumbar vertebrae) bones. A short exposure to weightlessness does not induce any change in bone mass and inner structure in either type of bone. In unloaded bones, the number of osteoclasts per square millimeter of the trabecular surface significantly increased when measured after histochemical demonstration of tartrate-resistant acid phosphatase. It is likely that a stimulation of bone resorption activity occurs in the trabeculae of unloaded bones during the early phase of a spaceflight. In tibia, osteoid seam thickness and total osteoclastic resorption surfaces at the endosteal level were not modified.


ABSTRACT: The author compares the Flight Surgeon utilization/training philosophies of the U.S. Air Force and the U.S. Navy. These two programs are compared as to general philosophies, basic and advanced training programs, continuing medical education opportunities, career opportunities, peer prestige, practice modalities, retention rates, and special aircrew member evaluations/follow-up. Some proposals for improving the programs are put forth. It is concluded that, in many ways, the aviation medicine problems faced by the USAF and the USN Flight Surgeons are quite similar. However, their programs, philosophies and aeromedical policies are seen to be quite divergent. Each service could learn from the other.

ABSTRACT: The mineral content of the central os calcis, and distal radius and ulna was measured by the monenergetic photon absorptiometric technique pre- and postflight on the SL-3 crewmen. No significant changes were observed in the radius and ulna. Only the SPT showed a loss in calcaneal mineral which slowly returned to preflight levels by the 87th postflight day.


ABSTRACT: None


ABSTRACT: None


ABSTRACT: Enzymatic hydrolysis of cellulose for sugar production offers advantages of higher conversion, minimal by-product formation, low energy requirements, and mild operating conditions over other chemical conversions. The development of a kinetic model, based on observable, macroscopic properties of the overall system, is helpful in design and economic evaluation of processes for sugar conversion and ethanol production. A kinetic model is presented, incorporating enzyme adsorption, product inhibition, and considers a multiple enzyme and substrate system. This model was capable of simulation saccharification of a lignocellulosic material, rice straw, at high substrate (up to 333 g/L) and enzyme concentrations (up to 9.2 FPU/mL) that are common to proposed process designs.


ABSTRACT: The use of high performance liquid chromatography (HPLC) is a common tool for the separation and quantitation of saccharification products in cellulase research. Many of the columns used both commercial and homemade, employ the cation exchange resin Dowex(Aminex)50WX4. A problem with this procedure is the interference to the response of the refactometer by certain ions (e.g. phosphate and citrate). These ions are present in culture media and hence in crude extracellular enzyme preparations. Their removal via dialysis poses the question of the degree of loss of the cellulase enzyme via adsorption to the dialysis membrane. These ions may also be used in the saccharification buffers and can produce peak responses with similar retention times to the sugars being analyzed. Phosphate ion produces a peak with approximately the same retention time as cellobiose when the 50W-X4 resin is used in its Ca2+,Pb2+, or H+ form.
forms. Depending on the concentration of both the phosphate ion and the disaccharide, there can be interference with or even total obliteration of the cellobiuse peak. This interference can be eliminated by precipitation of the phosphate by the addition of heavy metals.


ABSTRACT: The cryptic plasmid pRUT41 from Zymomonas mobilis was examined for its biological properties. This plasmid was found to be conjugally transferred from Z. mobilis CP4 to E. coli BM21 and to carry genes for antibiotic resistance (gentamicin, kanamycin, and streptomycin). Covalently closed circular plasmid DNA was isolated from eight transconjugants of E. coli BM21. These plasmids were identical in mobility on agarose gels and exhibited the same restriction patterns as the native pRUT41 plasmid isolated from Z. mobilis. The plasmid location of the antibiotic resistance genes was further confirmed by transforming E. coli BM21 with isolated pRUT41 plasmid from strain CP4 and with plasmids from the transconjugants of BM21. Resistance to streptomycin, kanamycin, and gentamicin was tightly linked and transferred together in all cases.

Wallis C., Melnick J.L. An Instrument For The Immediate Quantification Of Bacteria In Potable Waters.

ABSTRACT: A new semi-automated instrument is described which quantifies the number of bacteria in potable waters within 3 minutes, providing a permanent colorimetric record of the results. The bacterial-detection device can measure as few as 100 CFU/ml in potable waters. In brief, a 100-1000 ml sample of tap water is drawn thru a large surface, customized filter housed in the device, and bacteria, rust and humic acid in the water are concentrated there on. A reducing agent is used to remove the rust and humic acid from the filter. The filter is inverted and backflushed to elute the bacteria which are collected and reconcentrated onto a 7 mm diameter filter surface. The reconcentrated bacteria are stained, and the filter fibers are preferentially decolorized without removing the dye from the bacteria. The color intensity of the filter surface is compared to a color guide to determine the amount of bacteria in the test water.


ABSTRACT: The degradation of cellulosic biomass by an anaerobic and thermophilic bacterium, Clostridium thermocellum, has been under investigation. It has been found that this organism is able to degrade cellulose and accumulate reducing sugars in the fermentation broth. The degradation of cellulose and the utilization of the sugars has been tested in mixed-cultures where
the second organism is used to produce acetic acid. The direct production of a chemical (acetic acid) and a liquid fuel (ethanol) from cellulosic biomass—by a pure culture of C. thermocellum also appears possible. Although the conversion efficiency is quite good, the product concentration must be increased. A selection and adaptation technique has been used where a strain capable of tolerating 5 volume % ethanol has been isolated.


ABSTRACT: Culture filtrates of CL-847 strain of Trichoderma reesei grown on different carbon sources have been compared. The highest enzyme production is obtained with Watman CC 41 cellulose: 17.9 mg/mL of soluble proteins and 13.7 units filter paper (FP) activity. Wood pulps gave lower production values and more viscous culture media. About one-third of maximal enzyme production is obtained on lactose as the sole carbon source. Addition of 0.5% cellulosic inducer to 6% lactose media enhances enzyme production up to the following levels: 14.1 mg/mL of soluble proteins and 8.4 units of FP activity.


ABSTRACT: A partial amino acid sequence of human platelet-derived growth factor, the major mitogen in serum for cells of mesenchymal origin has been determined. A region of 104 contiguous amino acids shows virtual identity with the predicted sequence of p28 sis, the putative transorming protein of simian sarcoma virus (SSV). This similarity suggests a mechanism for transformation by SSV and other agents, involving expressing of growth factors.


ABSTRACT: Dust exposure on farms can be prevented by changes in work practices and by informing and educating farmers. Ventilation control during handling and prevention of growth of microbes are feasible measures and could be included in regulation schemes. Apart from information on existing work practices, an increased awareness of new technology is necessary.


ABSTRACT: This study was performed on B-747 aircrews operation on
regular passenger flights between Frankfurt and the U.S. west coast (9 h time difference). In an initial phase, sleep behavior was surveyed by daily logs in 38 crewmembers. The results for the layover period indicate congruent sleep patterns with shifts in sleep onset distinctly less than 9 h. In comparison with preflight control data, sleep duration was significantly prolonged and, on average, no sleep deficits were experienced before commencing the return flight. The main part of the study consisted of polygraphic sleep recordings and multiple sleep latency tests (MSLT) applied to four complete cockpit crews (12 members total) in a baseline period, during layover, and after return to homebase. In addition, body temperature and ECG were continuously recorded. During layover, mean bed times were shifted by 4.5 h at maximum. Sleep was disturbed by early and prolonged awakenings which led to a reduction of sleep efficiency. In contrast, no sleep deficits nor increases in daytime sleepiness occurred. Night duty associated with the return flight caused sleep deprivation which conversely resulted in good sleep during the first night back in Germany. However, during the second night after return, impaired sleep was observed, at least in part caused by the rhythm disturbances. As predicted by our resynchronization model, ECG and rectal temperature recordings gave evidence for a desynchronization of the circadian system and an internal dissociation of different body functions.


ABSTRACT: +Gz-induced loss of consciousness (G-LOC) continues to be a threat to aircrew flying high-performance fighter aircraft. All avenues to prevent G-LOC, and to reduce the resulting incapacitation should G-LOC occur, must be explored. Research has begun to accurately quantify all aspects of the G-LOC phenomenon. The emerging pattern from this research indicates that, theoretically, G-LOC incapacitation could be significantly reduce. Comparison of G-LOC with LOC induced by acute arrest of cerebral circulation reveals that the G-LOC incapacitation could be reduced by as much as 17 s. Results also indicate that the relative incapacitation period (confusion and disorientation) following unconsciousness could be reduced by at least 9 s for an individual who has previously experienced G-LOC. This suggests that exposure to G-LOC during centrifuge training could provide this orientation to G-LOC and potentially reduce the incapacitation period should it occur in-flight. This exposure may be likened to the current altitude-hypoxia training requirement for aircrew. Experience to date supports the contention that such training may be accomplished with an acceptable safety margin.


ABSTRACT: Aircrew incapacitation resulting from very high onset
sustained +Gz stress has resulted in significant losses of aircraft and aircrew. Enhanced protection and training toward prevention of +Gz-induced loss of consciousness (G-LOC) will continue to be vital. Techniques for reduction of the time of incapacitation, should G-LOC occur, must also be explored and developed. Current capability of aircraft autorecover as demonstrated by the Advanced Fighter Technology Integration F-16 (AFTI/F-16) promises to enhance safety from the acute incapacitation resulting from G-LOC (and spatial disorientation). Physiologic monitoring for determining G-LOC has certain advantages especially in the aerial combat arena. The optimum physiologic monitoring technique would be direct determination of failure of brain cell function at the cellular or subcellular level. Complete investigation of G-LOC is necessary to understand the phenomenon and to develop methods for physiologic monitoring of G-LOC. Intergration of physiologic monitoring techniques into aircraft autorecovery systems requires a broad approach for optimal development.


ABSTRACT: The progress in the development of life support for the crewman parallels the changing flight envelope of the airplane and spacecraft. A constant in this history is man. In spite of elaborate attempts to refine the selection of the crew, the basic lists of requirements has not changed. Only the urgency and the need for providing the entire list of requirements have been seen. Generally, progress in the flight envelope has demanded more reliable and often more complex provisions to support the crew. The debate as to how this should be done has often centered on the argument about having man wear or carry the life support elements versus integration of these provisions into the vehicle. This debate initiated the concept of risks/benefits, a debate that has now reached all aspects of man's endeavors, including his medical care. This paper will discuss the major milestones of providing life support, some of the key contributors (a role that General Armstrong played in a great way), and how this has provided the base for the next steps in aviation and space operations.

Whitley K.M., McGriff C.F. Test Plan For VCD Subsystem Checkout And Performance Testing. No Date.

ABSTRACT: None


ABSTRACT: The lessons of past and present manned space programs are clear. Successful design and operation of a spacecraft water system is contingent upon consideration of traditional sanitary engineering principles in the context of unique mission requirements. However, the aerospace solution to the traditional
terrestrial problem often requires an innovative design approach to succeed in the spacecraft environment. Future long duration space missions will require the same attention to basic principles, the same degree of innovation, and an extra measure of caution, because of the lack of terrestrial experience with direct human reuse of reclaimed water.


ABSTRACT: None


ABSTRACT: Towards the end of 1980 the first Spacelab will be launched. It represents the culmination of a major cooperative project between the nations subscribing to the European Space Agency and N.A.S.A. The Spacelab module contains a laboratory inside which a wide range of experiments can be carried out in an environment which, apart from the absence of gravity, is not unlike that of a terrestrial laboratory. From the point of view of the life scientist it represents an opportunity to carry out experiments to investigate the effect of xero gravity or modulated gravity on biological preparations including amn. The first mission will last seven days, but subsequent missions planned for the decade 1980-1990 may last up to thirty days. The purpose of the paper is to introduce participants to the facilities which are available in Spacelab and to explain the procedure by which experiments may be proposed. There is also a discussion of the present funding arrangements int he United Kingdom.


ABSTRACT: A ruminant can be thought of as a fermentation factory. The animal ingests plant polymers (in grass, hay, corn, silage, etc.) which are the raw material for its fermentation. Preliminary processing occurs in the oral cavity and consists mainly of comminution of food by mastication. The plant material is then swallowed and transported to the ruminant's complex stomach. The stomach, called the rumen reticulum or, more simply, rumen, is the site of fermentation.


ABSTRACT: This project has employed a computerized pursuit meter which has a high correlation with operational performance to test the principal antimotion sickness drugs. Proficiency scores on the pursuit meter task were improved over placebo scores in subjects with d-amphetamine 10 mg and 5 mg, the combination of
promethazine 25 mg plus scopolamine 0.4 mg with d-amphetamine 10 mg, and the combination of scopolamine 1 mg with d-amphetamine 10 mg. Scores were not significantly different from placebo scores in tests with scopolamine 0.25 mg, 0.5 mg, or 0.6 mg; marezine 50 mg; meclizine 50 mg; or dimenhydrinate 50 mg. This was also true for the combination of scopolamine 1 mg with d-amphetamine 5 mg, and that of promethazine 25 mg with d-amphetamine 10 mg. A statistically significant decrement of performance scores was seen with scopolamine 1 mg or 0.8 mg, and with promethazine 25 mg oral or 25 mg I.M. The combination of promethazine 25 mg with scopolamine 0.4 mg, and that of promethazine 25 mg oral plus 25 mg I.M. with d-amphetamine 10 mg, also gave significant decrements from placebo scores. These results indicate that selected doses and combination of antimotion sickness drugs can be used without loss of operational proficiency.


ABSTRACT: Pilot and plane capabilities to withstand high-Gz combat maneuvers are tactically important. Sustained 10-15 Gz capabilities of current and future planes outstrip safe physiologic limits in spite of the combined use of World War II -vintage straining maneuvers and relatively ineffective anti-G suits to prevent losses of vision and consciousness. However, the extreme arterial pressure increases needed to maintain cerebral blood flow (e.g. 400 mm Hg at heart level during exposures to 13.5 G when sitting upright) carry risks of anatomic damages to the circulatory system and rupture of air-containing, essentially unprotectable, lungs. These could be minimized, and incapacitating losses of consciousness avoided, by use of horizontal positions designed to eliminate heart-to-head hydraulic gradients. Development of a prone-position cockpit with a counterweighted, forward-looking head support plus optical-electronically aided all-directional visibility is the most physiologic, safest, and surest way to achieve this goal.


ABSTRACT: Symptoms consistent with hypersensitivity pneumonitis developed in several workers in two multistory buildings in an industrial complex. A health questionnaire survey was conducted to determine the extent of the problem. Eightyseven percent of the population of 1050 employees completed the health questionnaire. Serological testing identified 152 positive precipitin reactors to the fungus Aureobasidium pullulans; 115 reactors were symptomatic. The clinical and laboratory features at the time of the acute illness and during four years of follow-up are described. The agent, A pullulans, was identified as a contaminant of the heating-cooling ventilation units containing open waterspray chambers. Control was accomplished by replacement of the ventilation systems. A secondary source of antigen was found to be corrugated cardboard. Some sensitized
employees required removal from work exposure to corrugated cardboard to prevent recurrent symptoms.


ABSTRACT: Male Sprague-Dawley rats were placed in orbit for 7 days aboard the space shuttle. Bone histomorphometry was performed in the long bones and lumbar vertebrae of flight rats and compared with data derived from ground-based control rats. Trabecular bone mass was not altered during the 1st week of weightlessness. Strong trends were observed in flight rats for decreased periosteal bone formation in the tibial diaphysis, reduced osteoblast size in the proximal tibia, and decreased osteoblast surface and number in the lumbar vertebra. For the most part, histological indexes of bone resorption were normal in flight rats. The results indicate that 7 days of weightlessness are not of sufficient duration to induce histologically detectable loss of trabecular bone in rats. However, cortical and trabecular bone formation appear to be diminished during the 1st wk of spaceflight.


ABSTRACT: The protein profile of the cytoplasmic proteins of Streptococcus mutans GS-5 was determined by two-dimensional gel electrophoresis. Use of this recently developed, high-resolution analytical tool showed in excess of 140 cytoplasmic proteins. The profile consisted of mostly acidic components with pI values between 3.70 and 5.30 and relative molecular weights mainly in the 13,000 to 90,000 range. With sodium dodecyl sulfate-polyacrylamide gel electrophoresis, the proteins were resolved into 40-45 components. The binding of fluoride by the proteins reached a maximum value in 15 min., and it was linear with exogenous F- doses of up to 60-80 ppm per mg of protein (60-80 ug/g). The proteins bound 22 to 138 times more F- from assay mixtures containing 1 mM CaCl2 than from assay mixtures containing such ions as HgCl2, ZnCl2, CuCl2, MgCl2, MnCl2, or SnCl2. When NaF, SnF2, NH4F, CsF, (CH4)3NF, and Na2P03F were used as sources of F- (adjusted to 10 ppm of F- in all cases), the proteins bound 2.1, 1.8, 1.6, 1.4, and 0.3 ppm of F- per mg of protein, respectively. Initial fractionation of the plasma proteins by preparative column isoelectric focusing indicated that proteins with pI values of 4.1 to 4.5 as well as those with pI values of 5.0 to 5.3 bound twice as much F- as did the proteins outside these pI values.

ABSTRACT: Unusual vestibular responses to head movements in weightlessness may produce spatial orientation illusions and symptoms of space motion sickness. An integrated set of experiments was performed during Spacelab 1, as well as before and after the flight, to evaluate responses mediated by the otolith organs and semicircular canals. A variety of measurements were used, including eye movements, postural control, perception of orientation, and susceptibility to space sickness.


ABSTRACT: Normal (line 200) and dystrophic (line 307) embryonic chicken pectoralis muscle cells were studied in cell culture over a period of 2 weeks. During the first 4 days, normal and dystrophic cultures exhibited similar developmental increases in the number of nuclei within multinucleated myotubes; however, dystrophic muscle cells degenerated approximately twice as fast as normal cells once the initial burst of myoblast fusion was complete. The apparent synthesis rate of nonmyofibrillar proteins was similar in normal and dystrophic cells throughout development, but the apparent synthesis rates of myosin heavy chain and the myofibrillar protein fraction were 50%-90% higher in dystrophic muscle cultures once maturity had been reached (days 6-14). The specific activities of creatine kinase and phosphofructokinase were not affected by the dystrophic condition; however, specific activity of AMP-deaminase was depressed 25%-40% in the dystrophic muscle cultures.

Young, R. B., Schneible, P. A.

ABSTRACT: Myosin heavy chain concentrations, synthesis rates and degradation rates were studied in muscle cell cultures prepared from the breast muscle of 13-day normal (white leghorn) and dystrophic (line 307) chicken embryos. Muscle cells were studied after 7 days in culture, at which time they had reached a steady state with respect to myofibrillar protein synthesis and degradation. The quantity of myosin heavy chain was 10.5 ± 0.9 ug/culture (n=32) in normal cells and 8.10 ± 1.2 ug/culture (n=31) in dystrophic cells. However, the myosin heavy chain synthesis rate was 23 500 molecules/min/nucleus in normal cells and 39 900 molecules/min/nucleus in dystrophic cells, as determined by pulse labeling with [3H]leucine and measurement of the specific radioactivity of tRNA precursor pools. Myosin heavy chain half-lives rates were calculated to be 30.6 h in normal cells and 15.6 h in dystrophic cells when corrections were made for reutilization of [3H]leucine. Thus, dystrophic muscle cultures accumulate less myosin heavy chain, despite their faster synthesis rate, because of faster degradation of myosin heavy chain.
ABSTRACT: The source for nosocomial Legionnaires' disease is the water distribution system. However, the implications for legionella contamination in a hospital without known Legionnaires' disease is unclear. Therefore, culturing for Legionella pneumophila in the environment has not been routinely recommended. The authors conducted a prospective pneumonia study in three hospitals, none of which was known to have a major problem with endemic legionellosis. The water system of Hospital 1 was colonized with L. pneumophila, serogroup 1; Hospital 2 was colonized by L. pneumophila, serogroup 5 (which is rarely associated with disease); Hospital 3 was essentially free of L. pneumophila. Sputum culture on selective legionella media, direct fluorescent antibody testing, and serology were performed for all nosocomial pneumonias regardless of clinical impression. At the end of the study the incidence of nosocomial legionnaires' disease was found to be 9%, 0%, and 0% in Hospitals 1, 2, and 3, respectively. In Hospital 1, monoclonal antibody subtyping confirmed that the patient isolates were identical to the environmental isolates. The authors conclude that environmental culturing, despite the absence of known Legionnaires' disease, is useful. Positive cultures from the hospital water supply would mandate the introduction of legionella testing into the laboratory and stimulate physicians to consider Legionnaires' disease when encountering nosocomial pneumonias.


ABSTRACT: The plant growth regulators, indole-3-acetic acid (IAA) and gibberellic acid (GA3), were tested for their effects on spore germination and cellulase (B-1-4-endoglucanase) production by Trichoderma reesii. The addition of 10^-5 M IAA of GA3 enhanced cellulase production whereas higher concentration were inhibitory, both to spore germination and cellulase production.


ABSTRACT: None

Zdankiewicz E.M., Chu J. Phase Change Water Recovery For Space Station Parametric Testing And Analysis.

ABSTRACT: Vapor compression distillation (VCD) technology for phase change recovery of potable water from wastewater has evolved as a technically mature approach for use aboard the space station. A program to parametrically test an advance
preprototype vapor compression life systems for the national aeronautics and space administration (NASA) Johnson Space Center (JSC) During 1985. In parallel with parametric testing, a hardware improvement program was initiated to incorporate and verify certain key improvements into the advance preprototype VCDS following initial parametric tests. Specific areas of improvements included long-life, self-lubricated bearings, a lightweight, highly-efficient compressor and a long-life magnetic drive. These improvements are now incorporated and verification testing started. The advance preprototype VCDS was designed to reclaim 95% of the available wastewater at a nominal water recovery rate of 1.36 KG/H (3.0 LB/HR) and 308 K (95 F) condenser temperature. While this performance was maintained for the initial testing, a 300% improvement in water production rate (4.1 KG/H(9.0 LB/HR)) with a corresponding lower specific energy was achieved following incorporation of the improvements. The paper presents a summary of the results of the parametric test program conducted. Testing involved the characterization of key VCDS Performance factors (water production rate, water quality and specific energy) as a function of recycle loop solids concentration, distillation unit temperature and fluids pump speed. The objective of this effort was to expand the VCDS database to enable defining optimum performance characteristics for flight hardware development. Based upon the parametric testing results which were obtained. Projections are made for a phase change water recovery subsystem for the space station based upon the VCD concept. The projected unit processes 18.1 KG/Day (40.0 LB/Day) of wastewater, weighs 36.1 KG (79 LB), has a volume of only 0.21M3 (7.4 FT3) and requires only 84 W of electrical power for a specific energy of 76.8 W-H/KG (35 W-HR/LB).

Zeikus. Use Of Co-Cultures In The Production Of Ethanol By The Fermentative Of Biomass . U.S. Patent 4,400,470,.

ABSTRACT: Production of ethanol and enzymes by fermentation of biomass with co-culture of Clostridium thermocellum and C. thermohydrosulfuricum


ABSTRACT: None

Zeikus J.G. Thermophilic Bacteria: Ecology, Physiology And Technology. Reviews, Department of Bacteriology, University of Wisconsin, Madison, Wisconsin 53706, USA,.

ABSTRACT: Thermophilic bacteria are common in soil and volcanic habitats and have a limited species composition. Yet they possess all the major nutritional categories and metabolize the same substrates as mesophilic bacteria. The ability to proliferate at growth temperature optima well above 60 C is associated with extremely thermally stable macromolecules. As a consequence of growth at high temperature and unique macromolecular properties, thermophilic bacteria can possess high metabolic rates, physically and chemically stable enzymes, and
lower growth but higher end product yields than similar mesophilic species. Thermophilic processes appear more stable, rapid and less expensive, and facilitate reactant activity and product recovery. Thermophilic bacteria have application in chemical feedstock and fuel production, bioconversion of wastes, enzyme technology, and single cell protein production. This paper reviews the fundamental and applied aspects of thermophilic bacteria that are of potential industrial interest.


ABSTRACT: Effective biodegradation of organic wastes into methane requires the coordinated metabolic activities of different microbial populations. The intermediary metabolism of multicarbon and uni- and dicarbon transforming bacteria is described in mono- and co-culture fermentations. The results of physiological and biochemical experiments are presented in order to explain the fundamentals of mixed culture metabolism and to identify key control parameters which influence the rate of organic degradation, the yield of reduced metabolites, and thermodynamic efficiency in the anaerobic digestion process.
APPENDIX D
Space Medicine
Bibliography
SPACE MEDICINE
1977-1986
461 Selected Citations

Compiled by
Estelle J. Abrams, Karen Patrias, and Joy S. Richmond

November 1986
This is one of a series of Specialized Bibliographies prepared and distributed by the Public Services Division of the National Library of Medicine (NLM). These bibliographies are usually the result of a combination of manual and computerized searching, utilizing databases produced by NLM and others. Specialized Bibliographies are therefore generally more comprehensive in coverage than those bibliographies produced under NLM's Literature Search series. The only criterion for inclusion of a published work in a Specialized Bibliography is its relevance to biomedicine. The format, ownership, or location of the materials are not considered.
This bibliography was prepared in conjunction with the colloquium "Space Medicine: Newest Frontier of the Health Sciences" held at the National Library of Medicine on November 13, 1986. The colloquium was one of a series held in celebration of the Library's sesquicentennial.

Because there is a large volume of literature on space flight which covers all disciplines of science, this selective bibliography is limited, for the most part, to references on the biomedical aspects as they relate to the human factor in space flight or the space environment. These include physiological, biological, and behavioral functions. There are a limited number of references of a more general nature relating to equipment design, life support systems, environmental control, radiation effects, life sciences, and international cooperation. In general, references to animal and cell culture studies have been excluded.

This bibliography covers the ten-year period from 1977 to the present and includes only English language publications. Sources for the references include NLM's MEDLINE and CATLINE databases as well as BIOSIS, EMBASE, Aerospace Database, Dissertation Abstracts Online, Mental Health Abstracts, NASA RECON, PSYCHINFO, and Social SciSearch. All types of publications have been included: monographs, journal articles, technical reports, conference proceedings, and dissertations. This bibliography is extensive but not exhaustive; the exclusion of particular items is no reflection on their quality or usefulness.

"Space Medicine" has been divided into seven broad categories: bone metabolism, the cardiovascular system, general physiology, motion sickness, psychological/behavioral aspects, radiation effects, and other. The latter includes broad general publications as well as specific ones which fall outside the categories listed above.

For a comprehensive publication on the pre-1977 aspects of space medicine, the reader is referred to:

# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone Metabolism</td>
<td>1</td>
</tr>
<tr>
<td>The Cardiovascular System</td>
<td>2</td>
</tr>
<tr>
<td>General Physiology</td>
<td>6</td>
</tr>
<tr>
<td>Motion Sickness</td>
<td>18</td>
</tr>
<tr>
<td>Psychological/Behavioral Aspects</td>
<td>21</td>
</tr>
<tr>
<td>Radiation Effects</td>
<td>24</td>
</tr>
<tr>
<td>Other</td>
<td>26</td>
</tr>
</tbody>
</table>
BONE METABOLISM


Anderson SA, Cohn SH. Bone demineralization during space flight. Physiologist; 1985 Aug; 28(4): 212-7


Stepaniak PC, Furst JJ, Woodward D. Anabolic steroids as a countermeasure against bone demineralization during space flight. Aviat Space Environ Med; 1986 Feb; 57(2): 174-8


Whedon GD. Changes in weightlessness in calcium metabolism and in the musculoskeletal system. Physiologist; 1982 Dec; 25(6): 541-4


THE CARDIOVASCULAR SYSTEM


Belluschi A. Cardiac and cerebral vascular adaptation to gravitational stresses in man. Physiologist; 1981; 24(6 Suppl): S93-4


Bungo W, Johnson PC Jr. Cardiovascular examinations and observations of deconditioning during the space shuttle orbital flight test program. Aviat Space Environ Med; 1983 Nov; 54(11): 1001-4


Copley AL. Certain aspects of hemorheology in a near zero gravity environment. Biorheology; 1979; 16(1-2): 37-49


Frey MA, Mathes KL, Hoffler GW. Cardiovascular responses of women to lower body negative pressure. Aviat Space Environ Med; 1986 Jun; 57(6): 531-8


Katkov VE, Chestukhin VV, Nikolayenko EM. Central circulation of a normal man during 7-day head-down tilt and decompression of various body parts. Aviat Space Environ Med; 1983 Dec; 54(12 Pt 2): 524-30


Levitan BM, Montogomery LD, Bhagat PK, Zieglschmid JF. A comparison of limb plethysmograph systems proposed for use on the space shuttle. Aviat Space Environ Med; 1983 Jan; 54(1): 6-10


Moskalenko YE. Functional steadiness of the cerebral circulatory system under altered gravitational conditions. Aviat Space Environ Med; 1981 Mar; 52(3): 159-61


Panferova NE. Dependence of human responses to physical exertion during limitation of muscular activity. Human Physiol; 1980 May-Jun; 6(3): 223-6

Raven PB, Pape G, Taylor WF, Gaffney FA, Blomqvist CG. Hemodynamic changes during whole body surface cooling and lower body negative pressure. Aviat Space Environ Med; 1981 Jul; 52(7): 387-91


Shimizu M, Ghista DW, Sandler H. Cardiovascular regulatory response to lower body negative pressure following blood volume loss. Aviat Space Environ Med; 1979 Jan; 50(1): 24-33


GENERAL PHYSIOLOGY


Berry MA, Squires WG, Jackson AS. Fitness variables and the lipid profile in United States astronauts. Aviat Space Environ Med; 1980 Nov; 51(11): 1222-6

Bodde T. Coping in space: the answer of the body to zero gravity. Bioscience; 1982; 32(4): 249-51

Brown LR. Skylab oral health studies. Houston, Tex: National Aeronautics and Space Administration, Johnson Space Center; 1977; 10 p


Comfort A. Space gerontology. ZFA; 1979; 34(2): 147-52


DeJournette RL. Rocket propellant inhalation in the Apollo-Soyuz astronauts. Radiology; 1977 Oct; 125(1): 21-4
Dietlein LF, Rambaut PC, Nicogossian AE. Future thrusts in life sciences experimentation in space. Aviat Space Environ Med; 1983 Dec; 54(12 Pt 2): S6-8

Dintenfass L. Background and development of the space project on "aggregation of red cells". Australas Phys Eng Sci Med; 1983 Oct-Dec; 6(4): 156-65

Dintenfass L. First haemorheological experiment under zero gravity on space shuttle Discovery [letter]. Biorheology; 1985; 22(3): 249

Dintenfass L. Mystery of red cell aggregation under zero gravity. Experiment on STS 51-C. Med J Aust; 1985 Sep 30; 143(7): 281-3


Dixon GA, Adams JD, Harvey WT. Decompression sickness and intravenous bubble formation using a 7.8 psia simulated pressure-suit environment. Aviat Space Environ Med; 1986 Mar; 57(3): 223-8


Dunn CD, Lange RD. Erythropoietic effects of space flight. Acta Astronaut; 1979; 6(5-6): 725-32


Furniss T. Will man beat the zero g barrier? Flight International; 1985 Jun 8; 127: 51-3


Gibson EG. Skylab 4 crew observations. Houston, Tex: National Aeronautics and Space Administration, Johnson Space Center; 1977; 5 p


Grigoriev AI. Correction of changes in fluid-electrolyte metabolism in manned space flights. Aviat Space Environ Med; 1983 Apr; 54(4): 318-23


Gualtierotti T. The vestibular function research programme as a part of the Spacelab project: an investigation of the effect of free fall on unitary and integrated vestibular activity. Proc R Soc Lond [Biol]; 1977 Dec 30; 199(1137): 493-503

Harding R. Human problems of space travel. Spaceflight; 1985 Jun; 27: 254-6

Hatton DV, Leach CS, Nicogossian AE. Collagen breakdown and nitrogen dioxide inhalation. Arch Environ Health; 1977 Jan-Feb; 32(1): 33-6

Henney MR, Raylor GR, Molina TC. Mycological profile of crew during 56-day simulated orbital flight. Mycopathologia; 1978 Aug 10; 63(3): 131-44


Herbison GJ, Talbot JM. Muscle atrophy during space flight: research needs and opportunities. Physiologist; 1985 Dec; 28(6): 520-7

Hills BA. Compatible atmospheres for a space suit, space station, and shuttle based on physiological principles. Aviat Space Environ Med; 1985 Nov; 56(11): 1052-8


Homick JL, Reschke MF. Postural equilibrium following exposure to weightless space flight. Acta Otolaryngol (Stockh); 1977 May-Jun; 83(5-6): 455-64

Hong SK, Pendergast DR, Krasney JA, Claybaugh JR. Cardio-renal responses to a simulated gravity-free state induced by water immersion. Sangyo Ika Daigaku Zasshi; 1985 Mar 1; 7 Suppl: 205-14

Hordinsky JR. Skylab crew health: crew surgeon's report. Houston, Tex: National Aeronautics and Space Administration, Johnson Space Center; 1977; 5 p


Johnson PC. Fluid volumes changes induced by space flight. Acta Astronaut; 1979; 6(10): 1335-41


Kenyon RV, Young LR. Postural re-adaptation following exposure to weightlessness. Soc Neurosci Abstr; 1984; 10(1): 160

Kerwin JP. Skylab 2 crew observations and summary. Houston, Tex: National Aeronautics and Space Administration, Johnson Space Center; 1977; 3 p

Kimzey SL. A review of hematology studies associated with space flight. Biorheology; 1979; 16(1-2): 13-21


Kozerenko OP, Grigoriev AI, Egorov AD. Results of investigations of weightlessness effects during prolonged manned space flights onboard Salyut-6. Physiologist; 1981; 24(6 Suppl): S49-54


Lackner JR. Sensory factors in space flight. Sangyo Ika Daigaku Zasshi; 1985 Mar 1; 7 Suppl: 185-93


Leach CS. Medical results from STS 1-4: analysis of body fluids. Aviat Space Environ Med; 1983 Dec; 54(12 Pt 2): S50-4

Leach CS. An overview of the endocrine and metabolic changes in manned space flight. Acta Astronaut; 1981 Sep-Oct; 8: 977-86

Leach CS, Altchuler SI, Cintron-Trevino NM. The endocrine and metabolic responses to space flight. Med Sci Sports Exerc; 1983; 15(5); 432-40+


Leach CS, Johnson PC, Driscoll TB. Prolonged weightlessness effect on postflight plasma thyroid hormones. Aviat Space Environ Med; 1977 Jul; 48(7): 595-7


Leach CS, Rambaut PC, DiFerrante N. Amino-aciduria in weightlessness. Acta Astronaut; 1979; 6(10): 1323-34


Leonard JI, Leach CS, Rummel JA. Computer simulations of postural change, water immersion and bedrest: an integrative approach for understanding the spaceflight response. Physiologist; 1979 Dec; 22(6): S31-2


Martin DG, Convertino VA, Goldwater D, Ferguson EW, Schoomaker EB. Plasma viscosity elevations with simulated weightlessness. Aviat Space Environ Med; 1986 May; 57(5): 426-31


Miquel J. Comparison between the weightlessness syndrome and aging. Moffett Field, Calif: National Aeronautics and Space Administration, Ames Research Center; 1982; 8 p. Available from: NTIS HC A06/MF A01


Perry TW, Reid DH. Spacelab mission 4--the first dedicated life sciences mission. Aviat Space Environ Med; 1983 Dec; 54(12 Pt 1): 1123-8


Proceedings of the sixth annual meeting of the IUPS Commission on Gravitational Physiology. 1984 Sep 18-21, Lausanne, Switzerland. Physiologist; 1984 Dec; 27(6 Suppl): S1-148


Quadens O, Green H. Eye movements during sleep in weightlessness. Science; 1984 Jul 13; 225(4658): 221-2


Rüegg DG. Spinal reflexes in microgravity: measuring H reflexes during space flight [letter]. Science; 1985 Sep 27; 229(4720): 1409


Sandler H. Human involvement in long-term spaceflight. Sangyo Ika Daigaku Zasshi; 1985 Mar 1; 7 Suppl: 245-54


Scherer H, Clarke AH. The caloric vestibular reaction in space. Physiological considerations. Acta Otolaryngol (Stockh); 1985 Nov-Dec; 100(5-6): 328-36


Sending oldsters aloft? [news]. JAMA; 1981 Apr 24; 245(16): 1628

Sharp JC. Biomedical considerations in long-duration space flights. AAS Sci Technol Series; 1985; 62: 700


Shvartz E. Exercise requirements and fitness decrements in space station missions. Fed Proc; 1985; 44(3): 622


Taylor GR, Dardano JR. Human cellular immune responsiveness following space flight. Aviat Space Environ Med; 1983 Dec; 54(12 Pt 2): S55-9


Tigranian RA, Ushakov AS. Peculiar characteristics of crewmembers' metabolism on the second expedition aboard orbital station Salyut-4. Aviat Space Environ Med; 1977 Sep; 49(9): 824-7

Tigranian RA, Voronin LI. Changes of corticosteroid spectrum in urine in members of crew of spaceship "Soyuz-22". Endocrinol Exp (Bratisl); 1980 Mar; 14(1): 3-7


Ushakov AS, Ivanova SM, Brantova SS. Some aspects of energy metabolism in human blood erythrocytes under hypokinesia and during space flight. Aviat Space Environ Med; 1977 Sep; 48(9): 824-7


Vann RD, Torre-Bueno JR. A theoretical method for selecting space craft and space suit atmospheres. Aviat Space Environ Med; 1984 Dec; 55(12): 1097-102


Vernikos-Danellis J, Dzilman MF, Forsham P. Hormonal indices of tolerance to +Gz acceleration in female subjects. Aviat Space Environ Med; 1978 Jul; 49(7): 886-9


Vorobev EI, Gazenko OG, Genin AM, Egorov AD. Medical results of Salyut-6 manned space flights. Aviat Space Environ Med; 1983 Dec; 54(12 Pt 2): S31-40


West JB. Spacelab--the coming of age of space physiology research. J Appl Physiol; 1984 Dec; 57(6): 1625-31


Whittle MW. Caloric and exercise requirements of space flight: biostereometric results from Skylab. Aviat Space Environ Med; 1979 Feb; 50(2): 162-7


MOTION SICKNESS


Borison HL. Is space sickness a form of motion sickness? Physiologist; 1985 Dec; 28(6 Suppl): S25-7


Kohl RL, Calkins DS, Mandell AJ. Arousal and stability: the effects of five new sympathomimetic drugs suggest a new principle for the prevention of space motion sickness. Aviat Space Environ Med; 1986 Feb; 57(2): 137-43

Lackner JR, Graybiel A. The effective intensity of Coriolis, cross-coupling stimulation is gravitoinertial force dependent: implications for space motion sickness. Aviat Space Environ Med; 1986 Mar; 57(3): 229-35


Lackner JR, Graybiel A. Head movements in non-terrestrial force environments elicit motion sickness: implications for the etiology of space motion sickness. Aviat Space Environ Med; 1986 May; 57(5): 443-8

Lackner JR, Graybiel A. Sudden emesis following parabolic flight maneuvers: implications for space motion sickness. Aviat Space Environ Med; 1986 Apr; 57(4): 343-7

Lackner JR, Graybiel A. Variations in gravitoinertial force level affect the gain of the vestibulo-ocular reflex: implications for the etiology of space motion sickness. Aviat Space Environ Med; 1981 Mar; 52(3): 154-9


Martin NF. Carbonic anhydrase inhibitors for prevention of space motion sickness: an avenue of investigation. Aviat Space Environ Med; 1984 Dec; 55(12): 1148-50

Matsnev EI, Bodo D. Experimental assessment of selected antimotion drugs. Aviat Space Environ Med; 1984 Apr; 55(4): 281-6

Matsnev EI, Yakovleva IV, Tarasov IK, Alekseev VN, Kornilova LN, Mateev AD, Gorgiladze GI. Space motion sickness: phenomenology, countermeasures, and mechanisms. Aviat Space Environ Med; 1983 Apr; 54(4): 312-7

Megighian D, Martini A. Motion sickness and space sickness: clinical and experimental findings. ORL J Otorhinolaryngol Relat Spec; 1980; 42(4): 185-95


Schneider RC, Crosby EC. Motion sickness: part I--a theory. Aviat Space Environ Med; 1980 Jan; 51(1): 61-4

Stewart R. Space flight: III. Isolation of perceptual variable in parabola flight sickness with countermeasure to lower gastric pH. Percept Mot Skills; 1985 Jun; 60(3): 960-2


Talbot JM, Fisher KD. Space sickness. Physiologist; 1984 Dec; 27(6): 423-9

Thornton WE, Biggers WP, Thomas WG, Pool SL, Thagard NE. Electronystagmography and audio potentials in space flight. Laryngoscope; 1985 Aug; 95(8): 924-32


PSYCHOLOGICAL/BEHAVIORAL ASPECTS


Bluth BJ. The psychology and safety of weightlessness. New York: American Institute of Aeronautics and Astronautics; 1982; IAF Paper 82-252; 8 p (International Astronautical Congress; 33rd)

Bluth BJ. Astronaut stress in shuttle space laboratory work environment. AAS Sci Technol Ser; 1980; 50: 95-109

Bluth BJ. Sociological aspects of permanent manned occupancy of space. AIAA Student J; 1981 Fall; 19: 11-15, 48

Bluth BJ. Staying sane in space. Mechanical Eng; 1982 Jan; 104: 24-29


Christensen JM, Talbot JM. A review of the psychological aspects of space flight. Aviat Space Environ Med; 1986 Mar; 57(3): 203-12


Dunham HW. Community as process: maintaining the delicate balance. Am J Community Psychol; 1977 Sep; 5(3): 257-68


Gazenko OG. Psychological compatibility on earth and in outer space. Aviat Space Environ Med; 1980; 51(6): 622-23


Jones DR. More on psychiatry and space flight [letter]. Am J Psychiatry; 1984 Jul; 141(7): 918

Kanas N. Psychosocial factors affecting simulated and actual space missions. Aviat Space Environ Med; 1985 Aug; 56(8): 806-11


Kornilova LN, Syrykh GD, Tarasov IK, Yakovleva IY. Investigation of space perception by the crew of the experimental Soyuz-Apollo mission. Space Biol Aerospace Med; 1977; no. 5: 116-7 (Transl. into English from Kosmich Biol i Aviakosmich Med; 1977; no. 5: 90-1)


Lewis JL. Operator performance and localized muscle fatigue in a simulated space vehicle control task [doctoral dissertation]. Houston, Tex: University of Houston; 1979


Miksik O. Investigation of the dynamics of immediate psychological states in the first Czechoslovak cosmonaut. Cesk Psychol; 1979; 23(1): 32-41


Nagano H. Mental aberration in flight. Sangyo Ika Daigaku Zasshi; 1985 Mar 1; 7 Suppl: 59-65

Orlady HM. Controlling the risk in pilot incapacitation. Sangyo Ika Daigaku Zasshi; 1985 Mar 1; 7 Suppl: 66-75

Patterson ET. Towards the orthomolecular environment. J Orthomolecular Psychiatry; 1981; 10(4): 269-83

Ride D. "Which daughter?" Young Child; 1985 Jan; 40(2): 10-11


Sulc J, Moravek M. Analysis of verbal behaviour of the first Czechoslovak cosmonaut during space flight. Cesk Psychol; 1979; 23(1): 42-49


RADIATION EFFECTS


Buecker H. Biophysical research in space (radiation effects). In: Proceedings of a scientific meeting on the occasion of the inauguration of new buildings for the DFWLR Institute for Aerospace Medicine; 1983; Cologne, West Germany. Paris, France: European Space Agency; 1984: 106-11

Buecker H. Results of radiobiological spaceflight experiments (weightlessness influencing radiation response of biological matter). In: Life-sciences research in space: proceedings of a symposium; 1977 May 24-26; Cologne, West Germany. Paris, France: European Space Agency; 1977: 263-70


Fry RJ, Nachtwey DS, Johnson LB. Radiation effects and space travel. Health Phys; 1985; 49(1): 190


Kovalev EE. Radiation protection during space flight. Aviat Space Environ Med; 1983 Dec; 54(12 Pt 2): S16-23


Adamovich BA, Borshchenko VV, Vernikov YM, Prishchep AG, Rogatovskaya AP. A study of the pulsed method of laundering. Space Biol Aerospace Med; 1977; no. 5: 100-6 (Transl. into English from Kosmich Biol i Aviakosmiy Med; 1977; no. 5: 80-5)

Aerospace medicine and biology: a continuing bibliography with indexes. Washington, D.C.: National Aeronautics and Space Administration; 1964-


Bhagat PK, Lafferty JF, Bowman D, Kadaba MP. An ultrasonic plethysmograph for space flight applications. Aviat Space Environ Med; 1980; 51(2): 180-8


Brose HF. Environmental control and life support for an evolving capability manned space station. AAS Sci Technol Series; 1985; 60: 123-36

Buchanan P. The closing gap between occupational medicine and flight medicine in the space station era. Sangyo Ika Daigaku Zasshi; 1985 Mar 1; 7 Suppl: 237-44

Burnazyan AI, Vorobyev YI, Gazenko OG, Gurovskiy NN, Nefedov YG, Adamovich BA, Yegorov BB, Kovalev YY, Yegorov AD. Main stages and prospects of development of space biology and medicine. Space Biol Aerospace Med; 1977; no. 5: 1-9 (Transl. into English from Kosmich Biol i Aviakosmiy Med; 1977; no. 5: 3-12)

Chatterjee PC. Medical requirement for manned space programme. Aviat Med; 1984 Dec; 28: 102-6

Devincenzi DL, Griffiths LD. Exobiology experiments for space station. Physiologist; 1985 Dec; 28(Suppl): S185-6


Douglas WR. Current status of space medicine and exobiology. Aviat Space Environ Med; 1978 Jul; 49(7): 902-4

Engle E, Lott AS. Man in flight: biomedical achievements in aerospace. Annapolis, Md: Leeward; 1979; 396 p


Gunby P. Space station, shuttle offer new medical possibilities [news]. JAMA; 1984 May 11; 251(18): 2314-5


Hannoun C. Microbiology and space. In: Life sciences research in space: proceedings of a symposium; 1977 May 24-26; Cologne, West Germany. Paris, France: European Space Agency; 1977: 315

Hart LG. Wearing contact lenses in space shuttle operations. Aviat Space Environ Med; 1985 Dec; 56(12): 1224-5

Hasse H. Twenty years of manned space flight from the viewpoint of space medicine. Arlington, Va: Joint Publications Research Service; 1982; JPRS-81359; 19 p. (Transl. into English from Z Militaermed; 1981 Apr; no. 2: 52-60)

Heinrich M, Rudiger CE. Considerations in the design of life sciences research facilities for the Space Station. Physiologist; 1985 Dec; 28(6 Suppl): S161-2


Houtchens B. Management of trauma and emergency surgery on space station. J Trauma; 1984; 24(7): 663


Ivakhnov A. Goals of cosmonaut At'kov's medical studies on "Salyut-7". Arlington, Va: Joint Publications Research Service; 1984; JPRS-USP-84-003; 3 p. (Transl. into English from Izvestiya; 1984 Mar 3; p. 3). Available from: NTIS HC A07

Ivanov B, Bogdanovsky G. Four months under space-simulated conditions. Aviat Space Environ Med; 1978 Feb; 49(2): 437-8


Mohler SR. Age and space flight. Aviat Space Environ Med; 1985 Jul; 56(7): 714-7


Murphy JR. Medical considerations for manned interstellar flight. Brit Interplanetary Soc J; 1981 Nov; 34: 466-76


Rock JA. An expandable surgical chamber for use in conditions of weightlessness. Aviat Space Environ Med; 1984 May; 55(5): 403-4


Spain MA, Middleditch BS, Bafus DA, Galen T. Dehydrohalogenation of atmospheric contaminants in the space cabin. Aviat Space Environ Med; 1985 Mar; 56(3): 262-4


Trunkey DD, Frank IC. Trauma care in space. JEN; 1986 May-Jun; 12(3): 32A-35A


US/USSR space biology and medicine. Aviat Space Environ Med; 1983 Dec; 54(12 Pt 2): S1-72


Winkler LH. Space colonizatión--some physiological perspectives. Aviat Space Environ Med; 1978 Jul; 49(7): 898-901


APPENDIX E
Task Statements
1.0 Provide Support To The Mechanical Design And Integration Of Test Systems As Related To Microbiological Concerns

These are preliminary design recommendations for the integration and material compatibility of water reclamation subsystems as they relate to microbial concerns. These criteria are based on an ideal system and as such are subject to change depending on actual design implementation.

1.1 General

A major microbiological concern in a water-related system is the attachment of bacteria to surfaces and subsequent biofouling. The degree of attachment is dependent upon surface area and the nutrient conditions present. Although these factors cannot be eliminated, steps can be taken to reduce their influence in most cases. A second concern involves the ability to detect bacterial presence quickly and accurately. Proper preventive measures should be taken and problem areas identified and detected quickly. Some general recommendations are outlined below.

1.1.1 Bacterial Attachment and Biofilming

Surface areas available for bacterial attachment should be minimized. Plumbing runs, number of elbows, and storage tank size should be reduced wherever possible. Joints should be welded by automatic orbital welding techniques to eliminate the creation of internal surface areas and subsequent attachment sites for bacteria. Component materials (Section 1.2) and Subsystem Integration (Section 1.3) considerations are also important to reducing biofouling.

In addition, nutrient concentrations available to support microbial growth should be reduced. Component materials should not contribute nutrients to the system. Growth-promoting factors may be reduced in the water supply by physical or chemical means. For example, organic carbon, the single most important factor in biofilm formation, can be reduced by reverse osmosis membranes, UV irradiation and activated carbon beds.

1.1.2 Holding Time

A holding (storage) period is needed in order to validate and verify the quality of water before use. This time period is dictated by the time required to perform the necessary tests for verification. However, as long as a holding time is required it is not possible to verify the water quality just prior to use. In addition, a holding time requires not only the maintenance of water quality during the hold period but also during the use period as well. Finally, the greater the holding time which is placed on the water prior to use the more tank capacity that is required to store the water. At the present time, the minimum time required is estimated to be 24 hours. Although it is conceivable that the chemical parameters can be concluded and reported within an eight hour shift, the microbiological parameters will require at least 24 hours. A holding time greater than 24 hours is not recommended. In order to allow for the minimal holding time possible, viable plate counts should be performed on those parameters which can be completed within 24 hours and also provide the necessary information required for verification of water quality (Section 3.2). In addition, a near real-time method for total bacterial counts will be necessary.
1.1.3 Storage Tanks

Storage tanks, with their large volumes of water, can be especially difficult to control. Limiting the size of the tank and minimizing storage time will effectively reduce the attachment of bacteria to tank walls and eliminate a major reservoir for bacterial contamination and growth. Refrigeration of the storage tanks and their contents will usually slow the process of bacterial growth and subsequent fouling. Direct heat sterilization of the tank and its contents will control bacterial development. In addition, heat sterilization can be mechanically validated and thus the sterility easily verified. At lower temperatures than is normally required for conventional heat sterilization a process known as tyndallization may be used. Tyndallization is a series of daily heat spikes which destroys vegetative cells present and then allows for the subsequent germination of spores which may be present. These new vegetative cells are then destroyed by repeating the process.

1.1.4 Control of problem areas

Those areas which are especially prone to bacterial contamination such as sampling sites, replacement units (e.g. reverse osmosis unit, resin beds, activated carbon beds and particulate filters) and storage tanks will require special considerations. These areas should be easily accessible for periodic checking, routine maintenance and scheduled replacement. This will serve to reduce system down time when a problem is encountered or components need to be cleaned or replaced.

1.2 Material Recommendations

The choice of materials used in the construction of pharmaceutical and semiconductor water supplies remains the best source of information on system components. Wherever possible materials should be those which are flight approved. Listed below are recommendations applicable to the test system from these sources.

1.2.1 Stainless steel (316L)

Stainless steel (316L) is recommended for all applicable hardware components. Advantages are listed below:

- low carbon content
- low trace metal content
- highly resistant to pitting and corrosion
- able to tolerate high salt concentrations
- acceptable resistance to bacterial attachment
1.2.2 Gaskets

Use of Teflon gasket material is recommended.

1.2.3 Storage Tanks

Bellows tanks with an external piston are recommended. These tanks will eliminate the possibility of water entrapment in the piston mechanism which would serve as a reservoir for bacterial contamination.

1.2.4 Valves

Packless diaphragm valves are recommended in order to prevent water entrapment in the valve mechanism and a potential site for bacterial contamination.

1.2.5 Activated Carbon

Many grades of activated carbon are available. The highest quality anthracite is recommended.

1.2.6 Material compatibility with disinfectant

Care must be taken to ensure that the decontamination processes chosen are compatible with the hardware materials used. All hardware materials (RO membranes, ion exchange resins, etc.) should be compatible with proposed pretreatment processes, other subsystem components and proposed disinfection procedures and/or agents.

Stainless steel is suitable for disinfection with dry/moist heat procedures. In addition, 316L stainless steel can withstand treatment with hot water, chlorine, and iodine. Fiberglass-reinforced plastics (FRP) can tolerate hydrogen peroxide, ozone, and formaldehyde. Polyvinyl decafluoride (PVDF) compounds are resistant to gluteraldehyde and ultraviolet (UV) light.

1.3 System Design and Subsystem Integration

The ability to produce acceptable product water depends on the integration of basic structural and implemented hardware designs to discourage bacterial growth. Listed below are some problems likely to be encountered and recommendations to help govern them.

1.3.1 Stasis

Any segment of pipe containing water that is not recirculated on a frequent basis provides an area for nutrient deposition and eventual bacterial growth. These areas, often referred to as a "dead legs" can potentially serve as internal sites for system contamination.
Distribution lines should be plumbed as close to the point of use as possible. This will decrease the physical length of pipe required and reduce the amount of dead space present when the system is not in use. Minimize the use of elbows, valves, and use points in order to reduce possible "dead legs". Also, electronic water level indicators instead of a sight tube is recommended to eliminate standing water.

Recirculation or continuous operation is recommended to reduce static conditions and minimize "dead legs".

Point of use sites such as hand washers serve as potential reservoirs for bacterial growth due to contaminants from skin oils, hair, and respiratory droplets. Circulating pumps at these sites help reduce standing water and thereby help to eliminate the build-up of required nutrients necessary for the propagation of microorganisms. Circulation within water storage tanks would help to reduce bacterial populations. Circulation reduces the settling of growth-promoting substrates from materials and water sources which normally provide a primary layer for biofilm formation. Circulation will ensure uniform mixing of chemical biocides, if employed. It allows for increased filtration and exposure to UV irradiation (or disinfection).

1.3.2 Tank Vent Filters

1.3.2.1 Composition

The composition of the filter should be of a hydrophobic membrane to reduce water entrapment on the surface.

1.3.2.2 Placement

Place the unit in a vertical position to reduce further the possibility of water collection on the filter and subsequent microbial growth.

1.4 Sampling Ports

Sampling ports as will use points provide a place of entry for contaminating microorganisms. The ability to control such areas is based on a combination of design considerations and physical treatments. Recommendations are listed below.

1.4.1 Implementation of sterilization or disinfection procedures (Section 1.5).

1.4.2 Circulation to prevent water stagnation.

1.4.3 Elimination of gooseneck designs which may trap water.
1.5 Sterilization/Decontamination

In order to retard bacterial growth the system should be sterilized or decontaminated at the onset as well as during actual usage. This may include separate cleaning of specific hardware especially susceptible to the growth of microorganisms. Periodic cleaning or replacement of some materials would also be indicated. Below are listed recommendations for sterilization and decontamination of the system.

1.5.1 Routine removal of the outer length of outlet pipe for physical cleaning and sterilization (or disposal) would allow mechanical cleaning of biofilm formation.

1.5.2 Point of Use/Sampling Port Sterilization

Routine point of use/sampling port sterilization or decontamination is recommended. These measures will help eliminate environmental contamination to the system. Below are presented several possible means to accomplish this.

1.5.2.1 Ultraviolet (UV) irradiation

1.5.2.2 Routine and periodic treatment of the sampling ports with H2O2 or other acceptable disinfecting solution reduces the possibility of environmental contamination between uses.

1.5.2.3 Microbial Check Valve (MCV)

1.5.2.4 Flaming

1.5.3 Sterilization of hardware

1.5.3.1 R/O Membranes

Reverse osmosis membranes can be treated with high temperature (95C) to remove bacteria attached to them.

1.5.3.2 Activated Carbon Beds

Activated carbon beds can be steam sterilized to reduce bacterial levels.

1.5.3.3 Ion-exchange Resins

Ion-exchange resins can be sterilized with a 0.5% solution of formaldehyde. Regeneration of the beds with 2% sulfuric acid and 4% sodium hydroxide solutions will also help to control bacterial growth.
1.6 Operational Requirements

To operate efficiently, conditions must be maintained that will not overburden the system and cause premature failure of components. Recommendations for maintaining an efficient system are given below.

1.6.1 Water pretreatment

The R/O membrane and activated carbon bed are a major site for bacterial attachment due to 1) the large surface areas present and 2) the nutrient accumulation. Bacterial growth here will not only affect the efficiency of these components but all other subsystems downstream. Therefore, effective pretreatment of water entering these units will greatly extend the life of the of these subsystems by reducing the bacterial burden placed upon them.

1.6.2 Filters

Periodic replacement of air filters, vent filters, prefilters and particulate filters will decrease the possibility of airborne contamination and reduce the particulate burden placed on the reclamation system.

1.6.3 Continuous Operation

Continuous or semi-continuous operation, as opposed to batch processing, is recommended (Section 1.3.1). In addition to eliminating static conditions continuous operation will allow for increased observation of the system over an extended period of time to detect areas of weakness. It will also allow for the greater capacity for producing water if required for test evaluation and it will better simulate the operating conditions to be encountered aboard the Space Station.

1.6.4 Constant Flow

Maintenance of constant flow rates are recommended. Optimum flow rates of similar systems are reported to be between 5-10 ft./sec. Maintaining a constant flow is reported to help reduce the number of free-floating bacteria and nutrients available for attachment to surfaces.
2.0 Assist with the design of Human Subjects Test Protocols

2.1 Test Subject Protocols

The Boeing Aerospace Company (BAC) will identify potential subjects and route the names and contact information (work area, mail code, work phone number) to the BAC health nurse. The BAC health nurse will contact the potential subject and set up an appointment for initial screening. This initial screening will include a description of the project and completion of an informed consent form. The nurse will obtain a health questionnaire (HQ), a Duke University Health Profile (DUHP), and have the subject begin a symptom diary. The subject will be given an appointment with the examining physician (EP), and the HQ and DUHP results will be routed to the examining physician by the health nurse. The subject will bring the diary to the EP on the day of the initial examination.

At the initial examination, a full history and physical will be performed and recorded on the initial examination form. The laboratory will be drawn and the skin tests placed. When these results are available, the EP will indicate his/her opinion concerning the subject’s medical qualification for involvement and route all the information to the Environmental Health Physician (EHP). Guidelines for this determination are outlined in 2.12 below.

For the subject selected to be involved in the test, an appointment will be made with the EP one week before he/she is scheduled to participate. At this time, the brief pre-test examination will be done and recorded on the form. The repeat laboratory will also be drawn. When the results are available, the EP will again verify qualification, based on the guidelines presented in 2.14 below. The EP will then notify the EHP by telephone of the status of the subject, and route all the materials to the EHP. Each day of the testing, the EHP will notify the project manager of any changes in subject status.

Throughout the period from initial evaluation through testing and for six months beyond, the subject will continue the symptom diary. Each subject will be seen by the EP one week after each involvement, one month later and six and twelve months later. These follow-up visits will include review of any intercurrent illnesses or symptoms and a brief physical examination as indicated. Each month after involvement for 24 months, the health nurse will obtain the records of any visit to a physician other than the EP and route them to the EP. All records will then be routed to the EHP on all subjects monthly.
2.11 Initial Evaluation

2.111 Name of personal physician

2.112 Recent illnesses

2.113 Past medical history

2.1131 Chronic illnesses (Hypertension, Diabetes, etc.)

2.1132 Regular medicines, including OCP's and OTC

2.1133 Menstrual history

2.1134 Regular cream, ointment, oil use

2.1135 Other drugs, alcohol, tobacco

2.1136 Active skin or hair disorder

2.1137 Frequency of minor infectious diseases

2.11371 Respiratory (colds, pharyngitis, bronchitis)

2.11372 GI (gastroenteritis)

2.11373 UTI (bladder, kidney)

2.11374 GU (vaginitis, urethritis)

2.11375 Skin (acne, impetigo, cellulitis, athlete's foot)

2.114 Physical Exam

2.1141 Skin

2.1142 Heart

2.1143 Lungs

2.1144 Heart

2.1145 Abdomen

2.1146 GU (including pelvic)

2.1147 Neuro/Musculo Skeletal
2.115 Health Profile (DUHP)

2.116 Laboratory

2.116.1 CBC
2.116.2 U/A and culture
2.116.3 Wet prep/GM Stain (if indicated)
2.116.4 Serum pregnancy test
2.116.5 Stool culture
2.116.6 Special studies

2.117 Skin test anergy pack and PPD (Reading required in 48 hours)

2.118 Begin symptom diary

2.12 Disqualification Criteria for Initial Evaluation

2.12.1 No personal physician
2.12.2 Any chronic illness or regular medicine intake
2.12.3 Frequent minor illnesses

2.12.3.1 > 4 colds/yr.
2.12.3.2 > 2 GE/yr.
2.12.3.3 > 1 UTI/yr.
2.12.3.4 > 2 Vaginitis/yr.
2.12.3.5 > 1 Active Skin Infection/yr.

2.12.4 Abnormal physical finding
2.12.5 Poor DUHP score
2.12.6 Abnormal lab
2.13 Pre-Test Evaluation

2.131 Review symptom diary
2.132 Review recent menstrual history
2.133 Review recent topical use
2.134 Brief physical exam
2.135 Laboratory
   2.1351 U/A and culture
   2.1352 Wet prep/GM stain (if indicated)
   2.1353 Serum pregnancy test
   2.1354 Urine drug screen (legal ramifications)
   2.1355 Special Studies

2.14 Disqualification Criteria for Pre-test Evaluation

2.141 Significant new symptoms of infection
2.142 Testing likely to occur during menses (policy decision)
2.143 Any topical use on prohibited list
2.144 Abnormal physical finding
2.145 Positive urine culture ( > 10,000/ml of each organism)
2.146 Positive wet prep/GM stain
2.147 Positive or indeterminate serum pregnancy test
2.148 Positive urine drug screen (legal)
2.15 Post-Test Evaluation

2.151 Review symptom diary
2.152 Review menstrual history
2.153 Brief physical exam
2.154 Repeat health profile (DUHP)
2.155 Laboratory
   2.1551 U/A and culture
   2.1552 Wet prep/GM stain (if indicated)
   2.1553 Serum pregnancy test
   2.1554 Stool culture
   2.1555 Special studies

2.16 Detection of Sick Subjects

2.161 Continue symptom diary
2.162 Monitor visits to personal physician (by permission)
2.163 Subject notifies
2.17 Medical Staffing Options for Project Evaluations

2.171 Boeing/NASA Physician

<table>
<thead>
<tr>
<th>POSITIVE</th>
<th>NEGATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Good adherence to protocols</td>
<td>1) Low subject acceptability ?</td>
</tr>
<tr>
<td>2) Low additional cost</td>
<td>2) Objectivity</td>
</tr>
</tbody>
</table>

2.172 Personal Physician

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1) High subject acceptability</td>
<td>1) Objectivity</td>
</tr>
<tr>
<td>2) Awareness of involvement</td>
<td>2) High cost</td>
</tr>
<tr>
<td></td>
<td>3) Low adherence to protocol</td>
</tr>
</tbody>
</table>

2.173 Contract Physician

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Objectivity</td>
<td>1) cost</td>
</tr>
<tr>
<td>2) High adherence to protocol</td>
<td></td>
</tr>
</tbody>
</table>

2.174 Responsibility for subject problems, accidents, injuries, exposure

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1741 Human subjects guidelines</td>
<td></td>
</tr>
<tr>
<td>2.1742 JSC guidelines</td>
<td></td>
</tr>
</tbody>
</table>

2.175 Certification process
2.2 Human Subject Guidelines

2.21 Institutional Review Board

There are several large policy issues that require early decisions in order to continue to work on further details. The first of these is an approval of human subjects in general. The JSC Document provides the same categories of "minimal" and "reasonable" risk that are used by the UAH Institutional Review Board. These are guidelines published by the Department of Health and Human Services that clearly outline what is to be done. In the JSC document, it is made clear that the testing of ground-based projects does not come under the JSC HRPPC review. It is stated that this review would be carried out by the Institutional Review Board "of the Institution at which the test procedure development takes place". This review board is a group of persons with widely diverse backgrounds which reviews protocols for human subjects. At this point, we have not identified a MSFC IRB. An IRB should be designed for this review. If the MSFC legal department approves of delegating this authority to the UAH IRB, Dr. Crump can facilitate that process, as he is on the University-wide board. Dr. Crump could also facilitate designing an IRB for MSFC if one is needed.

2.22 System Certification

Certification prior to system use is another major policy issue. The JSC document makes it clear that the principal investigator for the project is the person whose signature certifies that 1) the system is safe, and 2) the subjects are medically qualified to participate. Certainly, one role of the Medical Support Team is to delineate and accept some of this risk. However, the principal investigator for this project must be specified, as it is clear that this person signs the "bottom line". The Medical Support Team can be advisory to that principal investigator and can go on record as having recommended to the principal investigator that all is well.

2.23 Subject Injury

Concerning the issue of injury or harm to the test subjects, the JSC Document states that (in HRPPC reviews) since the subjects are NASA employees, NASA accepts responsibility under the Federal Employee's Compensation Act or the Federal Tort Claims Act. If Boeing employees are to be the subjects in our tests, this line of responsibility will have to be clarified before we can proceed.

2.24 Supporting Documents (Appendix H)

2.241 JSC HRPPC
2.242 HHS
2.243 UAH IRB
2.244 Duke University Health Profile
3.0 Interpretation and recommendations pertaining to water quality requirements.

3.1 Identify current air/water quality requirements.

3.1.1 Johnson Space Center Requirements

The proposed requirements for potable and hygiene water as specified by the Johnson Space Center (JSC) are presented in Table 3-1.

3.1.2 Environmental Protection Agency (EPA)

The current recommended priority pollutants as established by the EPA are presented in Table 3-2.

3.1.3 State of Alabama

The current State of Alabama requirements for drinking water are presented in Table 3-3.

3.2 Recommend which chemical parameters should be monitored in order to verify water quality prior to use.

The current parameters recommended for water quality verification are listed in Table 3-4. The chemical parameters recommended for routine monitoring are based on the identification of these compounds as toxic by the EPA, the recommendation by EPA that these compounds be monitored for pharmaceutical products, the existence of standardized methods for their evaluation and the potential for rapid analysis (8 hours or less).

3.3 Identify the instrumentation and methodology to be used for water quality verification.

Based on the recommendations made pertaining to Section 3.2, Table 3-5 lists the instrumentation and methods required for chemical parameter verification.

3.4 Provide recommendations pertaining to microbiological monitoring of the potable and hygiene water loops in order to verify water quality.

The current microbiology requirements are presented in Table 3-6. The parameters recommended for water quality verification are presented in Table 3-7. The microbiological parameters recommended are based on standard microbiological procedures, current water quality requirements and the need for rapid results (6-24 hours). Determination of total bacteria will be conducted by an epifluorescence method in order to facilitate rapid results (4-6 hours). Conventional viable plate counts requiring a maximum incubation of 24 hours will also be conducted. The standard heterotrophic plate count (72-120 hours) will be used for after the fact verification and identification of isolates as required. Legionellae, fungi and yeast will be monitored routinely at a frequency to be determined at a later time.
Specific recommendations pertaining to viral monitoring will also be addressed at a later time.

### 3.5 Development of a method for total bacterial counts.

In order to detect the presence of bacteria on a near real-time basis a direct method for their detection and enumeration must be developed. It is recommended that an epifluorescence method be used. At present, personnel at the CSLS are reviewing current methods and will make a final recommendation upon completion of this review. It is estimated that approximately $4,000.00 in equipment upgrades and four man-months will be required for method development. Table 3-8 summarizes the current methods for enumeration and the current recommendations.

### 3.6 Provide information pertaining to laboratory analysis required for Legionella and AIDS screening.

The information outline below details pertinent information regarding the Legionellae and HIV (AIDS) virus.

#### 3.6.1 Legionellae

**A. General**

1. gram negative rod 0.3-0.9 x 2-20 um
2. usually motile
3. Ten(10) species determined by 1984 (Legionella symposium) nine(9) of which had been implicated in human disease (legionellosis)
4. More than one serogroup in some species
5. Incubation is at 35C for 4-7 days in a humid environment usually requiring 2.5% CO2

**B. Nomenclature**

1. Partial list of species
   * a. *L. pneumophilia* (pneumonia; also called Legionnaires disease; less severe infection termed Pontiac Fever)
   * b. *L. bozemanii* pneumonia
   * c. *L. micdadei* (pneumonia)
   * d. *L. dumoffii* (pneumonia)
   * e. *L. gormanii* (pneumonia)
   * f. *L. longbeachae* (?)
   * g. *L. jordanis* (pneumonia)
   * h. *L. oakridgensis* (not implicated)
   * i. *L. wadsworthii* (pneumonia)
   * j. *L. feii* (Pontiac Fever)

2. Species a, d, e, g, h and j have been isolated from environmental sources (water and soil)
C. Habitats

1. Pertaining to our areas of interest
   a. water heaters, especially those at low
      temperatures (<55C)
   b. water storage tanks
   c. potable water distribution outlets
      1. shower heads
      2. faucets
      3. showers
   d. evaporator condensers
   e. air compressor lines (at water separator)
   f. "dead legs" in piping

D. Ecological interactions

1. Interaction with other organisms

   a. Studies indicate *L. pneumophila* may derive
      many of its nutritional requirements from
      various species of green and blue-green algae.
      This may help explain the preponderance of
      Legionellae in cooling towers where conditions
      favoring algal growth i.e. direct or indirect
      sunlight, warmth and moisture are present.
      Dissemination of the organism in aerosols may
      also be enhanced by protection from desiccation
      due to the mucilage produced by the algae.

   b. *L. pneumophila* has been shown to grow
      intracellularly in some freshwater protozoans
      such as tetrahymena pyriformis which normally
      feed on bacteria. In this way the bacteria are
      protected from certain environmental factors.

   c. Certain species of the bacteria also appear to
      grow within vacuoles of ameba ubiquitous to the
      same aquatic environment and therefore may also
      protected as above.
E. Sampling from Environmental Sites

1. Water
   a. The volume of water sampled is dependent on site
      1. Potable water sources including holding tanks, cooling tower blowdowns and circulating pumps require at least 2-3 one(1) liter volumes
      2. Water condensers require about 3 one hundred (100) ml. volumes
      3. Other sites must be assessed individually based on probability of isolation
   b. All samples should be collected in sterile polypropylene containers
   c. Potable water from faucets should be collected after allowing steady flow for two(2) minutes
   d. Samples are processed within 30 hours

2. Air
   The ability of legionellae to survive in aerosols generated from evaporative condensers, cooling towers, etc. indicates that sampling at any aerosol generating site should be considered.
   a. Methods
      1. The use of an air sampler such as a six-stage Andersen unit at a rate of 0.0283 cubic millimeters per minute for 10 minutes (ambient air) up to 24 minutes (air/water lines). In general, a selective media for air impact is not recommended but is necessary here to reduce background organisms. Examples of such media are listed below.
      2. A glass impinger containing 0.25% yeast extract set to collect air at a rate of 0.0108 cubic millimeters per minute for 10 minutes may also be considered. The broth can be stained by direct fluorescence antibody procedures and plated on a selective media for examination of legionella-like organisms.
F. Isolation from Environmental Sites

1. A variety of isolation techniques have been used to select for Legionellae from environmental sources by reducing the number of background organisms.
   
a. Buffered charcoal-yeast extract (BCYE) agar containing a-ketoglutarate
b. BCYE supplemented with antibiotics
c. BCYE containing cysteine and ferric pyrophosphate
d. Acid pretreatment of the water sample
e. Heat pretreatment of the water sample
f. Any combination of the above

2. Although useful for initial isolation, only a and c should be considered for subculturing, as some studies have shown even 24 hour cultures become sensitive to these procedures.

3. Incubation time requires 4-7 days

G. Identification

Procedures involved in the identification of Legionellae include both colonial characterization and specific antigen-antibody responses.

1. Colony Characterization
   
a. Colonies are presumptively identified on selective media by their ground glass appearance
b. Their specific requirement for L-cysteine is used as a determinant i.e. will only see a colony on media containing a cysteine source

2. Antigen-Antibody Reactions
   
a. Based primarily on F.1.b., isolates are confirmed by direct fluorescent monoclonal antibody assays for *L. pneumophila*
b. Other Legionellae species and serogrouping within all species requires a polyclonal antibody not commercially available

3. Because of the unusual abundance of branched-chain fatty acids, a library of known Legionellae species fatty acid profiles may serve as a basis for the separation from non-legionella organisms as well as differentiation within the genus
H. Environmental Control

The detection of Legionellae does not necessarily mean it is also a reservoir for the organism. The ability to infect is dependent upon concentrations of the bacteria usually in the form of aerosols. Regardless, strategies can be employed to reduce the possibility of supporting its growth.

1. Material/Design
   a. Dead legs in piping or any area of stasis will increase the ability of the bacteria to grow
   b. Some investigators have found rubber gaskets in shower heads, tap faucets and fittings to harbor legionellae even after chlorination procedures because of the inability to reach these areas adequately. Replacement with inert materials discourage initial colonization in these areas

2. Disinfection
   a. Because legionellae has shown a symbiotic existence with other organisms standard methods such as chlorination to reduce these organisms will also affect growth of the bacteria
   b. Ultraviolet (UV.) light is effective in removing legionellae from water sources and would be of greatest use in areas of low flow or stasis
   c. Because low hot water temperatures (38-46C) favor colonization of legionellae elevation to 70C will eliminate most if not all activity. Even at a temperature of 60-63C the electron transport system of the organism is compromised
3.6.2 AIDS

Testing of the HIV (AIDS) Virus in Hygiene Loop Studies

Routine monitoring for the AIDS virus from the various ECLSS sources is not recommended for the following reasons:

A. The virus is transmissible through very limited means
   1. Sexual intercourse with an infected person
   2. Blood contamination including transfusion and the sharing of needles, razors, etc. by drug users
   3. Passage from an infected mother to her fetus or through breastmilk

B. The virus is infectious in only certain body fluids
   1. Blood
   2. Semen and vaginal secretions
   3. Breast milk

C. The virus is environmentally unstable

D. There is no evidence supporting the transmission of AIDS through any of the following routes:
   1. Coughing
   2. Sneezing
   3. Sweat exposure
   4. Saliva exposure
   5. Teardrop exposure
   6. Urine exposure

E. Studies of transmission of the virus to close but non-sexual contacts of AIDS patients living in the same household and sharing household items, facilities and washing items continue to support the absence of transmission of the virus in this setting

F. The virus is extremely sensitive to commonly used disinfectants including household bleach at a 1:10 dilution, alcohol, hydrogen peroxide, paraformaldehyde and heat (56°C for 10 min.)

G. The virus has only been recovered from blood or serum and commercial test kits are designed to look for antibody to the virus in these fluids. No other sources have been recognized by the Center for Disease Control (CDC) as viable recovery sites
3.7 Determine what parameters should be determined on a real-time, near real-time and delayed time basis in order to drink the potable water or to use the hygiene water.

Table 3-9 illustrates the analysis frequency possible for water quality verification. These are optimum frequencies possible and are directly related to laboratory equipment available, number of samples collected and number of qualified laboratory personnel available.

3.8 Explain what value results obtained from real time monitoring will provide in determining whether the water is usable.

Results obtained from real time (on line) monitoring will provide little information toward verifying water quality (due to low sensitivity and limited parameters currently available). It will, however, be useful in the operation of the reclamation system and identification of upset conditions.

3.9 Development and justify comprehensive air/water quality requirements for recycled air and water.

Recommendations concerning air/water quality requirements were made and a delineation of specific requirements were outlined by three general categories. A current listing of these compounds are presented at the end of this section.

3.7.1 Primary Requirements
3.7.2 Secondary Requirements
3.7.3 Mission Specific Requirements

3.10 Determine the short and long term effects of toxicants.

Not fully addressed at this time.
WATER QUALITY REQUIREMENTS

<table>
<thead>
<tr>
<th>QUALITY PARAMETERS</th>
<th>POTABLE</th>
<th>HYGIENE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PHYSICAL PARAMETERS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL SOLIDS (mg/l)</td>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>COLOR, TRUE (Pt/Co units)</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>TASTE &amp; ODOR (TTN/TON)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PARTICULATES (max size-microns)</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>pH</td>
<td>6.0-8.0</td>
<td>5.0-8.0</td>
</tr>
<tr>
<td>TURBIDITY (NTU)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>DISSOLVED GAS (free @ 35°F)</td>
<td>None</td>
<td>TBD</td>
</tr>
<tr>
<td>FREE GAS (@ STP)</td>
<td>None</td>
<td>TBD</td>
</tr>
<tr>
<td><strong>INORGANIC CONSTITUENTS (mg/l)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMMONIA</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>ARSENIC</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>BARIUM</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>CADMIUM</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>CALCIUM</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>CHLORIDE</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>CHROMIUM</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>COPPER</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>IODINE (TOTAL)</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>IRON</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>LEAD</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>MAGNESIUM</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>MANGANESE</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>MERCURY</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>NICKEL</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>NITRATE (NO3-N)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>POTASSIUM</td>
<td>340</td>
<td>340</td>
</tr>
<tr>
<td>SELENIUM</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>SILVER</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>SULFATE</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>SULFIDE</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>ZINC</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td><strong>BACTERICIDE (mg/l)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESIDUAL IODINE (minimum)</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>RESIDUAL IODINE (maximum)</td>
<td>4.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>
**WATER QUALITY REQUIREMENTS (continued)**

<table>
<thead>
<tr>
<th>QUALITY PARAMETERS</th>
<th>POTABLE</th>
<th>HYGIENE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AESTHETICS (mg/l)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CATIONS</td>
<td>30</td>
<td>--</td>
</tr>
<tr>
<td>ANIONS</td>
<td>30</td>
<td>--</td>
</tr>
<tr>
<td>CO2</td>
<td>15</td>
<td>--</td>
</tr>
<tr>
<td>MICROBIAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BACTERIA (CFU/100ml)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL COUNT</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ANAEROBES</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>AEROBES</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>GRAM NEGATIVE</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>GRAM POSITIVE</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>E-COLI</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ENTERIC</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VIRUS (PFU/100ml)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>YEAST &amp; MOLD (CFU/100ml)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>RADIOACTIVE CONSTITUENTS (pCi/l)</td>
<td>Note 1</td>
<td>TBD</td>
</tr>
<tr>
<td>ORGANIC PARAMETERS (ug/l)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL ACIDS</td>
<td>500</td>
<td>TBD</td>
</tr>
<tr>
<td>CYANIDE</td>
<td>200</td>
<td>TBD</td>
</tr>
<tr>
<td>HALOGENATED HYDROCARBONS</td>
<td>10</td>
<td>TBD</td>
</tr>
<tr>
<td>PHENOLS</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TOC (Less Non-Toxicants)</td>
<td>100</td>
<td>1,000</td>
</tr>
<tr>
<td>TOTAL ALCOHOLS</td>
<td>500</td>
<td>TBD</td>
</tr>
<tr>
<td>TOTAL ORGANIC CARBON (TOC)</td>
<td>500</td>
<td>10,000</td>
</tr>
<tr>
<td>ORGANIC CONSTITUENTS (mg/l)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECIFIC TOXICANTS</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Note 1: The maximum contaminant levels for radioactive material in potable and personal hygiene water shall conform to Nuclear Regulatory Commission (NRC) regulations (10CFR20, et al.) for control of dose to the public from the extant 1200+ man-made radionuclides. These maximum contaminant levels are listed in the Federal Register, Vol. 51, No. 6, 1986, Appendix B, as Table 2 (Reference Level Concentrations) Column 2 (Water).
Table 3-2
<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetyl benzene</td>
<td>1</td>
<td>16 (20ppb est amt)</td>
</tr>
<tr>
<td>Acrolein</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>Alkylbenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromochloromethane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>Bromochloropropane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>Bromoform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromomethane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>dibromomethane</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbontetrachloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Chlorodibromomethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-chloroethyl vinyl ether</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloroform</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Dibromochloromethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichlorobutane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>1,1-dichloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-dichloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1-dichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trans 1,2-dichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichlorofluoromethane</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>1,2-dichloropropane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,3-dichloropropene</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1,2-dichloropropylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimethylbenzene-methanamine</td>
<td>1</td>
<td>230</td>
</tr>
<tr>
<td>ethyl benzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methyl bromide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methyl chloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methylene chloride</td>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>propa-diene chloride</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>1,1,2,2-tetrachloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tetrachloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>toluene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-trans-dichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1,1-trichloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trichlorofluoromethane</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>vinyl chloride</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ORIGINAL PAGE IS OF POOR QUALITY
<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-cresol</td>
<td>8</td>
<td>160</td>
</tr>
<tr>
<td>p-chloro-m-cresol</td>
<td>8</td>
<td>150</td>
</tr>
<tr>
<td>4,6-dinitrocresol</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>phenol</td>
<td>4</td>
<td>55</td>
</tr>
<tr>
<td>2-chlorophenol</td>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>dichlorophenol</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>2,4-dichlorophenol</td>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>2,4,6-trichlorophenol</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>pentachlorophenol</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>chloromethylphenol</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>4-chloro-3-methylphenol</td>
<td>4</td>
<td>265</td>
</tr>
<tr>
<td>2,4-dimethylphenol</td>
<td>4</td>
<td>1000</td>
</tr>
<tr>
<td>2-nitrophenol</td>
<td>4</td>
<td>1000</td>
</tr>
<tr>
<td>4-nitrophenol</td>
<td>4</td>
<td>1000</td>
</tr>
<tr>
<td>2,4-dinitrophenol</td>
<td>4</td>
<td>1000</td>
</tr>
<tr>
<td>2-methyldinitrophenol</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>methylyphenol</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>2-methyl phenol</td>
<td>1</td>
<td>650</td>
</tr>
<tr>
<td>4-methyl phenol</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>phenol, 2,6-di-t-butyl-4-methyl-</td>
<td>1</td>
<td>16 (20ppb est amt)</td>
</tr>
<tr>
<td>phenol, 4-(1,1-dimethylethyl)</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>phenol cmpds</td>
<td>4</td>
<td>2,200</td>
</tr>
<tr>
<td>phenol cmpds (8)</td>
<td>6</td>
<td>600</td>
</tr>
<tr>
<td>phenol cmpds (6)</td>
<td>2</td>
<td>275</td>
</tr>
<tr>
<td>phenol, 2,6-di-t-butyl-4-methyl-</td>
<td>8</td>
<td>150</td>
</tr>
<tr>
<td>phenol (carbolic acid)</td>
<td>4</td>
<td>460</td>
</tr>
<tr>
<td>phenol, chloro- adduct</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>phenol, dichloromethyl</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>phenol, t-butyl</td>
<td>4</td>
<td>150</td>
</tr>
<tr>
<td>Compound</td>
<td>Source</td>
<td>Amt Det.</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>acenaphthene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>acenaphthylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>anthracene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>benzidine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>benzo-a-anthracene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo-a-pyrene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>benzo-b-fluoranthene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,4-benzofluoranthene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>benzo(g,h,i)perylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>benzo(k)fluoranthene</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>bis(2-chloro ethoxy)methane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bis(2-chloroethyl)ether</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bis(2-chloroisopropyl)ether</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-bromophenyl phenyl ether</td>
<td></td>
<td></td>
</tr>
<tr>
<td>butylbenzyl phthalate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-chloro naphthalene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-chlorophenyl phenyl ether</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>chrysene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dibenzo(a,h)anthracene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-dichlorobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,3-dichlorobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,4-dichlorobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,3'-dichlorobenzidine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>diethyl phthalate</td>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>dimethyl phthalate</td>
<td>1</td>
<td>240</td>
</tr>
<tr>
<td>di-n-butyl phthalate</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>2,4-dinitro toluene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,6-dinitro toluene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>di-n-octyl phthalate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-diphenylhydrazine (as azobenzene)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fluoranthene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fluorene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hexachlorobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hexachlorobutadiene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hexachlorocyclopentadiene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hexachloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>indeno(1,2,3-od)pyrene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>isophorone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* 2-methyl naphthalene</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>naphthalene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>nitrobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-nitrosodimethylamine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-nitrosodi-n-propylamine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-nitrosodiphenylamine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>phenanthrene</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 2-methyl naphthalene
<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt Det.</th>
</tr>
</thead>
<tbody>
<tr>
<td>phthalate, diethyl pentyl-</td>
<td>1</td>
<td>49</td>
</tr>
<tr>
<td>phthalate esters (2)</td>
<td>6</td>
<td>350</td>
</tr>
<tr>
<td>phthalate esters</td>
<td>1</td>
<td>140-15,000</td>
</tr>
<tr>
<td>phthalate ester cmpds (4)</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>phthalate ester cmpds (3)</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>phthalate, bis(2-ethyl hexyl)-</td>
<td>8</td>
<td>103</td>
</tr>
<tr>
<td>phthalate, bis(2-ethyl hexyl)-</td>
<td>1</td>
<td>4600</td>
</tr>
<tr>
<td>pyrene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2,4-trichlorobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,3,7,8-tetrachlorodibenzo-p-dioxin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PESTICIDE COMPOUNDS**

- Aldrin
- alpha-BHC
- beta-BHC
- gamma-BHC
- delta-BHC
- chlorodane
- 4,4'-DDD
- 4,4'-DDE
- 4,4'-DDT
- dieldrin
- endosulfan I
- endosulfan II
- endosulfan sulfate
- endrin
- endrin aldehyde
- heptachlor
- heptachlorexoxide
- toxaphene
- PCB-1016
- PCB-1221
- PCB-1232
- PCB-1242
- PCB-1248
- PCB-1254
- PCB-1260
### TABLE 3-3
#### STATE OF ALABAMA
#### DRINKING WATER STANDARDS

**Primary Standards**

<table>
<thead>
<tr>
<th>Inorganics</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>0.05 mg/l</td>
</tr>
<tr>
<td>Barium</td>
<td>1.0 mg/l</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.01 mg/l</td>
</tr>
<tr>
<td>Chromium</td>
<td>0.05 mg/l</td>
</tr>
<tr>
<td>Lead</td>
<td>0.05 mg/l</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.002 mg/l</td>
</tr>
<tr>
<td>Nitrate</td>
<td>10.0 mg/l</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.01 mg/l</td>
</tr>
<tr>
<td>Silver</td>
<td>0.05 mg/l</td>
</tr>
<tr>
<td>Fluoride</td>
<td>4.0 mg/l</td>
</tr>
</tbody>
</table>

**Organics**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endrin</td>
<td>0.0002 mg/l</td>
</tr>
<tr>
<td>Lindane</td>
<td>0.004 mg/l</td>
</tr>
<tr>
<td>Methoxy</td>
<td>0.1 mg/l</td>
</tr>
<tr>
<td>Toxaphene</td>
<td>0.005 mg/l</td>
</tr>
<tr>
<td>2,4 D</td>
<td>0.1 mg/l</td>
</tr>
<tr>
<td>2,4,5,TP Silvex</td>
<td>0.01 mg/l</td>
</tr>
<tr>
<td>Trihalomethanes</td>
<td>0.1 mg/l</td>
</tr>
</tbody>
</table>

**Volatile Organic Carbons**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>5 ug/l</td>
</tr>
<tr>
<td>1,4 dichlorobenzene</td>
<td>75 ug/l</td>
</tr>
<tr>
<td>Carbontetrachloride</td>
<td>5 ug/l</td>
</tr>
<tr>
<td>1,2 dichloroethane</td>
<td>5 ug/l</td>
</tr>
<tr>
<td>1,1 dichloroethylene</td>
<td>7 ug/l</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>5 ug/l</td>
</tr>
<tr>
<td>Vinyl chloride</td>
<td>2 ug/l</td>
</tr>
<tr>
<td>1,1,1 trichlorethene</td>
<td>200 ug/l</td>
</tr>
</tbody>
</table>

**Secondary Standards**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloride</td>
<td>250 mg/l</td>
</tr>
<tr>
<td>Color</td>
<td>15 NTU</td>
</tr>
<tr>
<td>Copper</td>
<td>1 mg/l</td>
</tr>
<tr>
<td>Iron</td>
<td>0.3 mg/l</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.5 mg/l</td>
</tr>
<tr>
<td>Sulfate</td>
<td>250 mg/l</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>500 mg/l</td>
</tr>
<tr>
<td>Zinc</td>
<td>5.0 mg/l</td>
</tr>
</tbody>
</table>
### TABLE 3-4

RECOMMENDATIONS FOR MONITORING

**PHYSICAL**
- Conductivity
- Color
- pH
- Turbidity

**INORGANIC**

**Non-Metals**
- Ammonia
- Chloride
- Bromide
- Iodide
- Nitrate
- Phosphate
- Sulfate

**Metals**
- Arsenic
- Barium
- Cadmium
- Chromium
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Selenium
- Silver
- Zinc

**ORGANICS**
- Cyanide
- TOC
- TOX
- Total Toxic Organics (TTO)

**MICROBIOLOGICAL**
- Total Bacteria
- Total Coliforms
- Heterotrophs
- Non-Saprophytic
### TABLE 3-5

**METHODS AND INSTRUMENTATION FOR WATER QUALITY VERIFICATION**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>METHOD</th>
<th>INSTRUMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PHYSICAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td>EPA 120.1</td>
<td>Cond. Meter</td>
</tr>
<tr>
<td>Color</td>
<td>EPA 110.3</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>pH</td>
<td>EPA 150</td>
<td>pH Meter</td>
</tr>
<tr>
<td>Turbidity</td>
<td>EPA 180</td>
<td>Nephelometer</td>
</tr>
<tr>
<td><strong>INORGANIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Metals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>EPA 350.2</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Chloride</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Bromide</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Iodide</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Nitrate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Nitrogen, Total</td>
<td>EPA 351.3</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Phosphate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Sulfate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td><strong>Metals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>EPA 206.3</td>
<td>AAH</td>
</tr>
<tr>
<td>Barium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Cadmium</td>
<td>EPA 213.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Chromium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Copper</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Iron</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Lead</td>
<td>EPA 239.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Magnesium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Manganese</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Mercury</td>
<td>EPA 245.1</td>
<td>Hg Analyzer</td>
</tr>
<tr>
<td>Nickel</td>
<td>EPA 249.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Potassium</td>
<td>EPA 258.1</td>
<td>AAF</td>
</tr>
<tr>
<td>Selenium</td>
<td>EPA 270.3</td>
<td>AAH</td>
</tr>
<tr>
<td>Silver</td>
<td>EPA 272.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Zinc</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td><strong>ORGANICS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>EPA 335.2</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Halogenated Hydrocarbon</td>
<td>EPA 612</td>
<td>GC/ECD</td>
</tr>
<tr>
<td>Organic Acids</td>
<td></td>
<td>HPLC</td>
</tr>
<tr>
<td>Organic Alcohols</td>
<td></td>
<td>HPLC</td>
</tr>
<tr>
<td>Pesticides</td>
<td>EPA 608</td>
<td>GC/ECD</td>
</tr>
<tr>
<td>Phenols</td>
<td>EPA 604</td>
<td>GC/FID</td>
</tr>
<tr>
<td>TOC</td>
<td>EPA 415.2</td>
<td>TOC Analyzer</td>
</tr>
<tr>
<td>Total Toxic Organics</td>
<td>EPA 624, 625</td>
<td>GC/MS</td>
</tr>
</tbody>
</table>
### TABLE 3-6

**MICROBIOLOGICAL REQUIREMENTS**

**Drinking Water**

**State of Alabama**

- **Total Coliforms**: <4 CFU/100 ML
- **Fecal Coliforms**: <1 CFU/100 ML

**Recreational Waters**

**American Public Health Association**

- **Total Plate Count**: <100 CFU/ML
- **Turbidity**: 1 NTU
TABLE 3-7

RECOMMENDATIONS FOR MICROBIOLOGICAL MONITORING

BACTERIA
- TOTAL BACTERIA
- TOTAL COLIFORMS
- HETEROTROPHS
- NON-SAPROPHYTIC
- LEGIONELLAE

FUNGI AND YEAST

VIRUSES
To Be Determined
### TABLE 3-8

**METHODS FOR ENUMERATION**

<table>
<thead>
<tr>
<th>Method</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viable Plate Counts</td>
<td>18-120 HOURS</td>
</tr>
<tr>
<td>Direct Microscopic Counts</td>
<td>4 HOURS</td>
</tr>
<tr>
<td>Fluorescence Microscopy</td>
<td>6 HOURS</td>
</tr>
<tr>
<td>Scanning Electron Microscopy</td>
<td>8-12 HOURS</td>
</tr>
<tr>
<td>Particle Counts</td>
<td>4 HOURS</td>
</tr>
</tbody>
</table>

**RECOMMENDATION:**

**FLUORESCEENCE MICROSCOPY**

**REQUIREMENTS:**

APPROXIMATELY $4,000 UPGRADE OF PHASE MICROSCOPE AND 4 MAN-MONTHS LABOR
TABLE 3-9

SAMPLING FREQUENCY REQUIRED FOR WATER QUALITY VERIFICATION

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>REAL-TIME</th>
<th>NEAR REAL TIME</th>
<th>DELAYED (24 HRS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Color</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>pH</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Turbidity</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>INORGANIC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Metals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bromide</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Iodide</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Nitrate</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Phosphate</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sulfate</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Metals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Barium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cadmium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chromium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Copper</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Iron</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lead</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Manganese</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Mercury</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Selenium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Silver</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Zinc</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ORGANICS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>TOC</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>TOX</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Total Toxic Organics (TTO)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>BACTERIA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Bacteria</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Total Coliforms</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterotrophs</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Saprophytic</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legionellae</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FUNGI AND YEAST</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SPECIFIC TOXICANTS

#### PRIMARY REQUIREMENTS

<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt detected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VOLATILES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Acetyl benzene</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>Acrolein</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Bromochloromethane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>* Bromochloropropane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>Bromoform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromomethane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbontetrachloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorodibromomethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-chloroethyl vinyl ether</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloroform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloromethane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Dibromochloromethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Dichlorobutane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>1,1-dichloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-dichloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1-dichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trans 1,2-dichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Dichlorofluoromethane</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>1,2-dichloropropane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,3-dichloropropene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,2-dichloropropylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Dimethylbenzene-methanamine</td>
<td>1</td>
<td>230</td>
</tr>
<tr>
<td>ethyl benzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methyl bromide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methyl chloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methylene chloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1,2,2-tetrachloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tetrachloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>toluene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-trans-dichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1,1-trichloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trichlorofluoromethane</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>vinyl chloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compound</td>
<td>Source</td>
<td>Amt detected</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------</td>
<td>--------------</td>
</tr>
<tr>
<td>p-chloro-m-cresol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4,6-dinitrocresol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>phenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-chlorophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4-dichlorophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4,6-trichlorophenol (1)</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>phenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-chloro-3-methylphenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4-dimethylphenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-nitrophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-nitrophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4-dinitrophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-methyldinitrophenol (1)</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>2-methyl phenol</td>
<td></td>
<td>650</td>
</tr>
<tr>
<td>4-methyl phenol</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>phenol, 2,6-di-t-butyl-4-methyl-</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>phenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-(1,1-dimethylethyl) phenol</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>phenol cmpds (4)</td>
<td></td>
<td>2,200</td>
</tr>
<tr>
<td>phenol cmpds (8)</td>
<td></td>
<td>600</td>
</tr>
<tr>
<td>phenol cmpds (6)</td>
<td></td>
<td>275</td>
</tr>
<tr>
<td>phenol, 2,6-di-t-butyl-4-methyl-</td>
<td></td>
<td>150</td>
</tr>
<tr>
<td>Compound</td>
<td>Source</td>
<td>Amt Det.</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>acenaphthene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>acenaphthylene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>anthracene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo-a-anthracene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo-a-pyrene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo-b-fluoranthene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>3,4-benzofluoranthene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo(g,h,i)perylene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo(k)fluoranthene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>bis(2-chloro ethoxy)methane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>bis(2-chloroethyl)ether</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>bis(2-chloroisopropyl)ether</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>bis(2-ethylhexyl)phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>4-bromophenyl phenyl ether</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>butylbenzyl phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2-chloro naphthalene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>4-chlorophenyl phenyl ether</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>chrysene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>dibenzo(a,h)anthracene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,2-dichlorobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,3-dichlorobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,4-dichlorobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>3,3'-dichlorobenzidine</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>diethyl phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>dimethyl phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>di-n-butyl phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2,4-dinitro toluene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2,6-dinitro toluene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>di-n-octyl phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,2-diphenylhydrazine (as azobenzene)</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>fluoranthene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>fluorene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>hexachlorobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>hexachlorobutadiene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>hexachlorocyclopentadiene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>hexachloroethane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>indeno(1,2,3-od)pyrene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>isophorone</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>* 2-methyl naphthalene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>naphthalene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>nitrobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>N-nitrosodimethylamine</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>N-nitrosodi-n-propylamine</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>N-nitrosodiphenylamine</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>phenanthrene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>* phthalate, diethyl pentyl-</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>* phthalate esters (2)</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>* phthalate esters</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>* phthalate, bis(2-ethyl hexyl)-</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>pyrene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,2,4-trichlorobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2,3,7,8-tetrachlorodibenzo-p-dioxin</td>
<td>1</td>
<td>100</td>
</tr>
</tbody>
</table>
PRIMARY REQUIREMENTS (CONT.)

PESTICIDE COMPOUNDS

Aldrin
alpha-BHC
beta-BHC
gamma-BHC
delta-BHC
chlorodane
4,4'-DDD
4,4'-DDE
4,4'-DDT
dieldrin
endosulfan I
endosulfan II
endosulfan sulfate
drin
endrin aldehyde
heptachlor
heptachlorepoxide
toxaphene
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
## SECONDARY REQUIREMENTS

<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt.</th>
<th>Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic Acid</td>
<td>5</td>
<td>300</td>
<td>orl hmn TDLo 1470 ug GIT</td>
</tr>
<tr>
<td>Acetic acid, phenyl</td>
<td>4</td>
<td>400</td>
<td>ihl hmn TDLo 816ppm/3min</td>
</tr>
<tr>
<td>Acetate, ethanol ethoxy</td>
<td>1</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Acetate, vinyl</td>
<td>1</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Acetone</td>
<td>3</td>
<td>3300</td>
<td>orl hmn TCLo 500ppm Eye</td>
</tr>
<tr>
<td>Diacetone alcohol</td>
<td>1</td>
<td>19ppb</td>
<td></td>
</tr>
<tr>
<td>Acetone cmpds (2)</td>
<td>4</td>
<td>250ppb</td>
<td></td>
</tr>
<tr>
<td>Acrylate, 3-methoxy-butyl</td>
<td>3</td>
<td>130ppm</td>
<td></td>
</tr>
<tr>
<td>Azepin-2-one, hexahydro</td>
<td>1</td>
<td>73ppb</td>
<td></td>
</tr>
<tr>
<td>Acrylamide</td>
<td>1</td>
<td>20ppb</td>
<td></td>
</tr>
<tr>
<td>2-Nitroaniline</td>
<td>1</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>3-Nitroaniline</td>
<td>1</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>4-Nitroaniline</td>
<td>1</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>Adipic Acid</td>
<td>1</td>
<td>6ppb</td>
<td>orl rat LDLo 3600mg</td>
</tr>
<tr>
<td>Adipate, tetramethylene</td>
<td>1</td>
<td>6ppb</td>
<td></td>
</tr>
<tr>
<td>Amide, butyl benzenesulfon</td>
<td>1</td>
<td>6ppb</td>
<td></td>
</tr>
<tr>
<td>Amide, N,N-di-n-butylform-</td>
<td>1</td>
<td>60ppb</td>
<td></td>
</tr>
<tr>
<td>Amide, N-methyl-N-ethyl form-1</td>
<td>1</td>
<td>1,103ppb</td>
<td></td>
</tr>
<tr>
<td>4-Chloroaniline</td>
<td>1</td>
<td>100ppb</td>
<td></td>
</tr>
<tr>
<td>Amide, N,N-dimethyl form-</td>
<td>1</td>
<td>541ppb</td>
<td></td>
</tr>
<tr>
<td>Amides (4)</td>
<td>1</td>
<td>3190ppb</td>
<td></td>
</tr>
<tr>
<td>Amides (2)</td>
<td>2</td>
<td>400ppb</td>
<td></td>
</tr>
<tr>
<td>Amine, dimethyl</td>
<td>1</td>
<td>80ppb</td>
<td>orl rat LD50 698mg</td>
</tr>
<tr>
<td>Amine, N,N-dimethyl benzyl-</td>
<td>1</td>
<td>74ppb</td>
<td></td>
</tr>
<tr>
<td>Amine, di-n-butyl</td>
<td>1</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>Amines (2)</td>
<td>1</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>Alcohol cmpds (2)</td>
<td>3</td>
<td>5000ppb</td>
<td></td>
</tr>
<tr>
<td>Alkene (C29H58)</td>
<td>3</td>
<td>10ppb</td>
<td></td>
</tr>
<tr>
<td>Butyric Acid</td>
<td>4</td>
<td>3000ppb</td>
<td>orl rat LD50 2940mg</td>
</tr>
<tr>
<td>Butyrates, 3-hydroxy</td>
<td>1</td>
<td>300ppb</td>
<td></td>
</tr>
<tr>
<td>-trimethylpentyliso</td>
<td>1</td>
<td>180ppb</td>
<td></td>
</tr>
<tr>
<td>1-Butanamine, n-butyl-</td>
<td>1</td>
<td>55ppb</td>
<td></td>
</tr>
<tr>
<td>Butanoate, 2 methoxymethyl-2-</td>
<td>1</td>
<td>900ppb</td>
<td></td>
</tr>
<tr>
<td>2-Butanone</td>
<td>1</td>
<td>60ppb</td>
<td></td>
</tr>
<tr>
<td>Butanone, 3-methyl-2-</td>
<td>1</td>
<td>500ppb</td>
<td>orl rat LD50 3040mg</td>
</tr>
<tr>
<td>Benzoic acid</td>
<td>3</td>
<td>848ppb</td>
<td></td>
</tr>
<tr>
<td>Butanoic acid cmpds (2)</td>
<td>6</td>
<td>150ppb</td>
<td>orl rat LD50 1300mg</td>
</tr>
<tr>
<td>Benzaldehyde</td>
<td>3</td>
<td>1000ppb</td>
<td>orl rat LD50 1330mg</td>
</tr>
<tr>
<td>Benzaldehyde cmpds (3)</td>
<td>4</td>
<td>150ppb</td>
<td></td>
</tr>
<tr>
<td>Benzyl alcohol</td>
<td>1</td>
<td>4700ppb</td>
<td>orl rat LD50 1330mg</td>
</tr>
<tr>
<td>Benzisoxazole</td>
<td>1</td>
<td>100ppb</td>
<td></td>
</tr>
</tbody>
</table>
### SECONDARY REQUIREMENTS (CONT.)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt.</th>
<th>Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>caprylic acid</td>
<td>1</td>
<td>273ppb</td>
<td>ivn mus LD₅₀ 600mg</td>
</tr>
<tr>
<td>cyanurate, triallyls iso-</td>
<td>1</td>
<td>12ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acids</td>
<td>4</td>
<td>40,800ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acids</td>
<td>2</td>
<td>92,210ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acids</td>
<td>3</td>
<td>81,500ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acids (5)</td>
<td>7</td>
<td>3,500ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acid cmpds (4)</td>
<td>6</td>
<td>52,000ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acids (5)</td>
<td>1</td>
<td>43,000ppb</td>
<td></td>
</tr>
<tr>
<td>unknown carboxylic acids</td>
<td>1</td>
<td>2,633ppb</td>
<td></td>
</tr>
<tr>
<td>Caproic Acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>caprolactam</td>
<td>1</td>
<td>15,000ppb</td>
<td></td>
</tr>
<tr>
<td>carbon disulfide</td>
<td>1</td>
<td>14-722ppb</td>
<td></td>
</tr>
<tr>
<td>Decan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>decan cmpds (2)</td>
<td>4</td>
<td>280ppb</td>
<td></td>
</tr>
<tr>
<td>Dodecyl alcohol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dodecanol</td>
<td>3</td>
<td>100ppb</td>
<td></td>
</tr>
<tr>
<td>dibenzofuran</td>
<td>1</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>dimethyl-benzene methanol</td>
<td>1</td>
<td>16ppb</td>
<td></td>
</tr>
<tr>
<td>dioxalane cmpds</td>
<td>3</td>
<td>600ppb</td>
<td></td>
</tr>
<tr>
<td>ether, ethyl propyl</td>
<td>1</td>
<td>34ppb</td>
<td></td>
</tr>
<tr>
<td>ether, ethylene glycol monobutyl-</td>
<td>1</td>
<td>100ppb</td>
<td></td>
</tr>
<tr>
<td>ether, p-chlorophenyl methoxyisobutyl</td>
<td>4</td>
<td>400ppb</td>
<td></td>
</tr>
<tr>
<td>ethers, glycol (2)</td>
<td>1</td>
<td>550ppb</td>
<td></td>
</tr>
<tr>
<td>ethers, glycol (2)</td>
<td>3</td>
<td>900ppb</td>
<td></td>
</tr>
<tr>
<td>furfuryl alcohol</td>
<td>5</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Heptanoic Acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-heptanone</td>
<td>6</td>
<td>100ppb</td>
<td></td>
</tr>
<tr>
<td>heptanone cmpds (2)</td>
<td>4</td>
<td>60ppb</td>
<td></td>
</tr>
<tr>
<td>Hexanol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hexanol, 2-ethyl-1-</td>
<td>6</td>
<td>100ppb</td>
<td></td>
</tr>
<tr>
<td>hexanol, 5-methyl-1-</td>
<td>1</td>
<td>150ppb</td>
<td></td>
</tr>
<tr>
<td>2-hexanone</td>
<td>1</td>
<td>50ppb</td>
<td></td>
</tr>
<tr>
<td>cyclohexanone</td>
<td>1</td>
<td>35ppb</td>
<td></td>
</tr>
<tr>
<td>isophorone</td>
<td>1</td>
<td>3ppb</td>
<td></td>
</tr>
<tr>
<td>lactone cmpds</td>
<td>3</td>
<td>130ppb</td>
<td></td>
</tr>
<tr>
<td>morpholine, 4-ethyl</td>
<td>1</td>
<td>470ppb</td>
<td></td>
</tr>
<tr>
<td>morpholine, n-ethyl</td>
<td>1</td>
<td>400ppb</td>
<td></td>
</tr>
<tr>
<td>nonanedioate, bis(2-ethyl hexyl)</td>
<td>1</td>
<td>1,100ppb</td>
<td></td>
</tr>
<tr>
<td>nonanedioic acid</td>
<td>1</td>
<td>6ppb</td>
<td></td>
</tr>
<tr>
<td>octanoate, methyl</td>
<td>3</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>Compound</td>
<td>Source</td>
<td>Amt.</td>
<td>Toxicity</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------</td>
<td>------</td>
<td>-------------------</td>
</tr>
<tr>
<td>palmitic acid</td>
<td>7</td>
<td>10</td>
<td>ivn mus LD$_{50}$ 57mg</td>
</tr>
<tr>
<td>pentane, 2,3-dimethyl-</td>
<td>1</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>pentane, 2,2,4-trimethyl-</td>
<td>1</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>4-methyl-2-pentanone</td>
<td>1</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>2-methyl-2,4-pentanediol</td>
<td>1</td>
<td>410</td>
<td></td>
</tr>
<tr>
<td>pentene, 4,4-dimethyl-1-</td>
<td>1</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>phosphate, diethyl pentyl-</td>
<td>1</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>phosphate, triethyl-</td>
<td>1</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>phosphate, teramethylpyro-</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>phosphate, tetramethylpyro-</td>
<td>2</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1-propene</td>
<td>1</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>propionic acid</td>
<td>1</td>
<td>6,000-17,222</td>
<td>orl rat LD$_{50}$ 1510mg</td>
</tr>
<tr>
<td>propylene glycol</td>
<td>1</td>
<td>300</td>
<td>orl rat LD$_{50}$ 800mg</td>
</tr>
<tr>
<td>Pyrrolidine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pyrrolidine, N-methyl-</td>
<td>1</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>pyrrolidone</td>
<td>1</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>styrene</td>
<td>1</td>
<td>50</td>
<td>ihn hmn TCLo 376ppm</td>
</tr>
<tr>
<td>salicylic acid</td>
<td>6</td>
<td>350000</td>
<td>orl rat LD$_{50}$ 891mg</td>
</tr>
<tr>
<td>thiophene, tetrahydro-1,1-dioxide</td>
<td>1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>thiourea</td>
<td>1</td>
<td>300-500</td>
<td></td>
</tr>
<tr>
<td>thiourea, tetramethyl</td>
<td>1</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>urea</td>
<td>1</td>
<td>&lt;16,000</td>
<td></td>
</tr>
<tr>
<td>Undecanoic Acid</td>
<td></td>
<td></td>
<td>ivn mus LD$_{50}$ 140mg</td>
</tr>
<tr>
<td>n-undecane</td>
<td>4</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>vanillan</td>
<td>6</td>
<td>200</td>
<td>orl rat LD$_{50}$ 1580mg</td>
</tr>
<tr>
<td>Xylenol</td>
<td></td>
<td></td>
<td>orl mus LD$_{50}$ 1070mg</td>
</tr>
<tr>
<td>xylenes, total</td>
<td>1</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>
4.0 Assist in determining the design specifications required as related to the Technical Demonstration Program

This topic has not been addressed.

5.0 Develop data base of all microorganisms recovered from previous subsystem testing

This topic was not addressed. An outline is presented below indicating pertinent areas which must be defined.

5.1 Biochemical Characterization of Unknowns
5.2 Identification of Presumptive Organisms
5.3 FAME profiling of isolates
5.4 Establish data base of isolates with respect to source
5.5 Identify isolates which potentially represent health risks
5.6 Characterize isolates based on susceptibility/resistance to antimicrobials

6.0 Estimates of health risk of individual microbes to test subjects

This topic was not addressed. The completion of 5.0 above must first be completed.

7.0 Assist with setting limits for safety of test subjects

This topic was addressed in 3.0 above.

8.0 Health monitoring of test subjects

8.1 Delineation of parameters to monitor well subjects
This topic was addressed in 2.15 above.
8.2 Guidelines for managing sick subjects
This topic was addressed in 2.16 above.

9.0 Assist in the preparation of test plans

9.1 Microbiological
This topic was in progress when funding ran out.
9.2 Chemical
This topic was not addressed.
10.0 Assist in the development of a QA/QC program to assure the validity, accuracy and precision of the analyses

This topic was not addressed but is related to both 9.1 and 9.2 above.

11.0 Assist in developing test plans required for future "man in the loop" testing

This topic was not addressed.
APPENDIX F
Supporting Documents
PROTECTION
OF
HUMAN SUBJECTS

CODE OF FEDERAL REGULATIONS
45 CFR 46

Revised as of March 8, 1983
INSTITUTIONAL REVIEW BOARDS; ETHICS GUIDANCE PROGRAM

Sec. 212. (a) Part I of title IV of the Public Health Service Act, as amended by section 103 of this Act, is amended by adding at the end the following new section:

"INSTITUTIONAL REVIEW BOARDS; ETHICS GUIDANCE PROGRAM

Sec. 474. (a) The Secretary shall by regulation require that each entity which applies for a grant or contract under this Act for any project or program which involves the conduct of biomedical or behavioral research involving human subjects submit in or with its application for such grant or contract assurances satisfactory to the Secretary that it has established (in accordance with regulations which the Secretary shall prescribe) a board (to be known as an 'Institutional Review Board') to review biomedical and behavioral research involving human subjects conducted at or sponsored by such entity in order to protect the rights of the human subjects of such research.

(b) The Secretary shall establish a program within the Department under which requests for clarification and guidance with respect to ethical issues raised in connection with biomedical or behavioral research involving human subjects are responded to promptly and appropriately.

(b) The Secretary of Health, Education, and Welfare shall within 240 days of the date of the enactment of this Act promulgate such regulations as may be required to carry out section 474(a) of the Public Health Service Act. Such regulations shall apply with respect to applications for grants and contracts under such Act submitted after promulgation of such regulations.

THE CODE OF FEDERAL REGULATIONS, 45 CFR 46, IMPLEMENTS THESE AMENDMENTS TO THE PUBLIC HEALTH SERVICE ACT.

salus ubi multi consiliarii
PART 46—PROTECTION OF HUMAN SUBJECTS

Subpart A—Basic HHS Policy for Protection of Human Research Subjects

Sec. 46.101 To what do these regulations apply?
46.102 Definitions.
46.103 Assurances.
46.104 Section reserved.
46.105 Section reserved.
46.106 Section reserved.
46.107 IRB membership.
46.108 IRB functions and operations.
46.109 IRB review of research.
46.110 Expedited review procedures for certain kinds of research involving no more than minimal risk, and for minor changes in approved research.
46.111 Criteria for IRB approval of research.
46.112 Review by institution.
46.113 Suspension or termination of IRB approval of research.
46.114 Consent for research.
46.115 IRB records.
46.116 General requirements for informed consent.
46.117 Documentation of informed consent.
46.118 Applications and proposals lacking definite plans for involvement of human subjects.
46.119 Research undertaken without the intention of involving human subjects.
46.120 Evaluation and disposition of applications and proposals.
46.121 Investigational new drug or device 30-day delay requirement.
46.122 Use of federal funds.
46.123 Early termination of research funding; evaluation of subsequent applications and proposals.
46.124 Conditions.

Subpart B—Additional Protections Pertaining to Biomedical and Behavioral Research Involving Prisoners as Subjects

Sec.
46.301 Applicability.
46.302 Purpose.
46.303 Definitions.
46.304 Composition of Institutional Review Boards where prisoners are involved.
46.305 Additional duties of the Institutional Review Boards where prisoners are involved.
46.306 Permitted activities involving prisoners.

Subpart C—Additional Protections Pertaining to Biomedical and Behavioral Research Involving Children as Subjects in Research

Sec.
46.401 To what do these regulations apply?
46.402 Definitions.
46.403 IRB duties.
46.404 Research not involving greater than minimal risk.
46.405 Research involving greater than minimal risk but presenting the prospect of direct benefit to the individual subjects.
46.406 Research involving greater than minimal risk and no prospect of direct benefit to individual subjects, but likely to yield generalizable knowledge about the subject's disorder or condition.
46.407 Research not otherwise approvable which presents an opportunity to understand, prevent, or alleviate a serious problem affecting the health or welfare of children.
46.408 Requirements for permission by parents or guardians and for assent by children.
46.409 Waiver.

Authority: 5 U.S.C. 301; sec. 474(a), 88 Stat. 352 (42 U.S.C. 289(f)-3(a)).

Subpart D—Additional Protections Pertaining to Research, Development, and Related Activities Involving Fetuses, Pregnant Women, and Human In Vitro Fertilization

Sec.
46.201 Applicability.
46.202 Purpose.
46.203 Definitions.
46.204 Ethical Advisory Boards.
46.205 Additional duties of the Institutional Review Boards in connection with activities involving fetuses, pregnant women, or human in vitro fertilization.
46.206 General limitations.
46.207 Activities directed toward pregnant women as subjects.
46.208 Activities directed toward fetuses in utero as subjects.
46.209 Activities directed toward fetuses ex utero, including nonviable fetuses, as subjects.
46.210 Activities involving the dead fetus, fetal material, or the placenta.
46.211 Modification or waiver of specific requirements.

Subpart E—Basic HHS Policy for Protection of Human Research Subjects


§ 46.101 To what do these regulations apply?
(a) Except as provided in paragraph (b) of this section, this subpart applies to all research involving human subjects conducted by the Department of Health and Human Services or funded in whole or in part by a Department grant, contract, cooperative agreement or fellowship.

(1) This includes research conducted by Department employees, except each Principal Operating Component head may adopt such nonsubstantive, procedural modifications as may be appropriate from an administrative standpoint.
(2) It also includes research conducted or funded by the Department of Health and Human Services outside the United States, but in appropriate circumstances, the Secretary may, under paragraph (e) of this section waive the applicability of some or all of the requirements of these regulations for research of this type.

(b) Research activities in which the only involvement of human subjects will be in one or more of the following categories are exempt from these regulations unless the research is covered by other subparts of this part:

(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), if
information taken from these sources is recorded in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

(3) Research involving survey or interview procedures, except where all of the following conditions exist: (i) responses are recorded in such a manner that the human subjects can be identified, directly or through identifiers linked to the subjects, (ii) the subject's responses, if they became known outside the research, could reasonably place the subject at risk of criminal or civil liability or be damaging to the subject's financial standing or employability, and (iii) the research deals with sensitive aspects of the subject's own behavior, such as illegal conduct, drug use, sexual behavior, or use of alcohol. All research involving survey or interview procedures is exempt, without exception, when the respondents are elected or appointed public officials or candidates for public office.

(4) Research involving the observation (including observation by participants) of public behavior, except where all of the following conditions exist: (i) observations are recorded in such a manner that the human subjects can be identified, directly or through identifiers linked to the subjects, (ii) the observations recorded about the individual, if they became known outside the research, could reasonably place the subject at risk of criminal or civil liability or be damaging to the subject’s financial standing or employability, and (iii) the research deals with sensitive aspects of the subject’s own behavior, such as illegal conduct, drug use, sexual behavior, or use of alcohol.

(5) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

(6) Unless specifically required by statute (and except to the extent specified in paragraph (i)), research and demonstration projects which are conducted by or subject to the approval of the Department of Health and Human Services, and which are designed to study, evaluate, or otherwise examine: (i) programs under the Social Security Act, or other public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

(c) The Secretary has final authority to determine whether a particular activity is covered by these regulations.

(d) The Secretary may require that specific research activities or classes of research activities conducted or funded by the Department, but not otherwise covered by these regulations, comply with some or all of these regulations.

(e) The Secretary may also waive applicability of these regulations to specific research activities or classes of research activities, otherwise covered by these regulations. Notices of these actions will be published in the Federal Register as they occur.

(f) No individual may receive Department funding for research covered by these regulations unless the individual is affiliated with or sponsored by an institution which assumes responsibility for the research under an assurance satisfying the requirements of this part, or the individual makes other arrangements with the Department.

(g) Compliance with these regulations will in no way render inapplicable pertinent federal, state, or local laws or regulations.

(h) Each subpart of these regulations contains a separate section describing to what the subpart applies. Research which is covered by more than one subpart shall comply with all applicable subparts.

(i) If, following review of proposed research activities that are exempt from these regulations under paragraph (b)(6), the Secretary determines that a research or demonstration project presents a danger to the physical, mental, or emotional well-being of a participant or subject of the research or demonstration project, then federal funds may not be expended for such a project without the written, informed consent of each participant or subject.

§ 46.102 Definitions.

(a) "Secretary" means the Secretary of Health and Human Services and any other officer or employee of the Department of Health and Human Services to whom authority has been delegated.

(b) "Department" or "HHS" means the Department of Health and Human Services.

(c) "Institution" means any public or private entity or agency (including federal, state, and other agencies).

(d) "Legally authorized representative" means an individual or judicial or other body authorized under applicable law to consent on behalf of a prospective subject to the subject's participation in the research.

(e) "Research" means a systematic investigation designed to develop or contribute to generalizable knowledge. Activities which meet this definition constitute "research" for purposes of these regulations, whether or not they are supported or funded under a program which is considered research for other purposes. For example, some "demonstration" and "service" programs may include research activities.
§ 46.103 Assurances.

(a) Each institution engaged in research covered by these regulations shall provide written assurance satisfactory to the Secretary that it will comply with the requirements set forth in these regulations.

(b) The Department will conduct or fund research covered by these regulations only if the institution has an assurance approved as provided in this section, and only if the institution has certified to the Secretary that the research has been reviewed and approved by an IRB provided for in the assurance, and will be subject to continuing review by the IRB. This assurance shall at a minimum include:

(1) A statement of principles governing the institution in the discharge of its responsibilities for protecting the rights and welfare of human subjects of research conducted at or sponsored by the institution, regardless of source of funding. This may include an appropriate existing code, declaration, or statement of ethical principles, or a statement formulated by the institution itself. This requirement does not preempt provisions of these regulations applicable to Department-funded research and is not applicable to any research in an exempt category listed in § 46.101.

(2) Designation of one or more IRBs established in accordance with the requirements of this subpart, and for which provisions are made for meeting space and sufficient staff to support the IRB’s review and recordkeeping duties.

(3) A list of the IRB members identified by name; earned degrees; representative capacity; indications of experience such as board certifications, licenses, etc., sufficient to describe each member’s chief anticipated contributions to IRB deliberations; and any employment or other relationship between each member and the institution; for example: full-time employee, part-time employee, member of governing panel or board, stockholder, paid or unpaid consultant. Changes in IRB membership shall be reported to the Secretary.¹

(4) Written procedures which the IRB will follow (i) for conducting its initial and continuing review of research and for reporting its findings and actions to the investigator and the institution; (ii) for determining which projects require review more often than annually and which projects need verification from sources other than the investigators that no material changes have occurred since previous IRB review; (iii) for insuring prompt reporting to the IRB of proposed changes in a research activity, and for insuring that changes in approved research, during the period for which IRB approval has already been given, may not be initiated without IRB review and approval except where necessary to eliminate apparent immediate hazards to the subject; and (iv) for insuring prompt reporting to the IRB and to the Secretary¹ of unanticipated problems involving risks to subjects or others.

(c) The assurance shall be executed by an individual authorized to act for the institution and to assume on behalf of the institution the obligations imposed by these regulations, and shall be filed in such form and manner as the Secretary may prescribe.

(d) The Secretary will evaluate all assurances submitted in accordance with these regulations through such officers and employees of the Department and such experts or consultants engaged for this purpose as the Secretary determines to be appropriate. The Secretary’s evaluation will take into consideration the adequacy of the proposed IRB in light of the anticipated scope of the institution’s research activities and the types of subject populations likely to be

¹ Reports should be filed with the Office for Protection from Research Risks, National Institutes of Health, Department of Health and Human Services, Bethesda, Maryland 20892.
involved, the appropriateness of the proposed initial and continuing review procedures in light of the probable risks, and the size and complexity of the institution.

(e) On the basis of this evaluation, the Secretary may approve or disapprove the assurance, or enter into negotiations to develop an approvable one. The Secretary may, limit the period during which any particular approved assurance or class of approved assurances shall remain effective or otherwise condition or restrict approval.

(f) Within 60 days after the date of submission to HHS of an application or proposal, an institution with an approved assurance covering the proposed research shall certify that the application or proposal has been reviewed and approved by the IRB. Other institutions shall certify that the application or proposal has been approved by the IRB within 30 days after receipt of a request for such a certification from the Department. If the certification is not submitted within these time limits, the application or proposal may be returned to the institution.

§ 46.104 [Reserved]
§ 46.105 [Reserved]
§ 46.106 [Reserved]
§ 46.107 IRB membership.

(a) Each IRB shall have at least five members, with varying backgrounds to promote complete and adequate review of research activities commonly conducted by the institution. The IRB shall be sufficiently qualified through the experience and expertise of its members, and the diversity of the members’ backgrounds including consideration of the racial and cultural backgrounds of members and sensitivity to such issues as community attitudes, to promote respect for its advice and counsel in safeguarding the rights and welfare of human subjects. In addition to possessing the professional competence necessary to review specific research activities, the IRB shall be able to ascertain the acceptability of proposed research in terms of institutional commitments and regulations, applicable law, and standards of professional conduct and practice. The IRB shall therefore include persons knowledgeable in these areas. If an IRB regularly reviews research that involves a vulnerable category of subjects, including but not limited to subjects covered by other subparts of this part, the IRB shall include one or more individuals who are primarily concerned with the welfare of these subjects.

(b) No IRB may consist entirely of men or entirely of women, or entirely of members of one profession.

(c) Each IRB shall include at least one member whose primary concerns are in nonscientific areas; for example: lawyers, ethicists, members of the clergy.

(d) Each IRB shall include at least one member who is not otherwise affiliated with the institution and who is not part of the immediate family of a person who is affiliated with the institution.

(e) No IRB may have a member participating in the IRB’s initial or continuing review of any project in which the member has a conflicting interest, except to provide information requested by the IRB.

(f) An IRB may, in its discretion, invite individuals with competence in special areas to assist in the review of complex issues which require expertise beyond or in addition to that available on the IRB. These individuals may not vote with the IRB.

§ 46.108 IRB functions and operations.

In order to fulfill the requirements of these regulations each IRB shall:

(a) Follow written procedures as provided in § 46.103(b)(4).

(b) Except when an expedited review procedure is used (see § 46.110), review proposed research at convened meetings at which a majority of the members of the IRB are present, including at least one member whose primary concerns are in nonscientific areas. In order for the research to be approved, it shall receive the approval of a majority of those members present at the meeting.

(c) Be responsible for reporting to the appropriate institutional officials and the Secretary any serious or continuing noncompliance by investigators with the requirements and determinations of the IRB.

§ 46.109 IRB review of research.

(a) An IRB shall review and have authority to approve, require modifications in (to secure approval), or disapprove all research activities covered by these regulations.

(b) An IRB shall require that information given to subjects as part of informed consent is in accordance with § 46.116. The IRB may require that information, in addition to that specifically mentioned in § 46.116, be given to the subjects when in the IRB’s judgment the information would meaningfully add to the protection of the rights and welfare of subjects.

(c) An IRB shall require documentation of informed consent or may waive documentation in accordance with § 46.117.

(d) An IRB shall notify investigators and the institution in writing of its decision to approve or disapprove the proposed research activity, or of modifications required to secure IRB approval of the research activity. If the IRB decides to disapprove a research activity, it shall include in its written notification

1 Reports should be filed with the Office for Protection from Research Risks, National Institutes of Health, Department of Health and Human Services, Bethesda, Maryland 20205.
a statement of the reasons for its
decision and give the investigator an
opportunity to respond in person or in
writing.

(e) An IRB shall conduct
continuing review of research covered
by these regulations at intervals
appropriate to the degree of risk, but
not less than once per year, and shall
have authority to observe or have a
third party observe the consent
process and the research.

46.110 Expedited review
procedures for certain kinds of
research involving no more than
minimal risk, and for minor
changes in approved research.

(a) The Secretary has established,
and published in the Federal
Register, a list of categories of
research that may be reviewed by the
IRB through an expedited review
procedure. The list will be amended,
as appropriate, through periodic
republication in the Federal
Register.

(b) An IRB may review some or all
of the research appearing on the list
through an expedited review
procedure, if the research involves no
more than minimal risk. The IRB may
also use the expedited review
procedure to review minor changes in
previously approved research during
the period for which approval is
authorized. Under an expedited
review procedure, the review may be
carried out by the IRB chairperson or
by one or more experienced reviewers
designated by the chairperson from
among members of the IRB. In
reviewing the research, the reviewers
can exercise all of the authorities of
the IRB except that the reviewers may
disapprove the research. A
research activity may be disapproved
only after review in accordance with
the non-expedited procedure set forth
in § 46.108(b).

(c) Each IRB which uses an
expedited review procedure shall
adopt a method for keeping all
members advised of research
proposals which have been approved
under the procedure.

(d) The Secretary may restrict,
suspend, or terminate an institution's
or IRB's use of the expedited review
procedure when necessary to protect
the rights or welfare of subjects.

46.111 Criteria for IRB
approval of research.

(a) In order to approve research
covered by these regulations the IRB
shall determine that all of the
following requirements are satisfied:

(1) Risks to subjects are
minimized: (i) By using procedures
which are consistent with sound
research design and which do not
unnecessarily expose subjects to risk,
and (ii) whenever appropriate, by
using procedures already being
performed on the subjects for
diagnostic or treatment purposes.

(2) Risks to subjects are reasonable
in relation to anticipated benefits, if
any, to subjects, and the importance
of the knowledge that may reasonably
be expected to result. In evaluating
risks and benefits, the IRB should
consider only those risks and benefits
that may result from the research (as
distinguished from risks and benefits
of therapies subjects would receive
even if not participating in the
research). The IRB should not
consider possible long-range effects
of applying knowledge gained in the
research (for example, the possible
effects of the research on public
policy) as among those research risks
that fall within the purview of its
responsibility.

(3) Selection of subjects is
equitable. In making this assessment
the IRB should take into account the
purposes of the research and the
setting in which the research will be
conducted.

(4) Informed consent will be
sought from each prospective subject
or the subject's legally authorized
representative, in accordance with,
and to the extent required by
§ 46.116.

(5) Informed consent will be
appropriately documented, in
accordance with, and to the extent
required by § 46.117.

(6) Where appropriate, the research
plan makes adequate provision for
monitoring the data collected to
insure the safety of subjects.

(7) Where appropriate, there are
adequate provisions to protect the
privacy of subjects and to maintain
the confidentiality of data.

(b) Where some or all of the
subjects are likely to be vulnerable to
corruption or undue influence, such as
persons with acute or severe physical
or mental illness, or persons who are
economically or educationally
disadvantaged, appropriate additional
safeguards have been included in the
study to protect the rights and welfare
of these subjects.

46.112 Review by institution.

Research covered by these
regulations that has been approved by
an IRB may be subject to further
appropriate review and approval or
disapproval by officials of the
institution. However, those officials
may not approve the research if it has
not been approved by an IRB.

46.113 Suspension or
termination of IRB approval of
research.

An IRB shall have authority to
suspend or terminate approval of
research that is not being conducted
in accordance with the IRB's
requirements or that has been
associated with unexpected serious
harm to subjects. Any suspension or
termination of approval shall include
a statement of the reasons for the
IRB's action and shall be reported
promptly to the investigator,
appropriate institutional officials, and
the Secretary.1

1 Reports should be filed with the Office
for Protection from Research Risks, National
Institutes of Health, Department of Health
and Human Services, Bethesda, Maryland
20205.
§ 46.114 Cooperative research.
Cooperative research projects are those projects, normally supported through grants, contracts, or similar arrangements, which involve institutions in addition to the grantee or prime contractor (such as a contractor with the grantee, or a subcontractor with the prime contractor). In such instances, the grantee or prime contractor remains responsible to the Department for safeguarding the rights and welfare of human subjects. Also, when cooperating institutions conduct some or all of the research involving some or all of these subjects, each cooperating institution shall comply with these regulations as though it received funds for its participation in the project directly from the Department, except that in complying with these regulations institutions may use joint review, reliance upon the review of another qualified IRB, or similar arrangements aimed at avoidance of duplication of effort.

§ 46.115 IRB records.
(a) An institution, or where appropriate an IRB, shall prepare and maintain adequate documentation of IRB activities, including the following:
(1) Copies of all research proposals reviewed, scientific evaluations, if any, that accompany the proposals, approved sample consent documents, progress reports submitted by investigators, and reports of injuries to subjects.
(2) Minutes of IRB meetings which shall be in sufficient detail to show attendance at the meetings; actions taken by the IRB; the vote on these actions including the number of members voting for, against, and abstaining; the basis for requiring changes in or disapproving research; and a written summary of the discussion of controverted issues and their resolution.
(3) Records of continuing review activities.
(4) Copies of all correspondence between the IRB and the investigators.
(5) A list of IRB members as required by § 46.103(b)(3).
(6) Written procedures for the IRB as required by § 46.103(b)(4).
(7) Statements of significant new findings provided to subjects, as required by § 46.116(b)(5).
(b) The records required by this regulation shall be retained for at least 3 years after completion of the research, and the records shall be accessible for inspection and copying by authorized representatives of the Department at reasonable times and in a reasonable manner.

§ 46.116 General requirements for informed consent.
Except as provided elsewhere in this or other subparts, no investigator may involve a human being as a subject in research covered by these regulations unless the investigator has obtained the legally effective informed consent of the subject or the subject's legally authorized representative. An investigator shall seek such consent only under circumstances that provide the prospective subject or the representative sufficient opportunity to consider whether or not to participate and that minimize the possibility of coercion or undue influence. The information that is given to the subject or the representative shall be in language understandable to the subject or the representative. No informed consent, whether oral or written, may include any exculpatory language through which the subject or the representative is made to waive or appear to waive any of the subject's legal rights, or releases or appears to release the investigator, the sponsor, the institution or its agents from liability for negligence.

(a) Basic elements of informed consent. Except as provided in paragraph (c) or (d) of this section, in seeking informed consent the following information shall be provided to each subject:
(1) A statement that the study involves research, an explanation of the purposes of the research and the expected duration of the subject's participation, a description of the procedures to be followed, and identification of any procedures which are experimental;
(2) A description of any reasonably foreseeable risks or discomforts to the subject;
(3) A description of any benefits to the subject or to others which may reasonably be expected from the research;
(4) A disclosure of appropriate alternative procedures or courses of treatment, if any, that might be advantageous to the subject;
(5) A statement describing the extent, if any, to which confidentiality of records identifying the subject will be maintained;
(6) For research involving more than minimal risk, an explanation as to whether any compensation and an explanation as to whether any medical treatments are available if injury occurs and, if so, what they consist of, or where further information may be obtained;
(7) An explanation of whom to contact for answers to pertinent questions about the research and research subjects' rights, and whom to contact in the event of a research-related injury to the subject; and
(8) A statement that participation is voluntary, refusal to participate will involve no penalty or loss of benefits to which the subject is otherwise entitled, and the subject may discontinue participation at any time without penalty or loss of benefits to which the subject is otherwise entitled.
(b) Additional elements of informed consent. When appropriate, one or more of the following elements of information shall also be provided to each subject:
§ 46.116 Informed consent.

(a) Except as provided in paragraph (c) of this section, informed consent shall be documented by the use of a written consent form approved by the IRB and signed by the subject or the subject's legally authorized representative. A copy shall be given to the person signing the form.

(b) Except as provided in paragraph (c) of this section, the consent form may be either of the following:

(1) A written consent document that embodies the elements of informed consent set forth above, or waive the requirements to obtain informed consent provided the IRB finds and documents that:

   (i) The research involves no more than minimal risk to the subjects;

   (ii) The waiver or alteration will not adversely affect the rights and welfare of the subjects;

   (iii) The research could not practicably be carried out without the waiver or alteration; and

   (iv) Possible new findings developed during the course of the research which may require additional information to be disclosed in order for informed consent to be legally effective.

(c) An IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either:

(1) That only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject’s wishes will govern; or

(2) That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.

In cases where the documentation requirement is waived, the IRB may require the investigator to provide subjects with a written statement regarding the research.

§ 46.117 Documentation of informed consent.

(a) Except as provided in paragraph (c) of this section, informed consent shall be documented by the use of a written consent form approved by the IRB and signed by the subject or the subject’s legally authorized representative. A copy shall be given to the person signing the form.

(b) Except as provided in paragraph (c) of this section, the consent form may be either of the following:

(1) A written consent document that embodies the elements of informed consent set forth above, or waive the requirements to obtain informed consent provided the IRB finds and documents that:

   (i) The research involves no more than minimal risk to the subjects;

   (ii) The waiver or alteration will not adversely affect the rights and welfare of the subjects;

   (iii) The research could not practicably be carried out without the waiver or alteration; and

   (iv) Possible new findings developed during the course of the research which may require additional information to be disclosed in order for informed consent to be legally effective.

(c) An IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either:

(1) That only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject’s wishes will govern; or

(2) That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.

In cases where the documentation requirement is waived, the IRB may require the investigator to provide subjects with a written statement regarding the research.

§ 46.118 Applications and proposals lacking definite plans for involvement of human subjects.

Certain types of applications for grants, cooperative agreements, or contracts are submitted to the Department with the knowledge that subjects may be involved within the
period of funding, but definite plans would not normally be set forth in the application or proposal. These include activities such as institutional type grants (including bloc grants) where selection of specific projects is the institution's responsibility; research training grants where the activities involving subjects remain to be selected; and projects in which human subjects' involvement will depend upon completion of instruments, prior animal studies, or purification of compounds. These applications need not be reviewed by an IRB before an award may be made. However, except for research described in § 46.101(b), no human subjects may be involved in any project supported by these awards until the project has been reviewed and approved by the IRB, as provided in these regulations, and certification submitted to the Department.

§ 46.119 Research undertaken without the intention of involving human subjects.

In the event research (conducted or funded by the Department) is undertaken without the intention of involving human subjects, but it is later proposed to use human subjects in the research, the research shall first be reviewed and approved by an IRB, as provided in these regulations, a certification submitted to the Department, and final approval given to the proposed change by the Department.

§ 46.120 Evaluation and disposition of applications and proposals.

(a) The Secretary will evaluate all applications and proposals involving human subjects submitted to the Department through such officers and employees of the Department and such experts and consultants as the Secretary determines to be appropriate. This evaluation will take into consideration the risks to the subjects, the adequacy of protection against these risks, the potential benefits of the proposed research to the subjects and others, and the importance of the knowledge to be gained.

(b) On the basis of this evaluation, the Secretary may approve or disapprove the application or proposal, or enter into negotiations to develop an approvable one.

§ 46.121 Investigational new drug or device 30-day delay requirement.

When an institution is required to prepare or to submit a certification with an application or proposal under these regulations, and the application or proposal involves an investigational new drug (within the meaning of 21 U.S.C. 355(i) or 357(d)) or a significant risk device (as defined in 21 CFR 812.3(m)), the institution shall identify the drug or device in the certification. The institution shall also state whether the 30-day interval required for investigational new drugs by 21 CFR 312.1(a) and for significant risk devices by 21 CFR 812.30 has elapsed, or whether the Food and Drug Administration has waived that requirement. If the 30-day interval has expired, the institution shall state whether the Food and Drug Administration has requested that the sponsor continue to withhold or restrict the use of the drug or device in human subjects. If the 30-day interval has not expired, and a waiver has not been received, the institution shall send a statement to the Department upon expiration of the interval. The Department will not consider a certification acceptable until the institution has submitted a statement that the 30-day interval has elapsed, and the Food and Drug Administration has not requested it to limit the use of the drug or device, or that the Food and Drug Administration has waived the 30-day interval.

§ 46.122 Use of Federal funds.

Federal funds administered by the Department may not be expended for research involving human subjects unless the requirement of these regulations, including all subparts of these regulations, have been satisfied.

§ 46.123 Early termination of research funding; evaluation of subsequent applications and proposals.

(a) The Secretary may require that Department funding for any project be terminated or suspended in the manner prescribed in applicable program requirements, when the Secretary finds an institution has materially failed to comply with the terms of these regulations.

(b) In making decisions about funding applications or proposals covered by these regulations the Secretary may take into account, in addition to all other eligibility requirements and program criteria, factors such as whether the applicant has been subject to a termination or suspension under paragraph (a) of this section and whether the applicant or the person who would direct the scientific and technical aspects of an activity has in the judgment of the Secretary materially failed to discharge responsibility for the protection of the rights and welfare of human subjects (whether or not Department funds were involved).

§ 46.124 Conditions.

With respect to any research project or any class of research projects the Secretary may impose additional conditions prior to or at the time of funding when in the Secretary's judgment additional conditions are necessary for the protection of human subjects.

Subpart B—Additional Protections Pertaining to Research Development, and Related Activities Involving Fetuses, Pregnant Women, and Human in Vitro Fertilization


§ 46.201 Applicability.

(a) The regulations in this subpart are applicable to all Department of Health, Education, and Welfare
The fetus, pregnant women, and (3) human in vitro fertilization.

(b) Nothing in this subpart shall be construed as indicating that compliance with the procedures set forth herein will in any way render inapplicable pertinent State or local laws bearing upon activities covered by this subpart.

(c) The requirements of this subpart are in addition to those imposed under the other subparts of this part.

§ 46.202 Purpose.
It is the purpose of this subpart to provide additional safeguards in reviewing activities to which this subpart is applicable to assure that they conform to appropriate ethical standards and relate to important societal needs.

§ 46.203 Definitions.
As used in this subpart:

(a) "Secretary" means the Secretary of Health, Education, and Welfare and any other officer or employee of the Department of Health, Education, and Welfare to whom authority has been delegated.

(b) "Pregnancy" encompasses the period of time from confirmation of implantation (through any of the presumptive signs of pregnancy, such as missed menses, or by a medically acceptable pregnancy test), until expulsion or extraction of the fetus.

(c) "Fetus" means the product of conception from the time of implantation (as evidenced by any of the presumptive signs of pregnancy, such as missed menses, or a medically acceptable pregnancy test), until a determination is made, following expulsion or extraction of the fetus, that it is viable.

(d) "Viable" as it pertains to the fetus means being able, after either spontaneous or induced delivery, to survive (given the benefit of available medical therapy) to the point of independently maintaining heartbeat and respiration. The Secretary may from time to time, taking into account medical advances, publish in the Federal Register guidelines to assist in determining whether a fetus is viable for purposes of this subpart. If a fetus is viable after delivery, it is a premature infant.

(e) "Nonviable fetus" means a fetus ex utero which, although living, is not viable.

(f) "Dead fetus" means a fetus ex utero which exhibits neither heartbeat, spontaneous respiratory activity, spontaneous movement of voluntary muscles, nor pulsation of the umbilical cord (if still attached).

(g) "In vitro fertilization" means any fertilization of human ova which occurs outside the body of a female, either through admixture of donor human sperm and ova or by any other means.

§ 46.204 Ethical Advisory Boards.

(a) One or more Ethical Advisory Boards shall be established by the Secretary. Members of these board(s) shall be so selected that the board(s) will be competent to deal with medical, legal, social, ethical, and related issues and may include, for example, research scientists, physicians, psychologists, sociologists, educators, lawyers, and ethicists, as well as representatives of the general public. No board member may be a regular, full-time employee of the Department of Health, Education, and Welfare.

(b) At the request of the Secretary, the Ethical Advisory Board shall render advice consistent with the policies and requirements of this Part as to ethical issues, involving activities covered by this subpart, raised by individual applications or proposals. In addition, upon request by the Secretary, the Board shall render advice as to classes of applications or proposals and general policies, guidelines, and procedures.

(c) A Board may establish, with the approval of the Secretary, classes of applications or proposals which:

(1) Must be submitted to the Board, or (2) need not be submitted to the Board. Where the Board so establishes a class of applications or proposals which must be submitted, no application or proposal within the class may be funded by the Department or any component thereof until the application or proposal has been reviewed by the Board and the Board has rendered advice as to its acceptability from an ethical standpoint.

(d) No application or proposal involving human in vitro fertilization may be funded by the Department or any component thereof until the application or proposal has been reviewed by the Ethical Advisory Board and the Board has rendered advice as to its acceptability from an ethical standpoint.

§ 46.205 Additional duties of the Institutional Review Boards in connection with activities involving fetuses, pregnant women, or human in vitro fertilization.

(a) In addition to the responsibilities prescribed for Institutional Review Boards under Subpart A of this part, the applicant's or offeror's Board shall, with respect to activities covered by this subpart, carry out the following additional duties:

(1) Determine that all aspects of the activity meet the requirements of this subpart;

(2) Determine that adequate consideration has been given to the manner in which potential subjects will be selected, and adequate provision has been made by the applicant or offeror for monitoring the actual informed consent process (e.g., through such mechanisms, when appropriate, as participation by the Institutional Review Board or subject advocates in: (i) Overseeing the actual process by which individual consents required by this subpart are secured either by approving induction of each individual into the activity or
verifying, perhaps through sampling, that approved procedures for induction of individuals into the activity are being followed, and (ii) monitoring the progress of the activity and intervening as necessary through such steps as visits to the activity site and continuing evaluation to determine if any unanticipated risks have arisen);

(3) Carry out such other responsibilities as may be assigned by the Secretary.

(b) No award may be issued until the applicant or offeror has certified to the Secretary that the Institutional Review Board has made the determinations required under paragraph (a) of this section and the Secretary has approved these determinations, as provided in §46.120 of Subpart A of this part.

(c) Applicants or offerors seeking support for activities covered by this subpart must provide for the designation of an Institutional Review Board, subject to approval by the Secretary, where no such Board has been established under Subpart A of this part.

§46.206 General limitations.
(a) No activity to which this subpart is applicable may be undertaken unless:
(1) Appropriate studies on animals and nonpregnant individuals have been completed;
(2) Except where the purpose of the activity is to meet the health needs of the mother or the particular fetus, the risk to the fetus is minimal and, in all cases, is the least possible risk for achieving the objectives of the activity.
(3) Individuals engaged in the activity will have no part in: (i) Any decisions as to the timing, method, and procedures used to terminate the pregnancy, and (ii) determining the viability of the fetus at the termination of the pregnancy; and
(4) No procedural changes which may cause greater than minimal risk to the fetus or the pregnant woman will be introduced into the procedure for terminating the pregnancy solely in the interest of the activity.

(b) No inducements, monetary or otherwise, may be offered to terminate pregnancy for purposes of the activity.

[40 FR 33528, Aug. 8, 1975, as amended at 40 FR 51638, Nov. 6, 1975]

§46.207 Activities directed toward pregnant women as subjects.

(a) No pregnant woman may be involved as a subject in an activity covered by this subpart unless: (1) The purpose of the activity is to meet the health needs of the mother and the fetus will be placed at risk only to the minimum extent necessary to meet such needs, or (2) the risk to the fetus is minimal.

(b) An activity permitted under paragraph (a) of this section may be conducted only if the mother and father are legally competent and have given their informed consent, except that the father's consent need not be secured if: (1) His identity or whereabouts cannot reasonably be ascertained, (2) he is not reasonably available, or (3) the pregnancy resulted from rape.

§46.208 Activities directed toward fetuses in utero as subjects.

(a) No fetus in utero may be involved as a subject in any activity covered by this subpart unless: (1) The purpose of the activity is to meet the health needs of the mother and the fetus will be placed at risk only to the minimum extent necessary to meet such needs, or (2) the risk to the fetus imposed by the research is minimal and the purpose of the activity is the development of important biomedical knowledge which cannot be obtained by other means.

(b) An activity permitted under paragraph (a) of this section may be conducted only if the mother and father are legally competent and have given their informed consent, except that the father's consent need not be secured if: (1) His identity or whereabouts cannot reasonably be ascertained, (2) he is not reasonably available, or (3) the pregnancy resulted from rape.

§46.209 Activities directed toward fetuses ex utero, including nonviable fetuses, as subjects.

(a) Until it has been ascertained whether or not a fetus ex utero is viable, a fetus ex utero may not be involved as a subject in an activity covered by this subpart unless:
(1) There will be no added risk to the fetus resulting from the activity, and the purpose of the activity is the development of important biomedical knowledge which cannot be obtained by other means, or
(2) The purpose of the activity is to enhance the possibility of survival of the particular fetus to the point of viability.

(b) No nonviable fetus may be involved as a subject in an activity covered by this subpart unless:
(1) Vital functions of the fetus will not be artificially maintained,
(2) Experimental activities which of themselves would terminate the heartbeat or respiration of the fetus will not be employed, and
(3) The purpose of the activity is the development of important biomedical knowledge which cannot be obtained by other means.

(c) In the event the fetus ex utero is found to be viable, it may be included as a subject in the activity only to the extent permitted by and in accordance with the requirements of other subparts of this part.

(d) An activity permitted under paragraph (a) or (b) of this section may be conducted only if the mother and father are legally competent and have given their informed consent, except that the father's informed consent need not be secured if: (1) His identity or whereabouts cannot reasonably be ascertained, (2) he is
not reasonably available, or (3) the pregnancy resulted from rape.

§ 46.210 Activities Involving the dead fetus, fetal material, or the placenta.
Activities involving the dead fetus, macerated fetal material, or cells, tissue, or organs excised from a dead fetus shall be conducted only in accordance with any applicable State or local laws regarding such activities.

§ 46.211 Modification or waiver of specific requirements.
Upon the request of an applicant or offeror (with the approval of its Institutional Review Board), the Secretary may modify or waive specific requirements of this subpart, with the approval of the Ethical Advisory Board after such opportunity for public comment as the Ethical Advisory Board considers appropriate in the particular instance. In making such decisions, the Secretary will consider whether the risks to the subject are so outweighed by the sum of the benefit to the subject and the importance of the knowledge to be gained as to warrant such modification or waiver and that such benefits cannot be gained except through a modification or waiver. Any such modifications or waivers will be published as notices in the Federal Register.

Subpart C—Additional Protections Pertaining to Biomedical and Behavioral Research Involving Prisoners as Subjects
Source: 43 FR 53655, Nov 16, 1978

§ 46.301 Applicability.
(a) The regulations in this subpart are applicable to all biomedical and behavioral research conducted or supported by the Department of Health, Education, and Welfare involving prisoners as subjects.
(b) Nothing in this subpart shall be construed as indicating that compliance with the procedures set forth herein will authorize research involving prisoners as subjects, to the extent such research is limited or barred by applicable State or local law.
(c) The requirements of this subpart are in addition to those imposed under the other subparts of this part.

§ 46.302 Purpose.
Inasmuch as prisoners may be under constraints because of their incarceration which could affect their ability to make a truly voluntary and uncoerced decision whether or not to participate as subjects in research, it is the purpose of this subpart to provide additional safeguards for the protection of prisoners involved in activities to which this subpart is applicable.

§ 46.303 Definitions.
As used in this subpart:
(a) "Secretary" means the Secretary of Health, Education, and Welfare and any other officer or employee of the Department of Health, Education, and Welfare to whom authority has been delegated.
(b) "DHEW" means the Department of Health, Education, and Welfare.
(c) "Prisoner" means any individual involuntarily confined or detained in a penal institution. The term is intended to encompass individuals sentenced to such an institution under a criminal or civil statute, individuals detained in other facilities by virtue of statutes or commitment procedures which provide alternatives to criminal prosecution or incarceration in a penal institution, and individuals detained pending arraignment, trial, or sentencing.
(d) "Minimal risk" is the probability and magnitude of physical or psychological harm that is normally encountered in the daily lives, or in the routine medical, dental, or psychological examination of healthy persons.

§ 46.304 Composition of Institutional Review Boards where prisoners are involved.
In addition to satisfying the requirements in § 46.107 of this part, an Institutional Review Board, carrying out responsibilities under this part with respect to research covered by this subpart, shall also meet the following specific requirements:
(a) A majority of the Board (exclusive of prisoner members) shall have no association with the prison(s) involved, apart from their membership on the Board.
(b) At least one member of the Board shall be a prisoner, or a prisoner representative with appropriate background and experience to serve in that capacity, except that where a particular research project is reviewed by more than one Board only one Board need satisfy this requirement.

§ 46.305 Additional duties of the Institutional Review Boards where prisoners are involved.
(a) In addition to all other responsibilities prescribed for Institutional Review Boards under this part, the Board shall review research covered by this subpart and approve such research only if it finds that:
(1) The research under review represents one of the categories of research permissible under § 46.306(a)(2);
(2) Any possible advantages accruing to the prisoner through his or her participation in the research, when compared to the general living conditions, medical care, quality of food, amenities and opportunity for earnings in the prison, are not of such a magnitude that his or her ability to weigh the risks of the research against the value of such advantages in the limited choice environment of the prison is impaired;
(3) The risks involved in the research are commensurate with risks that would be accepted by nonprisoner volunteers;
(4) Procedures for the selection of subjects within the prison are fair to
all prisoners and immune from arbitrary intervention by prison authorities or prisoners. Unless the principal investigator provides to the Board justification in writing for following some other procedures, control subjects must be selected randomly from the group of available prisoners who meet the characteristics needed for that particular research project;

(5) The information is presented in language which is understandable to the subject population;

(6) Adequate assurance exists that parole boards will not take into account a prisoner's participation in the research in making decisions regarding parole, and each prisoner is clearly informed in advance that participation in the research will have no effect on his or her parole; and

(7) Where the Board finds there may be a need for follow-up examination or care of participants after the end of their participation, adequate provision has been made for such examination or care, taking into account the varying lengths of individual prisoners' sentences, and for informing participants of this fact.

(b) The Board shall carry out such other duties as may be assigned by the Secretary.

(c) The institution shall certify to the Secretary, in such form and manner as the Secretary may require, that the duties of the Board under this section have been fulfilled.

§ 46.306 Permitted research involving prisoners.

(a) Biomedical or behavioral research conducted or supported by DHEW may involve prisoners as subjects only if:

(1) The institution responsible for the conduct of the research has certified to the Secretary that the Institutional Review Board has approved the research under § 46.305 of this subpart; and

(2) In the judgment of the Secretary the proposed research involves solely the following:

(A) Study of the possible causes, effects, and processes of incarceration, and of criminal behavior, provided that the study presents no more than minimal risk and no more than inconvenience to the subjects;

(B) Study of prisons as institutional structures or of prisoners as incarcerated persons, provided that the study presents no more than minimal risk and no more than inconvenience to the subjects;

(C) Research on conditions particularly affecting prisoners as a class (for example, vaccine trials and other research on hepatitis which is much more prevalent in prisons than elsewhere; and research on social and psychological problems such as alcoholism, drug addiction and sexual assaults) provided that the study may proceed only after the Secretary has consulted with appropriate experts including experts in penology medicine and ethics, and published notice, in the FEDERAL REGISTER, of his intent to approve such research; or

(D) Research on practices, both innovative and accepted, which have the intent and reasonable probability of improving the health or well-being of the subject. In cases in which those studies require the assignment of prisoners in a manner consistent with protocols approved by the IRB to control groups which may not benefit from the research, the study may proceed only after the Secretary has consulted with appropriate experts, including experts in penology medicine and ethics, and published notice, in the FEDERAL REGISTER, of his intent to approve such research.

(b) Except as provided in paragraph (a) of this section, biomedical or behavioral research conducted or supported by DHEW shall not involve prisoners as subjects.

Subpart D—Additional Protections for Children Involved as Subjects in Research.

Source: 48 FR 9818, March 8, 1983

§ 46.401 To what do these regulations apply?

(a) This subpart applies to all research involving children as subjects, conducted or supported by the Department of Health and Human Services.

(1) This includes research conducted by Department employees, except that each head of an Operating Division of the Department may adopt, such nonsubstantive, procedural modifications as may be appropriate from an administrative standpoint.

(2) It also includes research conducted or supported by the Department of Health and Human Services outside the United States, but in appropriate circumstances, the Secretary may, under paragraph (e) of § 46.101 of Subpart A, waive the applicability of some or all of the requirements of these regulations for research of this type.

(b) Exemptions (1), (2), (5) and (6) as listed in Subpart A at § 46.101(b) are applicable to this subpart.

Exemption (4), research involving the observation of public behavior, listed at § 46.101(b), is applicable to this subpart where the investigator(s) does not participate in the activities being observed. Exemption (3), research involving survey or interview procedures, listed at § 46.101(b) does not apply to research covered by this subpart.

(c) The exceptions, additions, and provisions for waiver as they appear in paragraphs (c) through (i) of § 46.101 of Subpart A are applicable to this subpart.

§ 46.402 Definitions.

The definitions in § 46.102 of Subpart A shall be applicable to this subpart as well. In addition, as used in this subpart:
(a) "Children" are persons who have not attained the legal age for consent to treatments or procedures involved in the research, under the applicable law of the jurisdiction in which the research will be conducted.

(b) "Assent" means a child's affirmative agreement to participate in research. Mere failure to object should not, absent affirmative agreement, be construed as assent.

(c) "Permission" means the agreement of parent(s) or guardian to the participation of their child or ward in research.

(d) "Parent" means a child's biological or adoptive parent.

(e) "Guardian" means an individual who is authorized under applicable state or local law to consent on behalf of a child to general medical care.

§ 46.403 IRB duties.

In addition to other responsibilities assigned to IRBs under this part, each IRB shall review research covered by this subpart and approve only research which satisfies the conditions of all applicable sections of this subpart.

§ 46.404 Research not involving greater than minimal risk.

HHS will conduct or fund research in which the IRB finds that no greater than minimal risk to children is presented, only if the IRB finds that adequate provisions are made for soliciting the assent of the children and the permission of their parents or guardians, as set forth in § 46.408.

§ 46.405 Research involving greater than minimal risk but presenting the prospect of direct benefit to the individual subjects.

HHS will conduct or fund research in which the IRB finds that more than minimal risk to children is presented by an intervention or procedure that holds out the prospect of direct benefit for the individual subject, or by a monitoring procedure that is likely to contribute to the subject's well-being only if the IRB finds that:

(a) The risk is justified by the anticipated benefit to the subjects;

(b) The relation of the anticipated benefit to the risk is at least as favorable to the subjects as that presented by available alternative approaches; and

(c) Adequate provisions are made for soliciting the assent of the children and permission of their parents or guardians, as set forth in § 46.408.

§ 46.406 Research involving greater than minimal risk and no prospect of direct benefit to individual subjects, but likely to yield generalizable knowledge about the subject's disorder or condition.

HHS will conduct or fund research in which the IRB finds that more than minimal risk to children is presented by an intervention or procedure that does not hold out the prospect of direct benefit for the individual subject, or by a monitoring procedure which is not likely to contribute to the well-being of the subject, only if the IRB finds that:

(a) The risk represents a minor increase over minimal risk;

(b) The intervention or procedure presents experiences to subjects that are reasonably commensurate with those inherent in their actual or expected medical, dental, psychological, social, or educational situations;

(c) The intervention or procedure is likely to yield generalizable knowledge about the subjects' disorder or condition which is of vital importance for the understanding or amelioration of the subjects' disorder or condition; and

(d) Adequate provisions are made for soliciting assent of the children and permission of their parents or guardians, as set forth in § 46.408.

§ 46.407 Research not otherwise approvable which presents an opportunity to understand, prevent, or alleviate a serious problem affecting the health or welfare of children.

HHS will conduct or fund research that the IRB does not believe meets the requirements of §§ 46.404, 46.405, or 46.406 only if:

(a) The IRB finds that the research presents a reasonable opportunity to further the understanding, prevention, or alleviation of a serious problem affecting the health or welfare of children; and

(b) The Secretary, after consultation with a panel of experts in pertinent disciplines (for example: science, medicine, education, ethics, law) and following opportunity for public review and comment, has determined either: (1) That the research in fact satisfies the conditions of §§ 46.404, 46.405, or 46.406, as applicable, or (2) the following:

(i) The research presents a reasonable opportunity to further the understanding, prevention, or alleviation of a serious problem affecting the health or welfare of children;

(ii) The research will be conducted in accordance with sound ethical principles;

(iii) Adequate provisions are made for soliciting the assent of children and the permission of their parents or guardians, as set forth in § 46.408.

§ 46.408 Requirements for permission by parents or guardians and for assent by children.

(a) In addition to the determinations required under other applicable sections of this subpart, the IRB shall determine that adequate provisions are made for soliciting the assent of the children, when in the judgment of the IRB the children are capable of providing assent. In determining whether children are capable of assenting, the IRB shall take into account the ages, maturity, and psychological state of the children involved. This judgment
may be made for all children to be involved in research under a particular protocol, or for each child, as the IRB deems appropriate. If the IRB determines that the capability of some or all of the children is so limited that they cannot reasonably be consulted or that the intervention or procedure involved in the research holds out a prospect of direct benefit that is important to the health or well-being of the children and is available only in the context of the research, the assent of the children is not a necessary condition for proceeding with the research. Even where the IRB determines that the subjects are capable of assenting, the IRB may still waive the assent requirement under circumstances in which consent may be waived in accord with § 46.116 of Subpart A.

(b) In addition to the determinations required under other applicable sections of this subpart, the IRB shall determine, in accordance with and to the extent that consent is required by § 46.116 of Subpart A, that adequate provisions are made for soliciting the permission of each child's parents or guardian. Where parental permission is to be obtained, the IRB may find that the permission of one parent is sufficient for research to be conducted under §§ 46.404 or 46.405. Where research is covered by §§ 46.406 and 46.407 and permission is to be obtained from parents, both parents must give their permission unless one parent is deceased, unknown, incompetent, or not reasonably available, or when only one parent has legal responsibility for the care and custody of the child.

§ 46.409 Wards.
(a) Children who are wards of the state or any other agency, institution, or entity can be included in research approved under §§ 46.406 or 46.407 only if such research is:

1. Related to their status as wards;
   or

2. Conducted in schools, camps, hospitals, institutions, or similar settings in which the majority of children involved as subjects are not wards.

(b) If the research is approved under paragraph (a) of this section, the IRB shall require appointment of an advocate for each child who is a ward, in addition to any other individual acting on behalf of the child as guardian or in loco parentis. One individual may serve as advocate for more than one child. The advocate shall be an individual who has the background and experience to act in, and agrees to act in, the best interests of the child for the duration of the child's participation in the research and who is not associated in any way (except in the role as advocate or member of the IRB) with the research, the investigator(s), or the guardian organization.
HUMAN SUBJECTS
Minimum Criteria Identifying the Viable Fetus

On March 13, 1975, regulations were published in the FEDERAL REGISTER (40 FR 11854) relating to the protection of human subjects in research, development, and related activities supported by Department of Health, Education, and Welfare grants and contracts. These regulations are codified at 45 CFR Part 46.

Elsewhere in this issue of the FEDERAL REGISTER, the Secretary is amending 45 CFR Part 46 by, among other things, adding a new Subpart B to provide additional protections pertaining to research, development, and related activities involving fetuses, pregnant women, and in vitro fertilization.

Section 46.203(d) of Subpart B provides inter alia as follows:

The Secretary may from time to time, taking into account medical advances, publish in the FEDERAL REGISTER guidelines to assist in determining whether a fetus is viable for purposes of this subpart.

This notice is published in accordance with §46.203(d). For purposes of Subpart B, the guidelines indicating that a fetus other than a dead fetus within the meaning of §46.203(f) is viable include the following:

an estimated gestational age of 20 weeks or more and a body weight of 500 grams or more.

FEDERAL REGISTER, VOL 40, AUGUST 8, 1975
RESEARCH ACTIVITIES WHICH MAY BE REVIEWED THROUGH EXPEDITED REVIEW PROCEDURES

Research activities involving no more than minimal risk and in which the only involvement of human subjects will be in one or more of the following categories (carried out through standard methods) may be reviewed by the Institutional Review Board through the expedited review procedure authorized in 46.110 of 45 CFR Part 46.

(1) Collection of: hair and nail clippings, in a nondisfiguring manner; deciduous teeth; and permanent teeth if patient care indicates a need for extraction.

(2) Collection of excreta and external secretions including sweat, unoccluded saliva, placenta removed at delivery, and amniotic fluid at the time of rupture of the membrane prior to or during labor.

(3) Recording of data from subjects 18 years of age or older using noninvasive procedures routinely employed in clinical practice. This includes the use of physical sensors that are applied either to the surface of the body or at a distance and do not involve input of matter or significant amounts of energy into the subject or an invasion of the subject's privacy. It also includes such procedures as weighing, testing sensory acuity, electrocardiography, electroencephalography, thermography, detection of naturally occurring radioactivity, diagnostic echography, and electroretinography. It does not include exposure to electromagnetic radiation outside the visible range (for example, x-rays, microwaves).

(4) Collection of blood samples by venipuncture, in amounts not exceeding 450 milliliters in an eight-week period and no more often than two times per week, from subjects 18 years of age or older and who are in good health and not pregnant.

(5) Collection of both supra- and subgingival dental plaque and calculus, provided the procedure is not more invasive than routine prophylactic scaling of the teeth and the process is accomplished in accordance with accepted prophylactic techniques.

(6) Voice recordings made for research purposes such as investigations of speech defects.

(7) Moderate exercise by healthy volunteers.

(8) The study of existing data, documents, records, pathological specimens, or diagnostic specimens.

(9) Research on individual or group behavior or characteristics of individuals, such as studies of perception, cognition, game theory, or test development, where the investigator does not manipulate subjects' behavior and the research will not involve stress to subjects.

(10) Research on drugs or devices for which an investigational new drug exemption or an investigational device exemption is not required.
HUMAN RESEARCH POLICY
AND
PROCEDURES FOR SPACE FLIGHT INVESTIGATIONS

PREPARED BY: Medical Sciences Division

APPROVED BY: S. L. Pool, M.D.
Chief, Medical Sciences Division

APPROVED BY: L. J. Dietlein, M.D.
Assistant Director for Life Sciences

CONCURRED BY: C. L. Huntoon, Ph.D.
Director, Space and Life Sciences

CONCURRED BY: Donald R. Puddy
Director, Flight Crew Operations

Date: October 1987

22 Oct 87

26 Oct 1987

Nov 30, 1987

JANUARY 29, 1988

Revision Date Approval Pages

SD SA Reissue
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2.0</td>
<td>WORKING PRINCIPLES FOR THE HRPPC</td>
<td>2-4</td>
</tr>
<tr>
<td>3.0</td>
<td>PROCEDURES AND REQUIREMENTS FOR INVESTIGATORS</td>
<td>4-10</td>
</tr>
<tr>
<td>4.0</td>
<td>APPENDIX 1 - Examples of Research Activities Involving No More Than Minimal Risk</td>
<td>11-12</td>
</tr>
<tr>
<td>5.0</td>
<td>APPENDIX 2 - Human Research Master Protocol</td>
<td>13-19</td>
</tr>
<tr>
<td>6.0</td>
<td>APPENDIX 3 - Training Protocol</td>
<td>20-21</td>
</tr>
<tr>
<td>7.0</td>
<td>APPENDIX 4 - NASA Human Research Minimal Risk Informed Consent Form</td>
<td>22-23</td>
</tr>
<tr>
<td>8.0</td>
<td>APPENDIX 5 - NASA Human Research Reasonable Risk Informed Consent Form</td>
<td>24-25</td>
</tr>
<tr>
<td>9.0</td>
<td>APPENDIX 6 - Guidelines Relative to Use of Experimental Animals During Preflight Crew Training</td>
<td>26-29</td>
</tr>
<tr>
<td>10.0</td>
<td>APPENDIX 7 - Guidelines Relative to Use of Experimental Animals During Crew Training Simulations Utilizing the Flight Research Animal Holding Facility (RAHF) and General Purpose Work Station (GPWS), Altitude Chamber Simulations (Closed Environments), and Actual Spaceflight</td>
<td>30-36</td>
</tr>
<tr>
<td>11.0</td>
<td>APPENDIX 8 - Guidelines for Radionuclide Use in Shuttle Payloads</td>
<td>37-39</td>
</tr>
<tr>
<td>12.0</td>
<td>APPENDIX 9 - Food And Drug Administration Forms</td>
<td>40-46</td>
</tr>
<tr>
<td>ACRONYMS AND ABBREVIATIONS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAALAC</td>
<td>American Association for Acceleration of Laboratory Animals</td>
<td></td>
</tr>
<tr>
<td>AALAS</td>
<td>American Association of Laboratory Animal Science</td>
<td></td>
</tr>
<tr>
<td>CDR</td>
<td>Commander</td>
<td></td>
</tr>
<tr>
<td>Co-PI</td>
<td>Co-Principal Investigator</td>
<td></td>
</tr>
<tr>
<td>DSU</td>
<td>Detailed Supplemental Objective</td>
<td></td>
</tr>
<tr>
<td>FAA</td>
<td>Federal Aviation Administration</td>
<td></td>
</tr>
<tr>
<td>FDA</td>
<td>Federal Drug Administration</td>
<td></td>
</tr>
<tr>
<td>GPWS</td>
<td>General Purpose Work Station</td>
<td></td>
</tr>
<tr>
<td>HRPPC</td>
<td>Human Research Policy and Procedures Committee</td>
<td></td>
</tr>
<tr>
<td>INDI</td>
<td>Investigational New Drug</td>
<td></td>
</tr>
<tr>
<td>IRB</td>
<td>Institutional Review Board</td>
<td></td>
</tr>
<tr>
<td>JSC</td>
<td>Johnson Space Center</td>
<td></td>
</tr>
<tr>
<td>MS</td>
<td>Mission Specialist</td>
<td></td>
</tr>
<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
<td></td>
</tr>
<tr>
<td>PI</td>
<td>Principal Investigator</td>
<td></td>
</tr>
<tr>
<td>PLT</td>
<td>Pilot</td>
<td></td>
</tr>
<tr>
<td>PS</td>
<td>Payload Specialist</td>
<td></td>
</tr>
<tr>
<td>RAHF</td>
<td>Research Animal Holding Facility</td>
<td></td>
</tr>
<tr>
<td>SMRB</td>
<td>Science Management Review Board</td>
<td></td>
</tr>
<tr>
<td>SPF</td>
<td>Specific Pathogen Free</td>
<td></td>
</tr>
<tr>
<td>SR&amp;QA</td>
<td>Safety Reliability and Quality Assurance</td>
<td></td>
</tr>
<tr>
<td>STS</td>
<td>Space Transportation System</td>
<td></td>
</tr>
</tbody>
</table>
1.0 INTRODUCTION

All flight investigations, domestic or foreign, involving human subjects which are funded, sponsored, or implemented by National Aeronautics and Space Administration (NASA), conducted in NASA facilities, aircraft or spacecraft, or which involve NASA participation to any degree, must be approved by the NASA-Johnson Space Center (JSC), Human Research Policy and Procedures Committee (HRPPC). The authority for this requirement is NMI 7100.8A and implementing NASA/JSC policy instructions. The HRPPC has the responsibility for ensuring the medical safety, health, and well-being of all human subjects in all pre-flight, inflight, and postflight activities and early supporting ground-based investigations associated with human flight experiments or Detailed Supplemental Objectives (DSOs). This responsibility extends to human investigative roles whether as subject or operator (experimenter).

The responsibility of HRPPC also includes all JSC human investigations, whether conducted on site or off site (e.g., medical centers, hospitals, etc.), in which JSC personnel participate as subjects, Principal Investigators (PIs) or Co-Principal Investigators (Co-PIs). JSC-funded human research at all other institutions in which no JSC personnel participation is directly involved, shall be reviewed by the Institutional Review Board (IRB) of the institution performing the research as prescribed in the JSC procurement document (see article G, JSCM 5100A, Rev. 14). It is recognized that some institutions will require that their own IRB also review the use of flight personnel as test subjects at their institutions. Such a review does not supplant the review by the JSC/HRPPC. This duplication of effort is unavoidable, because two different sets of requirements must be met.
This issuance is designed to detail the documentation requirements and the basis for these requirements in order to facilitate the approval process and allow the investigators to devote their energies to the conduct of their studies. The Committee has learned from past experience that providing the required documentation can be somewhat difficult; however, failure on the part of the PI to provide appropriate documentation in a usable form can lead to disapproval of some experimental protocols, disruption of training schedules, and unnecessary loss of time. Therefore, the Committee urges all persons associated with human research to adhere to the letter and spirit of the requirements set forth in this document.

2.0 WORKING PRINCIPLES FOR THE HRPPC

A. Ensuring the health, well-being, and safety of human research subjects is the fundamental basis for the entire process. The Committee approves only those investigations involving "minimal" or "reasonable risk." "Minimal risk" means that the harm or discomfort anticipated in the proposed research is not greater, considering probability and magnitude, than that encountered in the daily lives of healthy individuals, including the recognized risks inherent in a chosen occupation, such as spaceflight and ground support. Examples of "minimal risk" are found in Appendix 1. "Reasonable risk" means that the risks of harm anticipated in the proposed research are greater than those ordinarily encountered in daily life or during the performance of routine tests, but considered to be proper when weighed against the anticipated benefits or importance of the knowledge to be gained from the research.

B. The HRPPC does not duplicate the efforts of the Space Transportation System (STS) Payload Safety Review Panel in its review of inflight equipment or the efforts of Safety, Reliability and Quality Assurance (SRQA) in its
review of ground-based equipment, but the Committee does require documentation of such safety analyses.

C. Space flight personnel are viewed in the special light of their involvement in a mission. They will, on many occasions, act as test subjects or operators of tests in an environment potentially involving more risk than that on Earth due to the unusual aspects of space flight such as microgravity, alterations in atmospheric composition and pressure, multiple tasks being performed by a single subject, confined living conditions, timeline constraints, and remoteness from medical surveillance. Because of these factors, a more vigorous review process is required for spaceflight experiments than for similar ground-based investigations.

D. Protocols submitted to this Committee are of two types: Master and Training. A Master Protocol consists of a detailed description of all aspects of an investigation and is used for Spacelab studies, mid-deck experiments, Detailed Supplemental Objectives (USUs), and ground-based investigations. The Master Protocol is the first document to be submitted to the Committee for approval. A Training Protocol consists of a detailed description of the activities of a specific training tour and will generally be used only by Spacelab investigators. It will include objectives of the specific tour as well as a daily schedule of the training procedures (protocols) and equipment to be used. The basis for this requirement is that Spacelab life sciences experiments are expected to be evolutionary in nature; the experiences from training tours and baseline data collections are expected to mandate changes in protocols. Therefore, the HRPPC requires that the exact protocol for each training tour/baseline data collection be reviewed and approved on a tour-by-tour basis. Training protocol approvals in any event are valid for only a
12-month period. The PI must submit a statement to the HRPPC 30 days prior to the expiration of the 12-month period that no changes have been made and request an approval renewal.

E. Although ground-based training/baseline data collections are likely to involve less risk than in-flight experiments, the HRPPC requires that the rigor and discipline necessary for space flight experimentation be instituted to the extent possible during the ground-based phases to ensure familiarity with these procedures during flight.

F. The Committee meets regularly in executive session and utilizes written documentation exclusively in its evaluation of protocols. Verbal assurances or explanations are not acceptable.

G. All members of the HRPPC are voting members. The Chairman will vote only in the event of a tie. A member will abstain from voting only in case of conflict of interest. A quorum of the Committee shall consist of the Chairperson and six additional members. Members of the Committee will include six life scientists appointed by the Chairperson (including a secretary-recorder), and a representative from each of the following organizations: Chief Counsel; Director of Safety, Reliability and Quality Assurance; and the Astronaut Office. The Committee will also include one "lay" or non-life sciences member and one non-NASA, full-time, federal employee. Up to three ad hoc members in specialized disciplines may be added to the Committee on a temporary basis as deemed appropriate by the Chairperson.

3.0 PROCEDURES AND REQUIREMENTS FOR INVESTIGATIONS

A. Investigators shall provide to the Committee 20 loose-leaf copies of a complete Master Protocol of preflight, in-flight, and postflight activities.
(For Spacelab studies, these should be routed through the Mission Manager.) Master Protocols should be submitted no later than 6 months prior to a mission, for original approval. The format presented in Appendix 2 shall be employed. It is designed to elicit efficiently the appropriate information required by the Committee to grant approval and also to emphasize to the investigators certain responsibilities that must be considered when dealing with human subjects. If the protocol changes, the investigator must provide dated replacement pages with the changed sections indicated by bars in the margin as shown here and dated at the bottom of the page. The replacement pages will be submitted to the Committee by the Mission Manager.

B. As a matter of general practice, all human research protocols prior to submission to the HRPPC will have been approved by the SA Scientific Merit Review Committee (for JSC investigations), peer reviewed, and submitted to one or more of the following committees as appropriate:

1) JSC Radiation Safety Committee;
2) Medical Isotopes Operations Subcommittee;
3) STS Payload Safety Review Panel (for in-flight equipment);
4) Safety Reliability and Quality Assurance (for ground-based equipment).

C. At least 6 weeks prior to a training tour, the investigator shall provide the HRPPC with 20 copies of the Training Protocol to be used in the tour. If the experiment is to fly in the mid-deck or Spacelab, the Training Protocol will be routed through the Mission Manager to the HRPPC. On the other hand, if a URO is involved, it will be submitted to the HRPPC by a representative of the Science Management Review Committee (SMRC). The headings and contents of this protocol are detailed in Appendix 3. Again the format is
designed to improve the efficiency of information transfer and the elimination of unnecessary paperwork.

D. All protocols, training tours, and DSOs submitted to the Committee must be signed and dated by the PI.

E. After initial approval of a DSO, resubmittals of the same DSO can be in the form of a letter or memorandum to the Committee, stating any changes or problems with the DSO and the date of the original approval by the Committee.

F. Once the Secretary of the Human Research Policy and Procedures Committee has received a satisfactory and complete Master Protocol and/or subsequent Training Protocols for specific tours, the investigator will be officially informed in writing of the meeting date at which the protocol will be reviewed.

G. The Committee meets on the first and third Thursday of each month. Although the Committee works only from written documentation, it may be desirable to have a representative, who is intimately familiar with the study and its protocol, available to answer questions regarding details of the protocol and to deal with actions required by the HHPPC.

H. If the protocol is deemed deficient in some category, the PI will be informed directly or through the Mission Manager if additional information is required. Upon receipt by the Secretary of the Committee, the new information will be reviewed at the next scheduled meeting, if it is received 10 working days before such a meeting. It is imperative, therefore, that the process of protocol review be initiated at least 6 weeks before the anticipated training tour in order to allow for the possible exchange of questions and answers.
I. If the protocol is approved at the initial or subsequent meeting, the PI will be informed of such approval. In some cases, where minor deficiencies are found, the approval may be qualified with some stipulation that requires follow-up reports. Ordinarily, these should be sent to the Secretary within 2 weeks after the completion of the training tour. (For Spacelab investigations, such reports should be routed through the Mission Manager.)

J. During the conduct of human research, all activities will be immediately suspended (unless such suspension would endanger the subject), and the Center Director and the Chairman, Alternate Chairman, or Crew Surgeon immediately informed in the event of:

(1) Any injury to or illness of a subject;
(2) Any change in the environment or the subject's response that could lead to some medical disturbance;
(3) Any substantive change from the approved protocol.

Furthermore, any one of the following individuals has the authority to terminate the test and insist on a review of the circumstances prior to the resumption of test activities: 1) Principal Investigator; 2) Medical Officer; 3) Test Engineer or Director; 4) Test Subject; or 5) Mission Manager. A decision to terminate the test by any one of the above is binding upon the other responsible individuals.

K. A Medical Officer of the HRPCC will attend as many training tours as deemed necessary by the HRPCC. The Officer will receive the minutes from
training debriefing sessions. The Medical Officer may be the Crew Surgeon or other Flight Surgeon, an HRPPC member, or an appropriate representative designated by the HRPPC.

L. As indicated above, the Medical Officer attending a training session may terminate any experimental procedure that he/she determines to be unsafe or presents a medical hazard to the experimental subject. Minor equipment and procedure changes may be approved by the Medical Officer during the training tour. Any changes that the representative wishes to defer to the full HRPPC will delay that portion of the training until the HRPPC has ruled on the changes.

M. If, during a training tour, there is any (even minor) anomalous incident involving human subjects, the incident must be reported via telephone within 24 hours, and a written Incident Report submitted within one week to the Chairman. Such incidents might include adverse reactions to drugs or electrode paste, trauma, eye irritations, equipment failure (anomalous operation), animal bites or scratches, hematomata, etc.

N. All human research requiring data collection aboard the KC-135 will be reviewed and approved by the HRPPC at least 6 weeks prior to the scheduled flight. This approval applies as well to all payloads which may be potentially hazardous to the health of the crew and/or investigators, such as those utilizing toxic or radioactive substances.

O. The Mission Manager of a given integrated payload involving human investigations will ensure that the Science Manager presents the total medical/experimental requirements for the integrated payload to the HRPPC. This activity will be coordinated with the crew flight surgeon, and will
include medical operational (clinical) blood/fluid requirements, as well as
total crew time scheduling requirements for all phases of the mission (i.e.,
pre-, in-, and postflight periods).

P. Research involving STS flight personnel requires that the NASA HUMAN
RESEARCH MINIMAL RISK INFORMED CONSENT FORM 1416, acknowledging "minimal
risks" be completed (Appendix 4). In some cases, when the Committee feels a
study involves "reasonable risk", the crewmembers will be asked to complete
the NASA HUMAN RESEARCH REASONABLE RISK INFORMED CONSENT FORM 1416A (Appendix
5). This form will also be used for JSC studies, including those funded,
sponsored, or implemented by JSC, using test subjects other than crewmembers.
Either the NASA HUMAN RESEARCH MINIMAL RISK INFORMED CONSENT FORM 1416 or NASA
HUMAN RESEARCH REASONABLE RISK INFORMED CONSENT FORM 1416A must be signed by
the STS flight personnel involved in the research, before the start of any
training tour. These forms must then be sent to the Chairman of HRPPC and a
copy to the Flight Medicine Clinic.

Q. No crew training or ground-based investigation is permitted to com-
mence unless a Master Protocol has received original approval, the detailed
procedures have been approved 6 weeks prior to a training tour, and consent
forms have been obtained from the human subjects and filed with the HRPPC.

R. Studies involving animals must adhere to the guidelines which are
outlined in Appendices 6 and 7. Appendix 6 describes animal handling proce-
dures for preflight crew training activities. Flight simulations and space
flight procedures are described in Appendix 7.

S. If animals are used in an experiment, the investigator must include
the following information in Section 8 of the Master Protocol:
(1) Precautions to be used to maintain the Specific Pathogen-Free (SPF) status and tests used to ascertain SPF status prior to training or flight.

(2) Potential biohazards from cold-blooded vertebrates must be analyzed.
4.0 APPENDIX 1

EXAMPLES OF RESEARCH ACTIVITIES INVOLVING NO MORE THAN "MINIMAL RISK"

The following research activities (performed by standard methods) are considered to involve no more than "minimal risk".

(1) Collection of hair and nail clippings, in a nondisfiguring manner; deciduous teeth; and permanent teeth if patient care indicates a need for extraction.

(2) Collection of excreta and external secretions including sweat, uncannulated saliva, placenta removed at delivery, and amniotic fluid at the time of rupture of the membrane prior to or during labor.

(3) Recording of data from subjects 18 years of age or older using noninvasive procedures routinely employed in clinical practice. This includes the use of physical sensors that are applied either to the surface of the body or at a distance and do not involve input of matter or significant amounts of energy into the subject, or an invasion of the subject's privacy. It also includes such procedures as weighing, testing sensory acuity, electrocardiography, electroencephalography, thermography, detection of naturally occurring radioactivity, diagnostic echosonography, and electroretinography. It does not include exposure to electromagnetic radiation outside the visible range (for example, x-rays, microwaves).

(4) Collection of blood samples by venipuncture, in amounts not exceeding 450 milliliters in an 8-week period and no more than two times per week, from subjects 18 years of age or older and who are in good health and not pregnant.
(5) Collection of both supra- and subgingival dental plaque and calculus, provided the procedure is not more invasive than routine prophylactic scaling of the teeth, and the process is accomplished in accordance with accepted prophylactic techniques.

(6) Voice recordings made for research purposes such as investigations of speech defects.

(7) Moderate exercise by healthy volunteers.

(8) The study of existing data, documents, records, pathological specimens, or diagnostic specimens.

(9) Research on individual or group behavior or characteristics of individuals, such as studies of perception, cognition, game theory, or test development, where the investigator does not manipulate subjects' behavior and the research will not involve stress to subjects.

(10) Research on drugs or devices for which an investigational exemption is not required.
5.0 APPENDIX 2

HUMAN RESEARCH MASTER PROTOCOL*

Spacelab or Shuttle Flight Designation
Experiment Designation
Functional Objective Designation

1. TITLE

2. ORGANIZATION CONDUCTING THE RESEARCH

Normally the institution with which the PI is affiliated.

3. INVESTIGATORS

A. List all investigators starting with the PI, their addresses, and phone numbers. Attach a Curriculum Vitae for each investigator at the end of the protocol.

B. List technical personnel who will aid in and/or conduct the research. Attach qualifications at the end of the protocol. The Committee is interested in the qualifications of the technical staff that will be interacting with the test subjects, because they will be operating equipment or performing procedures on them.

4. HYPOTHESIS(ES)

The hypotheses should be clearly and succinctly stated. The Committee must consider scientific merit as a factor in weighing risks vs. benefits. This summary should abstract the details to be included in Section 5.

*All headings or statements in bold are to be included in the protocol and in the order listed.
5. PURPOSE OF RESEARCH

This section may be handled by attachment (as an appendix) of information submitted in the original proposal. However, the investigator should ensure that the following information is included:

A. HISTORICAL BACKGROUND

A brief background statement should trace development of key factors or principles which led to formulation of the hypothesis. Reference to pertinent scientific literature is essential.*

B. NEW INFORMATION EXPECTED

6. JUSTIFICATION FOR USE OF HUMAN SUBJECTS

Explain why humans are a necessary part of the study.

7. STUDY PLAN AND SCHEDULE

Give an overview of what will be accomplished during preflight training/baseline data collection sessions, in-flight experimentation, and postflight data acquisitions. For example, familiarization with the concepts of the experiment, procedures to be learned, equipment to be used, data collection, etc.

A. DATES/DURATION

Give as close an approximation as possible. Detailed schedules for Spacelab investigations should be included in Training Protocols.

B. PLACE(S) OF TRAINING/TEST

*Not required for a DSO.
C. SUBJECTS

Provide names, if known, or flight personnel designation; e.g., Mission Specialist (MS) MS1, MS2, Payload Specialist (PS) PS1, PS2, PS Backup, Commander (CDR), Pilot (PLT).

8. EXPERIMENTAL PROTOCOLS AND EQUIPMENT

This section contains some of the most important information used by the Committee. It is from this section that the Committee may identify potential problems that might be overlooked by the investigators. Experience has shown that incompleteness of this section is one of the major reasons for HRPPC disapproval.

A. PREFLIGHT TRAINING AND BASELINE DATA COLLECTION

Describe preflight training and baseline data collection in terms of step-by-step procedures and equipment used. All equipment items must be identified. In those instances where any hardware is used for training or ground-based testing, the PI is responsible for providing detailed descriptions and hazard analyses as an attachment to the protocol submittal. The PI is also responsible for maintaining configuration control of the hardware to prevent any modifications that would compromise the hazard analyses. Inspection records must be provided to assure the hardware configuration and to assure adherence to test requirements/procedures. Functional test and check-out of equipment utilizing non-flight-crew personnel is required. All equipment whether commercial, modified commercial or custom designed, used in fit and functional testing must be inspected by the SR&QA. These results, together with equipment safety certification must be submitted by the PI to the HRPPC prior to flight crew usage.
B. INFLIGHT ACTIVITIES

List step-by-step procedures and equipment used, approximate duration of the testing, how many flight personnel are necessary, and how many times the experiment will be performed.

C. POSTFLIGHT ACTIVITIES

If postflight testing of flight personnel is necessary, note how many times the test will be done, when, where, and what procedures and equipment will be used.

9. HAZARDS ANALYSES AND SAFETY PRECAUTIONS

Detail the conceivable hazards that might be encountered during the study and the precautions that will be taken to avoid them. For research involving animal handling, list precautions employed for minimizing zoonoses (see page 9 of handbook).

A. PREFLIGHT ACTIVITIES

1. POTENTIAL HAZARDS
2. PROTECTION TO MINIMIZE RISKS
3. ASSESSMENT OF RESIDUAL RISKS

B. IN-FLIGHT ACTIVITIES

1. POTENTIAL HAZARDS
2. PROTECTION TO MINIMIZE RISKS
3. ASSESSMENT OF RESIDUAL RISKS

C. POSTFLIGHT ACTIVITIES

1. POTENTIAL HAZARDS
2. PROTECTION TO MINIMIZE RISKS
3. ASSESSMENT OF RESIDUAL RISKS
10. POSSIBLE INCONVENIENCES OR DISCOMFORTS TO SUBJECTS

List additional factors that do not fall into the category of hazards but that should be considered.

11. EXTENT OF PHYSICAL EXAMINATIONS

In many cases, reliance on the annual physical examination for flight personnel is all that need be stated. If a special physical examination or special test is required, describe it and state why it is needed.

12. AVAILABILITY OF A PHYSICIAN AND MEDICAL FACILITIES

13. REQUIRED STATEMENTS FOR HUMAN RESEARCH SUBJECTS

A. The subject will be free to withdraw from the research at any time. [Except...(describe any circumstances under which it would be hazardous or unwise to do so.])

B. The identity of human subjects will not be released to the general public without his or her consent unless specifically required by law.

C. There will be no additional wage, salary, or other remuneration of any form paid, given, or in any manner delivered to the test subjects of this investigation where the subjects are NASA employees or NASA contractor employees and the terms of the contracts with NASA provide for participation as subjects in approved experiments.

D. The human research subjects are NASA employees, NASA contractor employees or independent contractors, and the training/testing is part of their employment or contractual circumstances. Therefore, NASA is responsible for compensation for injury, death, or property damage to the extent required by the Federal Employees Compensation Act or the Federal Tort Claims Act.
14. REQUIRED ATTACHMENTS

A. Include information concerning the human research to be communicated to the subjects in the course of obtaining their informed consent. Along with a signed consent form, attach a summary, signed by the subject, describing in layman's terms the procedures the subject will undergo. Should the subject be flown on the KC-135 airplane, include the following statement in the summary: "Since the KC-135 is considered to be a public aircraft within the meaning of the Federal Aviation Act of 1958, as amended, and as such, does not hold a current airworthiness certificate issued by the Federal Aviation Administration (FAA), any individual manifested to board the KC-135 should determine before boarding whether his/her personal life or accident insurance provides coverage under such conditions."

B. If required, attach the appropriate JSC Consent Form to be employed (see Appendices 4 & 5). Specify the appendix designation in this section. If not required, so state.

C. Attach a copy of the Approval by the PI's Institutional Review Board (Human Research or Ethics Committee). Specify the appendix designation.

D. Attach a copy of the Institutional Safety Authority's most recent certification of all ground-based equipment. Specify appendix designation(s).

E. If external radiation sources or radionuclides are employed (see Appendix 8), their use must have the approval of the JSC Radiation Safety Committee. Attach a copy of the Approval of the JSC Radiation Safety Committee. Specify appendix designation.

F. Research use of drugs for indications not in the package insert is subject to Federal Drug Administration (FDA) restrictions. Prior to shipping
the drug in interstate commerce, either its sponsor (the manufacturer) or the clinical investigator must file form FDA 1571, "Notice of Claimed Investigational Exemption For A New Drug (IND)" with the FDA. The FDA regulations also require each clinical investigator who uses investigational drugs in humans to file with the sponsor of the Investigational New Drug (IND) either form FDA 1572 or form FDA 1573, "Statement of Investigator" (See Section 12.0 Appendix 9). Attach a copy of each form that has been filed and proof of submission date (e.g. certified mail receipt) or a statement of not having received a written reply from the FDA 60 days after the submission of forms. Attach a copy of the FDA reply, if it had been received.
6.0 APPENDIX 3

TRAINING PROTOCOL*

Spacelab Designation

Experiment #

Training Tour #

Location of Training

Dates of Training

Subjects

1. TITLE

2. ORGANIZATION CONDUCTING THE RESEARCH

3. INVESTIGATORS AND TECHNICAL PERSONNEL

List the name of the PI, address, and phone number. Reference to the Master Protocol may be made for other investigators and technical personnel. If changes have been made, note the changes and supply qualifications if not already on file.

4. OBJECTIVES OF THIS TOUR

Stating the objectives of the specific training session will aid those who are conducting the tour to focus on what they wish to accomplish and help the Committee to understand the intent of an individual training tour. Relate the objectives to the results of previous training tours (if any).

5. DETAILED DAILY SCHEDULE OF TRAINING ACTIVITIES

The schedule will provide the Committee an idea of the intensity and duration of each day of training as well as the step-by-step procedures and

*All headings in bold are to be included in the protocol as listed.
equipment to be employed. Reference can be made to the Master Protocol for details, but each step must be listed and any deviation from the Master Protocol must be noted. If substantive or permanent changes from the Master Protocol have been made, supply dated and marked replacement pages for the Master Protocol. (See page 5 of this handbook.)

6. HAZARDS

Restate all of the potential hazards for the specific training tour as extracted from the Master Protocol.

7. INFORMED CONSENT FORM

If required, attach the appropriate consent form to be used. List information to be provided to the subjects. Reference may be made to Master Protocol. If a consent form is not required, so state.

8. ADDITIONAL ATTACHMENTS

A. Updated Safety Certificates (inspection and certification of ground-based equipment should be performed annually).

B. Updated IRB Certificates.

C. Qualifications of New Personnel.
7.0 APPENDIX 4

NASA HUMAN RESEARCH
MINIMAL RISK
INFORMED CONSENT FORM

1. I, the undersigned, do voluntarily give my informed consent for my participation as a test subject to the following test, experiment, or other evaluative procedure.

NAME OF EXPERIMENT ________________________________________________________

TRAINING TOUR NUMBER ______________________________________________________

FLIGHT TO WHICH ASSIGNED ________________________________________________

NAME OF DESIGNATED PRINCIPAL INVESTIGATOR ________________________________

NAME OF RESPONSIBLE NASA PROJECT SCIENTIST ________________________________

I understand that:

(a) This procedure is part of an experiment approved by NASA.

(b) I am performing these duties as part of my employment, with ____________________

(c) This procedure has been reviewed and approved by the JSC Human Research Policy and Procedures Committee (HRPPC) and determined that the procedure involves no more than minimal risk to the subject.

(d) "Minimal risk" means that the harm or discomfort anticipated in the proposed research is not greater, considering probability and magnitude, than those encountered in the daily lives of healthy individuals, including the recognized risks inherent in a chosen occupation, such as spaceflight and ground support.

(f) I am medically qualified to participate in the procedure.

(g) I may withdraw from the procedure at any time unless, as recommended by the Principal Investigator, or his/her designee, the withdrawal is dangerous or impossible.

(h) In the event of physical injury resulting from the procedure and calling for immediate action or attention that NASA will provide, or cause to be provided, the necessary treatment. I also understand that NASA will pay for any claims of injury, loss of life or property damage to the extent required by the Federal Employees' Compensation Act or the Federal Tort Claims Act. My agreement to participate shall not be construed as a release of NASA or any third party from any future liability which may arise from, or in connection with, the above procedures.

JSC Form 1416 (Rev Jul 87)
2. I, the undersigned, the Principal Investigator of the experiment designated above, certify that:

(a) I have accurately described the procedure to the test subject.

(b) The test set-up involves minimal risk to the test subject. All equipment used has been inspected and certified for safe and proper operation.

(c) The test subject is medically qualified to participate.

(d) The test protocol has not been changed from that approved by the JSC Human Research Policy and Procedures Committee (HRPPC).

APPROVED:

____________________________________________  ________________________________
Test Subject  Date

____________________________________________  ________________________________
Principal Investigator  Date

____________________________________________  ________________________________
Project Scientist  Date

This consent form is valid for a 60-day period from the date of signature by the subject and the Principal Investigator (which dates should be identical). A signed, dated copy of the form should be forwarded to the JSC Human Research Policy and Procedures Committee, Mail Code SA, Lyndon B. Johnson Space Center, Houston, Texas 77058.
8.0 APPENDIX 5

NASA HUMAN RESEARCH
REASONABLE RISK
INFORMED CONSENT FORM

1. I, the undersigned, do voluntarily give my informed consent for my participation as a test subject in the following test, experiment, or other evaluative procedure:

NAME OF EXPERIMENT

TRAINING TOUR NUMBER

FLIGHT TO WHICH ASSIGNED

NAME OF DESIGNATED PRINCIPAL INVESTIGATOR

NAME OF RESPONSIBLE NASA PROJECT SCIENTIST

I understand that:

(a) This procedure is part of an experiment approved by NASA.
(b) I am performing these duties as a part of my employment, with
(c) This procedure has been reviewed and approved by the JSC Human and Research Policy Procedures Committee (HRPPC) and determined that the procedure involves reasonable risk to the subject.
(d) "Reasonable risk" means that the risks of harm anticipated in the proposed research are greater than those ordinarily encountered in daily life or during the performance of routine tests, but considered to be proper when weighing the anticipated benefits and the importance of the knowledge to be gained from the research.
(e) The procedure has been explained to me prior to the execution of this form. I was afforded an opportunity to ask questions, and all questions asked were answered.
(f) I am medically qualified to participate in the procedure.
(g) I may withdraw from the procedure at any time unless, as recommended by the Principal Investigator, or his/her designee, the withdrawal is dangerous or impossible.
(h) In the event of physical injury resulting from the procedure and calling for immediate action or attention that NASA will provide, or cause to be provided, the necessary treatment. I also understand that NASA will pay for any claims of injury, loss of life or property damage to the extent required by the Federal Employees' Compensation Act or the Federal Tort Claims Act. My agreement to participate shall not be construed as a release of NASA or any third party from any future liability which may arise from, or in connection with, the above procedures.
2. I, the undersigned, the Principal Investigator of the experiment designated above, certify that:

(a) I have accurately described the procedure to the test subject.

(b) The test set-up involves reasonable risk to the test subject. All equipment used has been inspected and certified for safe and proper operation.

(c) The test subject is medically qualified to participate.

(d) The test protocol has not been changed from that approved by the JSC Human Research Policy and Procedures Committee (HRPPC).

APPROVED:

Test Subject ___________________________ Date ___________________________

Principal Investigator ___________________________ Date ___________________________

Project Scientist ___________________________ Date ___________________________

This consent form is valid for a 60-day period from the date of signature by the subject and the Principal Investigator (which dates should be identical). A signed, dated copy of the form should be forwarded to the JSC Human Research Policy and Procedures Committee, Mail Code SA, Lyndon B. Johnson Space Center, Houston, Texas 77058.
9.0 APPENDIX 6

GUIDELINES RELATIVE TO USE OF EXPERIMENTAL ANIMALS
DURING PREFLIGHT CREW TRAINING ACTIVITIES

These guidelines specifically address the training activities at the home institutions (medical centers/universities) of the PI conducting experiment-specific training and similar training activities at pertinent NASA facilities. Guidelines relative to animal standards and procedures for training simulations utilizing the flight Research Animal Holding Facility (RAHF), altitude chamber simulations (closed environments), and actual space flight are addressed in a separate appendix.

1. All animal holding facilities or breeding colonies will generally adhere to the guidelines and recommendations of the American Association of Laboratory Animal Science (AALAS) and the American Association for Acceleration of Laboratory Animal Care (AAALAC).

RATS

2. The Specific Pathogen-Free (SPF) criteria for rats are given in Enclosure 1. Certification by reliable commercial suppliers that their animals are free of these pathogens is acceptable to the Committee. Periodic inspection of the animals for clinical signs of illness by animal handlers is required. Should animals become clinically ill, they should be excluded from the colony and all reasonable attempts made to establish an etiologic diagnosis. In these circumstances, the remaining animals must be recertified pathogen-free, or, alternatively, a new supply secured from the vendor.
3. For training with rats at the above facilities, acceptable laboratory attire is recommended. Ordinarily, this means only a laboratory coat. The use of surgical masks and gloves is crew optional.

**SQUIRREL MONKEYS**

Specific Pathogen-Free (SPF) certification will be valid for a period of 6 months. Should hands-on training with squirrel monkeys be required at any of the above facilities, the SPF criteria for space flight animals shall apply (Enclosure 2). It must be re-emphasized here that the crew will not be permitted to come in contact with *Herpesvirus saimiri*-positive squirrel monkeys at any time.

**FROGS**

The risk of amphibian zoonosis is almost non-existent. Acceptable laboratory attire is recommended, viz., a laboratory coat. Other protective measures are crew optional.
SPF CRITERIA FOR RATS

<table>
<thead>
<tr>
<th>MICROORGANISM</th>
<th>CULTURE SITE/MATERIAL OR IDENTIFICATION TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BACTERIA:</strong></td>
<td></td>
</tr>
<tr>
<td>Streptobacillus moniliformis</td>
<td>Oral</td>
</tr>
<tr>
<td>Streptococcus pyogenes</td>
<td>Oral, Nasal</td>
</tr>
<tr>
<td>Salmonella sp.</td>
<td>Fecal</td>
</tr>
<tr>
<td>Leptospira sp.</td>
<td>Urine</td>
</tr>
<tr>
<td>Campylobacter sp.</td>
<td>Fecal</td>
</tr>
<tr>
<td><strong>VIRUSES:</strong></td>
<td></td>
</tr>
<tr>
<td>Lymphocytic choriomeningitis virus</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td><strong>FUNGI:</strong></td>
<td></td>
</tr>
<tr>
<td>All Dermatophytes</td>
<td>Skin (Clinical Inspection)</td>
</tr>
<tr>
<td><strong>ECTOPARASITES:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skin, Hair</td>
</tr>
<tr>
<td><strong>ENDOPARASITES:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feces, Caecal Contents</td>
</tr>
</tbody>
</table>

Enclosure 1
### SPF CRITERIA FOR SQUIRREL MONKEYS

<table>
<thead>
<tr>
<th>MICROORGANISM</th>
<th>CULTURE SITE/MATERIAL OR IDENTIFICATION TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BACTERIA:</strong></td>
<td></td>
</tr>
<tr>
<td>Shigella sp.</td>
<td>Fecal</td>
</tr>
<tr>
<td>Salmonella sp.</td>
<td>Fecal</td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td>Oral, Fecal</td>
</tr>
<tr>
<td>Mycobacterium tuberculosis</td>
<td>Skin Test, X-Ray</td>
</tr>
<tr>
<td>Pasteurella multocida</td>
<td>Nasal, Fecal</td>
</tr>
<tr>
<td>Campylobacter sp.</td>
<td>Fecal</td>
</tr>
<tr>
<td>Leptospira sp.</td>
<td>Urine</td>
</tr>
<tr>
<td>Streptococcus pyogenes</td>
<td>Oral, Nasal</td>
</tr>
<tr>
<td><strong>VIRUSES:</strong></td>
<td></td>
</tr>
<tr>
<td>Lymphocytic choriomeningitis virus</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td>Herpes tamarinus</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td>Herpesvirus saimiri</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td><strong>ENDOPARASITES:</strong></td>
<td></td>
</tr>
<tr>
<td>Trichomonas</td>
<td>Oral</td>
</tr>
<tr>
<td>Acanthocephlans</td>
<td>Feces</td>
</tr>
<tr>
<td>Strongyloides</td>
<td>Feces</td>
</tr>
<tr>
<td>Entamoeba histolytica</td>
<td>Feces</td>
</tr>
<tr>
<td>Hemoprotozoa</td>
<td>Blood</td>
</tr>
<tr>
<td><strong>Fungi:</strong></td>
<td></td>
</tr>
<tr>
<td>All Dermatophytes</td>
<td>Skin</td>
</tr>
</tbody>
</table>

Enclosure 2
10.0 APPENDIX 7

GUIDELINES RELATIVE TO USE OF EXPERIMENTAL ANIMALS DURING CREW TRAINING SIMULATIONS UTILIZING THE FLIGHT RESEARCH ANIMAL HOLDING FACILITY (RAHF) AND GENERAL PURPOSE WORK STATION (GPWS), ALTITUDE CHAMBER SIMULATIONS (CLOSED ENVIRONMENTS), AND ACTUAL SPACEFLIGHT

This memorandum summarizes the HRPPC's current requirements and recommendations regarding subject standards and procedures as viewed in the context of past advisory group meetings on this and related topics.

(1) All animal holding facilities and/or breeding colonies will generally adhere to the guidelines and recommendations of the American Association of Laboratory Animal Science (AALAS) and the American Association for Accreditation of Laboratory Animal Care (AAALAC).

(2) Only Specific Pathogen-Free (SPF) rats and squirrel monkeys will be utilized for subject training and flight activities. The SPF criteria for rats are given in Enclosure 1, and for squirrel monkeys in Enclosure 2. The risk of amphibian zoonosis is almost non-existent, therefore no special certification is required.

(3) Other animal species proposed for approved flight experiments will be considered by the Committee on an individual basis.

(4) The following general guidelines will be followed where applicable:
A. Standard Microbiological Practices

1. Work surfaces will be decontaminated with a suitable disinfectant after use or at least daily.

2. All waste liquids, solids, tissues, syringes and needles will be placed in durable, leakproof, puncture-resistant, sealed containers for eventual autoclaving, incineration, or other appropriate decontamination/disposal procedure post-training, post-simulation or postflight. Such materials will not be transported between Spacelab and Orbiter.

3. Hypodermic needles and syringes shall be used only for the parenteral injection or aspiration of fluids from laboratory animals and diaphragm bottles. Only needle-locking syringes or disposable needle syringe units (i.e., the needle is integral to the syringe) are to be used for the injection or aspiration of fluids. Needles should not be bent, sheared or removed from the syringe following use. Needles should not be replaced in the plastic sheath or guard prior to disposal. Needle and syringe should be promptly placed in puncture-proof container for eventual decontamination, preferably by autoclaving, before final discard.

4. Personnel will use appropriate antiseptic wet wipes or other available means for cleaning hands after handling animals, when departing the laboratory, and especially before eating.

5. Laboratory coat (or equivalent) will be worn when animals are handled.
B. Animal Certification

1. Animals will be certified SPF by the supplier for the proscribed organisms listed in Enclosures 1 and 2. The rats will be housed together in pairs in filtered cages. One animal or each pair will be sampled for microbial screening 72 hours prior to crew contact. Presumptive results will be available in 24 hours and definitive results in 72 hours. The crew will not be exposed to either animal in a given cage if the sampled animal cultures are positive for a proscribed organism. Rat viral serology will be completed two weeks prior to crew exposure according to established protocols.

2. The Squirrel Monkeys will be screened for proscribed organisms at six-month intervals. The flight animals selected will have viral serology screening completed one month before use and will be cultured for proscribed bacteria 96 hours prior to crew contact. All microbiological test results will be forwarded to the Committee as part of the Operational Readiness Review (ORR).

3. SPF certified Squirrel Monkeys will at all times be housed in their own dedicated vivarium apart from other non-certified sub-human primates. The dedicated vivarium will be provided with a separate ventilation system so as to preclude contamination from other animals.

C. Research Animal Holding Facility (RAHF) and General Purpose Work Station (GPWS) Inflight Guidelines

1. With the improved integrity of animal enclosures and associated flight procedures, THE ROUTINE USE OF LABORATORY ATTIRE IS NOT REQUIRED.
If anomalous situations should develop which produce free contaminants, all crewmembers will use suitable protective measures (viz., surgical masks) until the particular experiment or procedure is terminated and the contaminant removed from the spacecraft. This precaution is necessary in the closed microgravity environment, since contamination does not remain localized in the continuous atmosphere of the Spacelab and Orbiter.

Particular care should be exercised during the following procedures:

a. Rats: Waste tray and food canister changeout; cage removal; condensate bottle changeout; GPWS operations involving animals.

b. Squirrel Monkeys: Waste tray changeout; urine canister changeout; food canister changeout; blood sample collection.

2. HEPA filtration system of the RAHF and GWPS will filter all particles greater than 0.3 microns.

3. Biological samples from animals shall not contaminate the spacecraft or crew at any time including collection, transport and storage procedures.

4. Animals transported between the RAHF and GPWS must be enclosed in a carrier.

5. Equipment and procedures for the housing, transport, and experimental protocol must preclude any possibility of animal escape into the spacecraft.
### SPF CRITERIA FOR RATS

<table>
<thead>
<tr>
<th>MICROORGANISM</th>
<th>CULTURE SITE/MATERIAL OR IDENTIFICATION TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BACTERIA:</strong></td>
<td></td>
</tr>
<tr>
<td>Streptobacillus moniliformis</td>
<td>Oral</td>
</tr>
<tr>
<td>Spirillum minus</td>
<td>Oral</td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td>Oral, Nasal</td>
</tr>
<tr>
<td>Streptococcus pyogenes</td>
<td>Oral, Nasal</td>
</tr>
<tr>
<td>Bacillus piliformis</td>
<td>Liver (Invoke with Cortisone)</td>
</tr>
<tr>
<td>Corynebacterium kutscheri</td>
<td>Fecal, Oral</td>
</tr>
<tr>
<td>Salmonella sp.</td>
<td>Fecal</td>
</tr>
<tr>
<td>Pasteurella pneumotropica</td>
<td>Oral, Nasal</td>
</tr>
<tr>
<td>Leptospira sp.</td>
<td>Urine</td>
</tr>
<tr>
<td>Campylobacter sp.</td>
<td>Fecal</td>
</tr>
<tr>
<td><strong>VIRUSES:</strong></td>
<td></td>
</tr>
<tr>
<td>Lymphocytic choriomeningitis virus</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td>Rat parvoviruses</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td>Rat coronavirus</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td>Sialodacryadenitis virus</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td>Sendai virus</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td><strong>Fungi:</strong></td>
<td></td>
</tr>
<tr>
<td>All Dermatophytes</td>
<td>Skin</td>
</tr>
<tr>
<td><strong>ECTOPARASITES:</strong></td>
<td></td>
</tr>
<tr>
<td>Skin, Hair</td>
<td></td>
</tr>
<tr>
<td><strong>ENDOPARASITES:</strong></td>
<td></td>
</tr>
<tr>
<td>Feces, Caecal Contents</td>
<td></td>
</tr>
</tbody>
</table>
### SPF CRITERIA FOR SQUIRREL MONKEYS

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Culture Site/Material or Identification Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bacteria:</strong></td>
<td></td>
</tr>
<tr>
<td>Shigella sp.</td>
<td>Fecal</td>
</tr>
<tr>
<td>Salmonella sp.</td>
<td>Fecal</td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td>Oral, Fecal</td>
</tr>
<tr>
<td>Mycobacterium tuberculosis</td>
<td>Skin Test, X-Ray</td>
</tr>
<tr>
<td>Pasteurella multocida</td>
<td>Nasal, Fecal</td>
</tr>
<tr>
<td>Campylobacter sp.</td>
<td>Fecal</td>
</tr>
<tr>
<td>Leptospira sp.</td>
<td>Urine</td>
</tr>
<tr>
<td>Streptococcus pyogenes</td>
<td>Oral, Nasal</td>
</tr>
<tr>
<td><strong>Viruses:</strong></td>
<td></td>
</tr>
<tr>
<td>Lymphocytic choriomeningitis virus</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td>Herpes tamarinus</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td>Herpesvirus saimiri</td>
<td>Blood (Serology)</td>
</tr>
<tr>
<td><strong>Endoparasites:</strong></td>
<td></td>
</tr>
<tr>
<td>Trichomonas</td>
<td>Oral</td>
</tr>
<tr>
<td>Acanthocephalans</td>
<td>Feces</td>
</tr>
<tr>
<td>Strongyloides</td>
<td>Feces</td>
</tr>
<tr>
<td>Entamoeba histolytica</td>
<td>Feces</td>
</tr>
<tr>
<td>Hemoproteozoa</td>
<td>Blood</td>
</tr>
<tr>
<td><strong>Fungi:</strong></td>
<td></td>
</tr>
<tr>
<td>All Dermatophytes</td>
<td>Skin</td>
</tr>
</tbody>
</table>

Enclosure 2
**SPF CRITERIA FOR MACACA MULATTA**

<table>
<thead>
<tr>
<th>VIRUSES</th>
<th>BACTERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herpesvirus simiae</td>
<td>Mycobacterium tuberculosis</td>
</tr>
<tr>
<td>Yaba</td>
<td>Shigella sp.</td>
</tr>
<tr>
<td>Yaba-like viruses (OrTeCu, BEMP, and Tanapox)</td>
<td>Salmonella sp.</td>
</tr>
<tr>
<td>Monkey pox</td>
<td>Pasturella multocida</td>
</tr>
<tr>
<td>Measles (Rubeola)</td>
<td>Yersinia pseudotuberculosis</td>
</tr>
<tr>
<td>Lymphocytic choriomeningitis</td>
<td>Yersinia enterocolitica</td>
</tr>
<tr>
<td>Rabies</td>
<td>Streptococcus pyogenes</td>
</tr>
<tr>
<td>SAIDS (SRV-1, SRV-2)</td>
<td>Campylobacter sp.</td>
</tr>
<tr>
<td>HIV</td>
<td></td>
</tr>
<tr>
<td>STLV III</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PARASITES</th>
<th>SPIROCHETES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hymenolepsis nana</td>
<td>Leptospira sp.</td>
</tr>
<tr>
<td>Entamoeba histolytica</td>
<td></td>
</tr>
<tr>
<td>Giardia intestinitis</td>
<td>Fungi:</td>
</tr>
<tr>
<td>Giardia lamblia</td>
<td>All dermatophytoses</td>
</tr>
<tr>
<td>Balantidium coli</td>
<td></td>
</tr>
<tr>
<td>Trichomonas hominis</td>
<td></td>
</tr>
<tr>
<td>Ascaris sp.</td>
<td></td>
</tr>
<tr>
<td>Strongyloides sp.</td>
<td></td>
</tr>
<tr>
<td>Acanthocephalans</td>
<td></td>
</tr>
</tbody>
</table>

Enclosure 3
GUIDELINES FOR
RADIONUCLIDE USE IN SPACE FLIGHT PAYLOADS

The large number of permutations of radionuclide type, amount, chemical and physical form, and degree of containment requires that each experiment involving radionuclides be evaluated on its own merit. Nonetheless, some general guidelines can be set forth. These guidelines are not hard and fast and may be waived if other safety features or procedures are deemed adequate.

1. No payload containing radioactive material or other sources of ionizing radiation shall create a situation whereby:

   a. Radiation levels which, if an individual were continuously present in the area, could result in the individual's receiving a dose in excess of 2 millirems in any 1 hour, or

   b. Radiation levels which, if an individual were continuously present in the area, could result in the individual's receiving a dose in excess of 100 millirems in any 7 consecutive days, or in excess of 5,000 millirems in a 365-day period.

2. No payload or experiment, by design, shall cause quantities of radioactive material to be released into an occupied space which could result in uniform air concentrations in excess of the values specified in Appendix B, table I, column 1 of title 10, Code of Federal Regulations, part 20. For calculation purposes, the volume of the crew compartment is 65 m³ and that of the Spacelab is 77 m³.
The maximum permissible dose and the maximum permissible concentrations of radionuclides as recommended are primarily for the purpose of keeping the average dose to the crewmembers as low as reasonably achievable and not because of the likelihood of specific injury to an individual.

3. General rules for safe use of radioactive materials shall be followed:

a. Wear disposable gloves and a surgical-type mask at all times while handling radioactive liquids or powders. The gloves should prevent contamination of the hands where a mask should reduce chances of inhalation and/or ingestion.

b. Do not eat or drink in any area where radioactive material is being used.

c. Wipe all work surfaces after use of radioactive materials.

d. Practice good personal hygiene habits by always thoroughly cleaning hands after handling radioactive sources.

e. Never mouth-pipette liquids containing radioactive materials. To the maximum extent possible minimize handling and transfers of radioactive materials in flight.

f. Dispose of radioactive waste only in specifically designated receptacles that are properly shielded and labeled.

g. Confine radioactive solutions, specimens, powders, and waste in double containment, plainly identified and labeled. Containment must be leakproof and puncture resistant. (Hood, glove box, or vented...
workbench could be considered one of the containers, but not stowage bins.)

h. All transfers of radioactive liquids should be accomplished by the "buddy system." The individual performing the transfer will be assisted by an assistant to catch or trap droplets, aerosols, etc., with absorbent material to ensure that no trap droplets or aerosols are released into the occupied areas.

4. Contingency plans for all conceivable off-nominal situations shall be developed and tested.

5. Individuals trained in Health Physics shall be involved with the stowage, the post-mission handling of payloads utilizing radioactive materials capable of producing radioactive contamination, and post-mission survey for contamination of the spacecraft.

Adherence to the guidelines is important for radiological protection of the operator and other crewmembers in the Spacelab or crew compartment. Moreover, such adherence is important in minimizing contamination buildup in the spacecraft which can interfere with other investigators' experiments.
NOTICE OF CLAIMED INVESTIGATIONAL EXEMPTION FOR A NEW DRUG

Name of Sponsor ___________________________ Date ________________

Address ____________________________________ Telephone ( )

Name of Investigational Drug ___________________________________________________________________________

FOR A DRUG:

Food and Drug Administration
Office of New Drug Evaluation (HFN-106)
5600 Fishers Lane
Rockville, Maryland 20857

Dear Sir:

The sponsor, ____________________________________________, submits this notice of claimed investigational exemption for a new drug under the provisions of section 505(i) of the Federal Food, Drug, and Cosmetic Act and § 312.1 of Title 21 of the Code of Federal Regulations.

Attached hereto in triplicate are:

1. The best available descriptive name of the drug, including to the extent known, the chemical name and structure of any substance, and a statement of how it is to be administered. (If the drug has only a code name, enough information should be supplied to identify the drug.)

2. Complete list of components of the drug, including any reasonable alternates for inactive components.

3. Complete statement of quantitative composition of drug, including reasonable variations that may be expected during the investigational stage.

4. Description of source and preparation of, any new-drug substances used as components, including the name and address of each supplier or processor, other than the sponsor, or each new-drug substance.

5. A statement of the methods, facilities, and controls used for the manufacturing, processing, and packing of the new drug to establish and maintain appropriate standards of identity, strength, quality, and purity as needed for safety and to give significance to clinical investigations made with the drug.

6. A statement covering all information available to the sponsor derived from preclinical investigations and any clinical studies and experience with the drug as follows:

a. Adequate information about the preclinical investigations, including studies made on laboratory animals, on the basis of which the sponsor has concluded that it is reasonably safe to initiate clinical investigations with the drug. Such information should include identification of the person who conducted each investigation, identification and qualifications of the individuals who evaluated the results and concluded that it is reasonably safe to initiate clinical investigations with the drug and a statement of where the investigations were conducted and where the records are available for inspection; and enough details about the investigations to permit scientific review. The preclinical investigations shall not be considered adequate to justify clinical testing unless they give proper attention to the conditions of the proposed clinical testing. When this information, the outline of the plan of clinical pharmacology, or any progress report on the clinical pharmacology, indicates a need for full review of the preclinical data before a clinical trial is undertaken, the Department will notify the sponsor to submit the complete preclinical data and to withhold clinical trials until the review is completed and the sponsor notified. The Food and Drug Administration will be prepared to confer with the sponsor concerning this action.

b. If the drug has been marketed commercially or investigated (e.g., outside the United States), complete information about such distribution or investigation shall be submitted, along with a complete bibliography of any publications about the drug.

c. If the drug is a combination of previously investigated or marketed drugs, an adequate summary of preexisting information from preclinical and clinical investigations and experience with its components, including all reports available to the sponsor suggesting side-effects, contraindications, and ineffectiveness in use of such components: Such summary should include an adequate bibliography of publications about the components and may incorporate by reference any information concerning such components previously submitted by the sponsor to the Food and Drug Administration. Include a statement of the expected pharmacological effects of the combination.

d. If the drug is a radioactive drug, sufficient data must be available from animal studies or previous human studies to allow a reasonable calculation of radiation absorbed dose upon administration to a human being.

7. A total (one in each of the three copies of the notice) of all informational material, including label and labeling, which is to be supplied to each investigator: This shall include an accurate description of the prior investigations and experience and their results pertinent to the safety and possible usefulness of the drug under the conditions of the investigation. It shall not represent that the safety or usefulness of the drug has been established for the purposes to be investigated. It shall describe all relevant hazards, contraindications, side-effects, and precautions suggested by prior investigations and experience with the drug under investigation and related drugs for the information of clinical investigators.

8. The scientific training and experience considered appropriate by the sponsor to qualify the investigators as suitable experts to investigate the safety of the drug, bearing in mind what is known about the pharmacological action of the drug and the phase of the investigational program that is to be undertaken.

9. The names and a summary of the training and experience of each investigator and of the individual charged with monitoring the progress of the investigation and evaluating the evidence of safety and effectiveness of the drug as it is received from the investigators, together with a statement that the sponsor has obtained from each investigator a completed and signed form, as provided in subparagraph (12) or (13) of this paragraph, and that the investigator is qualified by scientific training and experience as an appropriate expert to under-
take the phase 1 the investigation outlines... pages of the "Notice of Claimed Investigational Exemption for a New Drug." (In crucial situations, phase 3 investigators may be added and this form supplemented by rapid communication methods, and the signed Form FD-1573 shall be obtained promptly thereafter.)

10. An outline of any phase or phases of the planned investigations and a description of the institutional review committee, as follows:

a. Clinical pharmacology. This is ordinarily divided into two phases:
   Phase 1 starts when the new drug is first introduced into man - only animal and in vitro data are available - with the purpose of determining human toxicity, metabolism, absorption, elimination, and other pharmacological action, preferred route of administration, and safe dosage range; phase 2 covers the initial trials on a limited number of patients for specific disease control or prophylaxis purposes. A general outline of these phases shall be submitted, identifying the investigator or investigators, the hospitals or research facilities where the clinical pharmacology will be undertaken, any expert committees or panels to be utilized, the maximum number of subjects to be involved, and the estimated duration of these early phases of investigation. Modification of the experimental design on the basis of experience gained need be reported only in the progress reports on these early phases, or in the development of the plan for the clinical trial, phase 3. The first two phases may overlap, and, when indicated, may require additional animal data before these phases can be completed or phase can be undertaken. Such animal tests shall be designed to take into account the expected duration of administration of the drug to human beings, the age groups and physical status, as for example, infants, pregnant women, premenopausal women, of those human beings to whom the drug may be administered, unless this has already been done in the original animal studies. If a drug is a radioactive drug, the clinical pharmacology phase must include studies which will obtain sufficient data for dosimetry calculations. These studies should evaluate the excretion, whole body retention, and organ distribution of the radioactive material.

b. Clinical trial. This phase 3 provides the assessment of the drug's safety and effectiveness and optimum dosage schedules in the diagnosis, treatment, or prophylaxis of groups of subjects involving a given disease or condition. A reasonable protocol is developed on the basis of the facts accumulated in the earlier phases, including completed and submitted animal studies. This phase is conducted by separate groups following the same protocol (with reasonable variations and alternatives permitted by the plan) to produce well-controlled clinical data. For this phase, the following data shall be submitted:
   i. The names and addresses of the investigators. (Additional investigators may be added.)
   ii. The specific nature of the investigations to be conducted, together with information or case report forms to show the scope and detail of the planned clinical observations and the clinical laboratory tests to be made and reported.
   iii. The approximate number of subjects (a reasonable range of subjects is permissible and additions may be made), and criteria proposed for subject selection by age, sex, and condition.
   iv. The estimated duration of the clinical trial and the intervals, exceeding 1 year, at which progress reports showing the results of investigations will be submitted to the Food and Drug Administration.
   c. Institutional review board (IRB). The sponsor must give assurance that an IRB that complies with the requirements set forth in Part 5 of this chapter will be responsible for the initial and continuing review and approval of the proposed clinical study. The sponsor must also provide assurance that the investigators will report to the IRB all changes in the research activity and all unanticipated problems involving risks to human subjects or others, and that the investigators will not make any changes in the research without IRB approval, except where necessary to eliminate apparent immediate hazard to the human subjects. FDA will regard the signing of the Form FDA-1571 as providing the necessary assurances above.

Ordinarily, a plan for clinical trial will not be regarded as reasonable unless, among other things, it provides for more than one independent competent investigator to maintain adequate case histories of an adequate number of subjects, designed to record observations and permit evaluation of any and all discernible effects attributable to the drug in each individual treated, and comparable records on any individuals employed as controls. These records shall be individual records for each subject maintained to include adequate information pertaining to each, including age, sex, conditions treated, dosage, frequency of administration of the drug, results of all relevant clinical observations and laboratory examinations made, adequate information concerning any other treatment given and a full statement of any adverse effects and useful results observed, together with an opinion as to whether such effects or results are attributable to the drug under investigation.

11. A statement that the sponsor will notify the Food and Drug Administration if the investigation is discontinued, and the reason therefor.

12. A statement that the sponsor will notify each investigator if a new-drug application is approved, or if the investigation is discontinued.

13. If the drug is to be sold, a full explanation why sale is required and should not be regarded as the commercialization of a new drug for which an application is not approved.

14. A statement that the sponsor assures that clinical studies in humans will not be initiated prior to 30 days after the date of receipt of the notice by the Food and Drug Administration and that he will continue to withhold or to restrict clinical studies if requested to do so by the Food and Drug Administration prior to the expiration of such 30 days. If such request is made, the sponsor will be provided specific information as to the deficiencies and will be afforded a conference on request. The 30-day delay may be waived by the Food and Drug Administration upon showing of good reason for such waiver; and for investigations subject to institutional review committee approval as described in item 10c above, and additional statement ensuring that the investigation will not be initiated prior to approval of the study by such committee.

15. When requested by the agency, an environmental impact analysis report pursuant to § 25.1 of this chapter.

16. A statement that all nonclinical laboratory studies have been, or will be, conducted in compliance with the good laboratory practice regulations set forth in Part 58 of this chapter, or, if such studies have not been conducted in compliance with such regulations, a statement that describes in detail all differences between the practices used in conducting the study and those required in the regulations.

Very truly yours,

ORIGINAL PAGE IS OF POOR QUALITY

SPONSOR PER

INDICATE AUTHORITY

(This notice may be amended or supplemented from time to time on the basis of the experience gained with the new drug. Progress reports may be used to update the notice.)

ALL NOTICES AND CORRESPONDENCE SHOULD BE SUBMITTED IN TRIPlicate.

41
TO: SUPPLIER OF THE DRUG: (Name and address, include ZIP Code)

DATE

NAME OF DRUG

Dear Sir:

The undersigned submits this statement as required by section 505(i) of the Federal Food, Drug, and Cosmetic Act and § 312.1 of Title 21 of the Code of Federal Regulations as a condition for receiving and conducting clinical pharmacology with a new drug limited by Federal (or United States) law to investigational use.

1. A STATEMENT OF THE EDUCATION AND TRAINING THAT QUALIFIES ME FOR CLINICAL PHARMACOLOGY

2. THE NAME AND ADDRESS OF THE MEDICAL SCHOOL, HOSPITAL, OR OTHER RESEARCH FACILITY WHERE THE CLINICAL PHARMACOLOGY WILL BE CONDUCTED

3. If the experimental project is to be conducted on institutionalized subjects or is conducted by an individual affiliated with an institution which agrees to assume responsibility for the study, assurance must be given that an institutional review committee is responsible for initial and continuing review and approval of the proposed clinical study. The membership must be comprised of sufficient members of varying background, that is, lawyers, clergymen, or laymen as well as scientists, to assure complete and adequate review of the research project. The membership must possess not only broad competence to comprehend the nature of the project, but also other competencies necessary to judge the acceptability of the project or activity in terms of institutional regulations, relevant law, standards of professional practice, and community acceptance. Assurance must be presented that the investigator has not participated in the selection of committee members; that the review committee does not allow participation in its review and conclusions by any individual involved in the conduct of the research activity under review (except to provide information to the committee); that the investigator will report to the committee for review any emergent problems, serious adverse reactions, or proposed procedural changes which may affect the status of the investigation and that no such change will be made without committee approval except where necessary to eliminate apparent immediate hazards; that reviews of the study will be conducted by the review committee at intervals appropriate to the degree of risk, but not exceeding 1 year, to assure that the research project is being conducted in compliance with the committee's understanding and recommendations; that the review committee is provided all the information on the research project necessary for its complete review of the project; and that the review committee maintains adequate documentation of its activities and develops adequate procedures for reporting its findings to the institution. The documents maintained by the committee are to include the names and qualifications of committee members, records of information provided to subjects in obtaining informed consent, committee discussion on substantive issues and their resolution, committee recommendations, and dated reports of successive reviews as they are performed. Copies of all documents are to be retained for a period of 3 years past the completion or discontinuance of the study and are to be made available upon request to duly authorized representatives of the Food and Drug Administration. (Favorable recommendations by the committee are subject to further appropriate review and rejection by institution officials. Unfavorable recommendations, restrictions, or conditions may not be overruled by the institution officials.) Procedures for the organization and operation of institutional review committees are contained in guidelines issued pursuant to Chapter 1-40 of the Grants Administration Manual of the U.S. Department of Health, Education, and Welfare, available from the U.S. Government Printing Office. It is recommended that these guidelines be followed in establishing institutional review committees and that the committees function according to the procedures described therein. A signing of the Form FD-1572 will be regarded as providing the above necessary assurance; however, if the institution has on file with the Department of Health, Education, and Welfare, Division of Research Grants, National Institutes of Health, an "accepted general assurance," and the same committee is to review the proposed study using the same procedures, this is acceptable in lieu of the above assurances and a statement to this effect should be provided with the signed FD-1572. (In addition to sponsor's continuing responsibility to monitor the study, the Food and Drug Administration will undertake investigations in institutions periodically to determine whether the committees are operating in accord with the assurances given by the sponsor.)
4. THE ESTIMATED DURATION OF THE PROJECT AND THE MAXIMUM NUMBER OF SUBJECTS THAT WILL BE INVOLVED

5. A GENERAL OUTLINE OF THE PROJECT TO BE UNDERTAKEN (Modification is permitted on the basis of experience gained without advance submission of amendments to the general outline, but with the approval of the review committee and upon notification of the sponsor.)

THE MAXIMUM NUMBER OF SUBJECTS INVOLVED

THE ESTIMATED DURATION OF THE PROJECT

THE UNDERSIGNED UNDERSTANDS THAT THE FOLLOWING CONDITIONS GENERALLY APPLICABLE TO NEW DRUGS FOR INVESTIGATIONAL USE GOVERN HIS RECEIPT AND USE OF THIS INVESTIGATIONAL DRUG

a. The sponsor is required to supply the investigator with full information concerning the preclinical investigation that justifies clinical pharmacology.

b. The investigator is required to maintain adequate records of the disposition of all receipts of the drug, including dates, quantity, and use by subjects, and if the clinical pharmacology is suspended, terminated, discontinued, or completed, to return to the sponsor any unused supply of the drug. If the investigational drug is subject to the comprehensive Drug Abuse Prevention and Control Act of 1970, adequate precautions must be taken, including storage of the investigational drug in a securely locked, substantially constructed cabinet, or other securely locked, substantially constructed enclosure to which is limited, to prevent theft or diversion of the substance into illegal channels of distribution.

c. The investigator is required to prepare and maintain adequate case histories designed to record all observations and other data pertinent to the clinical pharmacology.

d. The investigator is required to furnish his reports to the sponsor who is responsible for collecting and evaluating the results, and presenting progress reports to the Food and Drug Administration at appropriate intervals, not exceeding 1 year. Any adverse effect which may reasonably be regarded as caused by, or is probably caused by, the new-drug shall be reported to the sponsor promptly, and if the adverse effect is alarming it shall be reported immediately. An adequate report of the clinical pharmacology should be furnished to the sponsor shortly after completion.

e. The investigator shall maintain the records of disposition of the drug and the case reports described above for a period of 2 years following the date the new-drug application is approved for the drug; or if no application is to be filed or is approved until 2 years after the investigation is discontinued and the Food and Drug Administration so notified. Upon the request of a scientifically trained and specifically authorized employee of the Department, at reasonable times, the investigator will make such records available for inspection and copying. The names of the subjects need not be divulged unless the records of the particular subjects require a more detailed study of the cases, or unless there is reason to believe that the records do not represent actual studies or do not represent actual results obtained.

f. The investigator certifies that the drug will be administered only to subjects under his personal supervision or under the supervision of the following investigators responsible to him,


and that the drug will not be supplied to any other investigator or to any clinic for administration to subjects.

g. The investigator certifies that he will inform any patient or any persons used as controls, or their representatives, that drugs are being used for investigational purposes, and will obtain the consent of the subjects, or their representatives, except where this is not feasible or, in the investigator's professional judgment, is contrary to the best interests of the subjects.

h. The investigator is required to assure the sponsor that for investigations involving institutionalized subjects the studies will not be initiated until the institutional review committee has reviewed and approved the study. (The organization and procedure requirements for such a committee should be explained to the investigator by the sponsor as set forth in Form FD-1571, division 10, unit c.)

Very truly yours,

Name of Investigator ____________________________

Address ______________________________________
TO:  SUPPLIER OF DRUG (Name and address, include Zip Code)  
NAME OF INVESTIGATOR (Print or Type)  
NAME OF DRUG  
DATE  

Dear Sir:  
The undersigned,  
 submits this statement as required by section 505(i) of the Federal Food, Drug, and Cosmetic Act and §312.1 of Title 21 of the Code of Federal Regulations as a condition for receiving and conducting clinical investigations with a new drug limited by Federal (or United States) law to investigational use.  

1. STATEMENT OF EDUCATION AND EXPERIENCE  

a. COLLEGES, UNIVERSITIES, AND MEDICAL OR OTHER PROFESSIONAL SCHOOLS ATTENDED, WITH DATES OF ATTENDANCE DEGREES, AND DATES DEGREES WERE AWARDED  

b. POSTGRADUATE MEDICAL OR OTHER PROFESSIONAL TRAINING (Indicate dates, names of institutions, and nature of training)  

c. TEACHING OR RESEARCH EXPERIENCE (Indicate dates, institutions, and brief description of experience)  

d. EXPERIENCE IN MEDICAL PRACTICE OR OTHER PROFESSIONAL EXPERIENCE (Indicate dates, institutional affiliations, nature of practice, or other professional experience)  

2. REPRESENTATIVE LIST OF PERTINENT MEDICAL OR OTHER SCIENTIFIC PUBLICATIONS (Indicate titles of articles, name of publications and volume, page number, and date)  

FORM FDA 1573 (4/79)  
PREVIOUS EDITION MAY BE USED UNTIL SUPPLY IS EXHAUSTED.
2a. If the investigation is to be conducted on institutionalized subjects or is conducted by an individual affiliated with an institution which agrees to assume responsibility for the study, assurance must be given that an institutional review committee is responsible for initial and continuing review and approval of the proposed clinical study. The membership must be comprised of sufficient members of varying background, that is, lawyers, clergymen, or laymen as well as scientists, to assure complete and adequate review of the research project. The membership must possess not only broad competence to comprehend the nature of the project, but also other competencies necessary to judge the acceptability of the project or activity in terms of institutional regulations, relevant law, standards of professional practice, and community acceptance. Assurance must be presented that the investigator has not participated in the selection of committee members; that the review committee does not allow participation in its review and conclusions by any individual involved in the conduct of the research activity under review (except to provide information to the committee); that the investigator will report to the committee for review any emergent problems, serious adverse reactions, or proposed procedural changes which may affect the status of the investigation and that no such change will be made without committee approval except where necessary to eliminate apparent immediate hazards; that reviews of the study will be conducted by the review committee at intervals appropriate to the degree of risk, but not exceeding 1 year, to assure that the research project is being conducted in compliance with the committee's understanding and recommendations; that the review committee is provided all the information on the research project necessary for its complete review of the project; and that the review committee maintains adequate documentation of its activities and develops adequate procedures for reporting its findings to the institution. The documents maintained by the committee are to include the names and qualifications of committee members, records of information provided to subjects in obtaining informed consent, committee discussion on substantive issues and their resolution, committee recommendations, and dated reports of successive reviews as they are performed. Copies of all documents are to be retained for a period of 3 years past the completion or discontinuance of the study and are to be made available upon request to duly authorized representatives of the Food and Drug Administration. (Favorable recommendations by the committee are subject to further appropriate review and rejection by institution officials. Unfavorable recommendations, restrictions, or conditions may not be overruled by the institution officials.) Procedures for the organization and operation of institutional review committees are contained in guidelines issued pursuant to Chapter 1-40 of the Grants Administration Manual of the U.S. Department of Health, Education, and Welfare, available from the U.S. Government Printing Office. It is recommended that these guidelines be followed in establishing institutional review committees and that the committees function according to the procedures described therein. A signing of the Form FD 1573 will be regarded as providing the above necessary assurances; however, if the institution has on file with the Department of Health, Education, and Welfare, Division of Research Grants, National Institutes of Health, an "accepted general assurance," and the same committee is to review the proposed study using the same procedures, this is acceptable in lieu of the above assurances and a statement to this effect should be provided with the signed FD 1573. (In addition to sponsor's continuing responsibility to monitor the study, the Food and Drug Administration will undertake investigations in institutions periodically to determine whether the committees are operating in accord with the assurances given by the sponsor.)

b. A description of any clinical laboratory facilities that will be used. (If this information has been submitted to the sponsor and reported by him on Form FD 1571, reference to the previous submission will be adequate).

3. The investigational drug will be used by the undersigned or under his supervision in accordance with the plan of investigation described as follows: (Outline the plan of investigation including approximation of the number of subjects to be treated with the drug and the number to be employed as controls, if any; clinical uses to be investigated; characteristics of subjects by age, sex and condition; the kind of clinical observations and laboratory tests to be undertaken prior to, during, and after administration of the drug; the estimated duration of the investigation; and a description or copies of report forms to be used to maintain an adequate record of the observations and test results obtained. This plan may include reasonable alternates and variations and should be supplemented or amended when any significant change in direction or scope of the investigation is undertaken.)
4. THE UNDERSIGNED UNDERSTANDS THAT THE FOLLOWING CONDITIONS, GENERALLY APPLICABLE TO NEW DRUGS FOR INVESTIGATIONAL USE, GOVERN HIS RECEIPTS AND USE OF THIS INVESTIGATIONAL DRUG:

a. The sponsor is required to supply the investigator with full information concerning the preclinical investigations that justify clinical trials, together with fully informative material describing any prior investigations and experience and any possible hazards, contraindications, side-effects, and precautions to be taken into account in the course of the investigation.

b. The investigator is required to maintain adequate records of the disposition of all receipts of the drug, including dates, quantities, and use by subjects, and if the investigation is terminated, suspended, discontinued, or completed, to return to the sponsor any unused supply of the drug. If the investigational drug is subject to the Comprehensive Drug Abuse Prevention and Control Act of 1970, adequate precautions must be taken including storage of the investigational drug in a securely locked, substantially constructed cabinet, or other securely locked substantially constructed enclosure, access to which is limited, to prevent theft or diversion of the substance into illegal channels of distribution.

c. The investigator is required to prepare and maintain adequate and accurate case histories designed to record all observations and other data pertinent to the investigation on each individual treated with the drug or employed as a control in the investigation.

d. The investigator is required to furnish his reports to the sponsor of the drug who is responsible for collecting and evaluating the results obtained by various investigators. The sponsor is required to present progress reports to the Food and Drug Administration at appropriate intervals not exceeding 1 year. Any adverse effect that may reasonably be regarded as caused by, or probably caused by, the new drug shall be reported to the sponsor promptly, and if the adverse effect is alarming, it shall be reported immediately. An adequate report of the investigation should be furnished to the sponsor shortly after completion of the investigation.

e. The investigator shall maintain the records of disposition of the drug and the case histories described above for a period of 2 years following the date a new-drug application is approved for the drug; or if the application is not approved, until 2 years after the investigation is discontinued. Upon the request of a scientifically trained and properly authorized employee of the Department, at reasonable times, the investigator will make such records available for inspection and copying. The subjects' names need not be divulged unless the records of particular individuals require a more detailed study of the cases, or unless there is reason to believe that the records do not represent actual cases studied, or do not represent actual results obtained.

f. The investigator certifies that the drug will be administered only to subjects under his personal supervision or under the supervision of the following investigators responsible to him,

__________________________
(Name of Investigator)

__________________________
(Address)

h. The investigator is required to assure the sponsor that for investigations involving institutionalized subjects, the studies will not be initiated until the institutional review committee has reviewed and approved the study. The organization and procedure requirements for such a committee should be explained to the investigator by the sponsor as set forth in Form FD 1571, division 10, unit c.

Very truly yours,

__________________________
(Name of Investigator)

__________________________
(Address)

ORIGINAL PAGE IS OF POOR QUALITY

(This form should be supplemented or amended from time to time if new subjects are added or if significant changes are made in the plan of investigation.)

NASA-JSC
I. INTRODUCTION

An institution of higher education is eligible to receive funds for research from the Department of Health and Human Services (HHS) only if the institution complies with certain policies designed to protect human research subjects. This eligibility is secured initially by submission for HHS approval of an institutional assurance, which is a written document committing the institution to policy and procedural requirements in research. Specifically, the assurance must include a statement of principles for the protection of human subjects of research conducted at or sponsored by the institution (regardless of funding source), designation of an institutional review board (IRB) with certain prescribed research review functions, an identification of IRB members, and written procedures to be followed by the IRB in carrying out its functions. The purpose of this document is to put in place at The University of Alabama in Huntsville the foregoing policies, procedures, and mechanisms as the predicate for an approved assurance.

II. INSTITUTIONAL REVIEW BOARD - STRUCTURE AND ROLE

A. Establishment and Composition.

1. The Use of Human Subjects in Research Committee (hereinafter referred to as the "UHSRC") has been established as the Institutional Review Board (hereinafter referred to as the "IRB") for The University of Alabama in Huntsville.

2. The UHSRC shall be composed of at least five (5) members, with diverse backgrounds possessing the professional competence to promote complete and adequate review of research activities and ascertain acceptability in terms of institutional commitments and regulations, applicable law and standards of professional conduct and practice.

3. Representation on the UHSRC shall include:
   a. Men and women,
   b. Representation of more than one profession,
   c. At least one member whose primary concerns are non-scientific, i.e., lawyer, ethicist, clergy member,
   d. At least one member who is not affiliated with UAH, either personally or by immediate familial relationship.

4. No person shall serve as a member of the UHSRC where such service would constitute a conflict of interest involving the proposed research project under review.

5. The UHSRC will invite individuals with specific competencies to assist in its review of complex issues. Within the scope of their
invitations, these invited individuals will serve as full members of the UHSRC, except that they shall not have a vote.

B. Function and Operation.

1. The UHSRC shall follow written procedures for full review at convened meetings at which a majority of members are present, which shall include at least one member whose primary concerns are in non-scientific areas. In order for research to be approved it shall receive the approval of a majority of those members present at the meeting.

2. The UHSRC shall be responsible for reporting to the appropriate University officials and the Secretary of the Department of Health and Human Services (hereinafter referred to as "HHS") any serious or continuing non-compliance by investigators with the requirements and determinations of the UHSRC.

3. The following definitions apply throughout these procedures:
   a. "Certification" means the official notification by the University to the HHS in accordance with the requirements of the applicable federal regulations that a research project or activity involving human subject has been reviewed and approved by the UHSRC in accordance with the approved assurance on file at HHS.
   b. "Human Subject" means a living individual about whom an investigator conducting research obtains either date through intervention or interaction with the individual, or identifiable private information.
   c. "Interaction" includes communication or interpersonal contact between investigator and subject.
   d. "Intervention" includes both physical procedures by which data are gathered in manipulation of the subject or subject's environment that are performed for research purposes.
   e. "Minimal Risk" means that the risks of harm anticipated in the proposed research are not greater, considering probability and magnitude, than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.
   f. "Private Information" includes information about behavior that occurs in a context in which an individual can reasonably expect that no observation or recording is taking place and information which has been provided for specific purposes by an individual in which the individual can reasonably expect will not be made public. Private information must be individually identifiable in order for obtaining the information to constitute research involving human subjects.
   g. "Research" means a systematic investigation designed to
develop or contribute to generalizable knowledge. Activities which meet this definition constitute "research" for purposes of these procedures, whether or not they are supported or funded under a program which is considered "research" for other purposes.

C. Records

The UHSRC shall maintain the following records:

1. A statement of principles governing the University in the discharge of its responsibilities for protecting the right and welfare of human subjects of research conducted at, or sponsored by, the University, regardless of source of funding.

2. Records reflecting that the UHSRC has been designated by the University as its IRB and that provisions have been made for meeting space and sufficient staff to support review and record keeping duties.

3. A list of the UHSRC members identified by name, earned degrees, representative capacity, indications of experience such as board certification, licenses, etc. sufficient to describe each member's chief anticipated contributions to the UHSRC deliberations and any employment or other relationship between each member and the institution. Changes in the UHSRC membership shall be reported to the Secretary of HHS.

4. Written procedures which the UHSRC will follow:
   a. For conducting its initial and continuing review of research and for reporting its findings and actions to the investigator and to the University;
   b. For determining which projects require review more often than annually and which projects need verification from sources other than the investigators that no material changes have occurred since previous review by the UHSRC;
   c. For insuring prompt reporting to the UHSRC of proposed changes in a research activity, and for insuring that changes in approved research, during the period for which UHSRC approval has already been given may not be initiated without UHSRC review and approval except where necessary to eliminate apparent immediate hazards to the subject; and
   d. For insuring prompt reporting to the UHSRC and to the Secretary of HHS of unanticipated problems involving risks to subjects or others.

5. The assurance which shall be executed by an individual authorized to act for the University and to assume on behalf of the University the obligations imposed by applicable federal regulations.

6. Copies of all applications or proposals submitted to HHS. Within sixty (60) days after the date of submission to HHS of an application or
proposal, the UHSRC shall certify that the application or proposal has been reviewed and approved.

III.

INSTITUTIONAL REVIEW BOARD REVIEW PROCESS

A. Exempt Review.

1. Certain research activities are considered exempt from the usual process of the UHSRC. As listed below, these activities do not require informed consent unless the Secretary of HHS specifically determines that the project presents a danger to the physical, mental, or emotional well-being of a participant of the project. Projects of an institutional or training grant nature that may eventually involve human subjects do not require UHSRC review for the initial request for funds. However, any activities that are not exempt as listed below must have UHSRC review and HHS certification before human subjects are actually involved in the project.

2. The following activities are considered exempt from UHSRC review:

a. Research to be conducted in established or commonly accepted educational settings, involving normal educational practices, such as

i. research on regular or special educational instructional strategies, or

ii. research on the effectiveness of, or the comparison among, instructional techniques, curricular, or classroom management methods.

b. Research which will involve the use of educational tests (cognitive, diagnostic, aptitude, achievement), if the information taken from these sources is to be recorded in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

c. Research which will involve survey or interview procedures. No exemption can be given under this subsection if

i. the research involves children as subjects, or

ii. the subjects could be identified directly or through identifiers linked to the subjects and

   Number One. The subject's responses if known outside the research could place them at risk of civil or criminal liability, damage their financial standing or employability, or

   Number Two. The research deals with sensitive areas
such as illegal conduct, drug or alcohol use or sexual behavior.

d. Research which will involve survey or interview of elected or appointed officials or candidates for public office.

e. Research which will involve the observation (including observation by participants) of public behavior. No exemption can be given under this subsection

i. for research involving children in which the investigator participates in the activities being observed.

ii. if the subjects could be identified directly or through identifiers linked to the subjects and

Number One. The subject’s responses if known outside the research could place them at risk of civil or criminal liability, damage their financial standing or employability or

Number Two. The research deals with sensitive areas such as illegal conduct, drug or alcohol use or sexual behavior.

f. Research which will involve the collection or study of existing data, documents, records, pathological specimens or diagnostic specimens if these sources are publicly available or if the information is to be recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

B. Expedited Review.

Expedited review is allowed of research activities which involve no more than minimal risks to human subjects and which can be placed in one or more of the ten categories noted below. Expedited review is not allowed for research involving children except for collections which are part of the usual diagnostic or therapeutic regimen of children. The following activities may be considered for expedited review:

1. Collection of hair and nail clippings in a non-disfiguring manner; deciduous teeth; and permanent teeth if patient care indicates a need for extraction.

2. Collection of excreta and external secretions of sweat, uncannulated saliva, placenta removal at delivery and amniotic fluid at the time of rupture of membranes prior to or during labor.

3. Recording of data from subject 18 years of age or older using noninvasive procedures routinely employed in clinical practice. This includes the use of physical sensors that are applied either to the surface of the body or at a distance and do not involve input of matter of
significant amounts of energy into the subject or an invasion of the sub-
ject's privacy. It also includes such procedures as weighing, testing
sensory acuity, electrocardiography, electroencephalography, thermography,
detection of naturally occurring radioactivity, diagnostic echography, and
electroneuretinography. It does not include exposure to electromagnetic
radiation outside the visible range (for example, x-rays, microwaves).

4. Collection of blood samples by venipuncture, in amounts not
exceeding 450 milliliters in an eight-week period and no more often than two
times per week, from subjects 18 years of age or older and who are in good
health and not pregnant.

5. Collection of both supra- and subgingival dental plaque and
calculus, provided the procedure is not more invasive than routine
prophylactic scaling of the teeth and the process is accomplished in ac-
cordance with accepted prophylactic techniques.

6. Voice recordings made for research purposes such as investigations
of speech defects.

7. Moderate exercise by healthy volunteers.

8. The study of existing data, documents, records, pathological
specimens, or diagnostic specimens.

9. Research on individual or group behavior or characteristics of
individuals, such as studies of perception, cognition, game theory, or test
development, where the investigator does not manipulate subjects' behavior
and the research will not involve stress to subjects. Research involving
sensitive matters such as sexual or political behavior may require full
review. Expedited review is not appropriate if the subject's responses, if
known outside the research, could place them at risk of civil or criminal
liability or damage their financial standing or employability.

10. Research on drugs or devices for which an investigational new drug
exemption or an investigational device exemption is not required.

The expedited review may be carried out by the UHSRC chair person or by
one or more experienced reviewers designated by the chair person from among
members of the UHSRC. These reviewers exercise all the authorities of the
UHSRC for approval of research, but disapproval requires subsequent full
review. Proposals approved in this manner will be discussed at the next
regular meeting of the UHSRC. The use of the expedited review may be
suspended or terminated by the Secretary of HHS when necessary to protect
the rights or welfare of subjects.

C. Full Review.

1. In general, full review of all proposed research projects involv-
ing the use of human subjects will be required for all non-exempt research
projects which do not qualify for an expedited review.

a. In the event research is undertaken without the intention of
involving human subjects, but it is later proposed to use
human subjects in the research, at the time of the proposal to use human subjects the research shall then be reviewed and approved by the UHSRC and a certification submitted to, and approved by, the HHS.

b. Cooperative research projects are those projects, normally supported through grants, contracts, or similar arrangements, which involve institutions in addition to the grantee or prime contractor. In the case of a cooperative research project in which the University is the grantee or prime contractor, then the University will remain responsible to HHS for safeguarding the rights and welfare of human subjects. Also, when the University joins with another institution in a cooperative research project, the University will comply with these procedures as though it received funds for its participation in the project directly from HHS. In cases involving cooperative research projects, the University may use joint review, reliance upon the review of another qualified IRB or similar arrangements aimed at avoidance of duplication of effort.

2. Criteria for approval of research.

a. In order to approve research covered by these procedures the UHSRC shall determine that all of the following requirements are satisfied:

i. risks to subjects are minimized:

   Number One. By using procedures which are consistent with sound research design and which do not unnecessarily expose subjects to risks, and

   Number Two. Whenever appropriate, by using procedures already being performed on the subjects for diagnostic or treatment purposes.

ii. risks to subjects are reasonable in relation to anticipated benefits, if any, to subject, and the importance of the knowledge that may reasonably be expected to result. In evaluating risks and benefits, the UHSRC will consider only those risks and benefits that may result from the research (as distinguished from risks and benefits of therapy subjects would receive even if not participating in the research). The UHSRC will not consider possible long-range effects of applying knowledge gained in the research (for example, the possible effects of the research on public policy) as among those research risks that fall within the purview of its responsibility.

iii. selection of subjects is equitable. In making this assessment the UHSRC will take into account the purposes of the research and the setting in which the research
will be conducted.

iv. informed consent will be sought from each prospective subject or the subject's legally authorized representative, in accordance with, the provisions of Section III (C)(3).

v. informed consent will be appropriately documented, in accordance with the provisions of Section III (C)(3).

vi. where appropriate, the research plan makes adequate provision for monitoring the data collected to insure the safety of subjects.

vii. where appropriate, there are adequate provisions to protect privacy of subjects and to maintain the confidentiality of data.

b. Where some or all of the subjects are likely to be vulnerable to coercion or undue influence, such as persons with acute or severe physical or mental illness, or persons who are economically or educationally disadvantaged, appropriate additional safeguards must be included in the study to protect the rights and welfare of these subjects.

3. Informed consent.

a. Except as provided elsewhere in these procedures, no investigator may involve a human being as a subject in research covered by these procedures unless the investigator has obtained the legally effective informed consent of the subject or the subject's legally authorized representative. An investigator shall seek such consent only under circumstances that provide the prospective subject or the representative sufficient opportunity to consider whether or not to participate and that minimize the possibility of coercion or undue influence. The information that is given to the subject or the representative shall be in language understandable to the subject or the representative. No informed consent, whether oral or written, may include any exculpatory language through which the subject or the representative is made to waive or appear to waive any of the subject's legal rights, or releases or appears to release the investigator, the sponsor, the institution or its agents from liability for negligence.

b. Except as provided elsewhere in this section, in seeking informed consent the following information shall be provided to each subject:

i. a statement that the study involves research, an explanation of the purposes of the research and the expected duration of the subject's participation, a description
of the procedures to be followed, and identification of any procedures which are experimental;

ii. a description of any reasonably foreseeable risks or discomforts to the subject;

iii. a description of any benefits to the subject or to others which may reasonably be expected from the research;

iv. a disclosure of appropriate alternative procedures or courses of treatment, if any, that might be advantageous to the subject;

v. a statement describing the extent, if any, to which confidentiality of records identifying the subject will be maintained;

vi. for research involving more than minimal risks, an explanation as to whether any compensation and an explanation as to whether any medical treatments are available if injury occurs and, if so, what they consist of, or where further information may be obtained;

vii. an explanation of whom to contact for answers to pertinent questions about the research and research subject's rights, and whom to contact in the event of a research-related injury to the subject; and

viii. a statement that participation is voluntary, refusal to participate will involve no penalty or loss of benefits to which the subject is otherwise entitled, and the subject may discontinue participation at any time without penalty or loss of benefits to which the subject is otherwise entitled.

c. When appropriate, one or more of the following elements of information shall also be provided to each subject:

i. a statement that the particular treatment or procedure may involve risks to the subject (or to the embryo or fetus, if the subject is or may become pregnant) which are currently unforeseeable;

ii. anticipated circumstances under which the subject's participation may be terminated by the investigator without regard to the subject's consent;

iii. any additional cost to the subject that may result from participation in the research;

iv. the consequences of a subject's decision to withdraw from the research and procedures for orderly termination of participation by the subject;
v. a statement that significant new findings developed during the course of the research which may relate to the subject's willingness to continue participation will be provided to the subject; and

vi. the approximate number of subjects involved in the study.

d. The UHSRC may approve a consent procedure which does not include, or which alters, some or all of the elements of informed consent set forth above, or waive the requirement to obtain informed consent provided that the UHSRC finds and documents that:

i. the research or demonstration project is to be conducted by or subject to the approval of state or local government officials and is designed to study, evaluate, or otherwise examine:

   Number One: Programs under the Social Security Act, or other public benefit or service program;

   Number Two: Procedures for obtaining benefits or services under those programs;

   Number Three: Possible changes in or alternatives to those programs or procedures; or

   Number Four: Possible changes in methods or levels of payment for benefits for services under those programs; and

ii. the research could not practicably be carried out without the waiver or alteration.

e. The UHSRC may approve a consent procedure which does not include, or which alters, some or all of the elements of informed consent set forth above, or waive the requirements to obtain informed consent provided the UHSRC finds and documents that:

i. the research involves no more than minimal risk to the subjects;

ii. the waiver or alteration will not adversely effect the rights and welfare of the subject;

iii. the research could not practicably be carried out without the waiver or alteration; and

iv. whenever appropriate, the subjects will be provided with additional pertinent information after participation.

f. Nothing in these procedures is intended to limit the
authority of a physician to provide emergency medical care, to the extent the physician is permitted to do so under applicable federal, state or local law.

g. Except as otherwise provided, informed consent shall be documented by the use of a written consent form approved by the UHSRC and signed by the subject or subject's legally authorized representative. A copy shall be given to the person signing the form.

h. Except as otherwise provided, the consent form may be either of the following:

i. a written consent document that embodies the elements of informed consent required by Section III(C)(3) of these procedures. This form may be read to the subject or the subject's legally authorized representative, but in any event, the investigator shall give either the subject or the representative adequate opportunity to read it before it is signed; or

ii. a "short form" written consent document stating that the elements of informed consent required by Section III(C)(3) have been presented orally to the subject or the subject's legally authorized representative. When this method is used, there shall be a witness to the oral presentation. Also, the oral presentation shall include those items contained in a written summary, which has received the prior approval of the UHSRC, of what is to be said to the subject or the representative. Only the short form itself is to be signed by the subject or the representative. However, the witness shall sign both the short form and a copy of the summary, and the person actually obtaining consent shall sign a copy of the summary. A copy of the summary shall be given to the subject or the representative in addition to a copy of the "short form."

i. The UHSRC may waive the requirement for the investigator to obtain a signed consent form for some or all of the subject if it finds either:

i. that the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern; or

ii. that the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.
j. In cases where the documentation requirement for informed consent is waived, the UHSRC may require the investigator to provide such subjects with a written statement regarding the research.

4. The UHSRC shall have authority to suspend or terminate approval of research that is not being conducted in accordance with UHSRC's requirements or that has been associated with unexpected serious harm to subjects. Any suspension or termination of approval shall include a statement of the reasons for the UHSRC's action and shall be reported promptly to the investigator, appropriate institutional officials, and the Secretary of HHS at the Office for Protection from Research Risks, National Institutes of Health, Department of Health and Human Services, Bethesda, Maryland, 20205.

5. Procedures.

IV.

SPECIAL REQUIREMENTS - RESEARCH INVOLVING FETUSES, PREGNANT WOMAN AND HUMAN IN VITRO FERTILIZATION

A. The UHSRC has special responsibilities in research involving fetuses, pregnant women, and human in vitro fertilization. This includes monitoring the actual informed consent process and may extend to approval of procedures for induction of individuals into the activity. The Secretary of HHS, through a specific Ethical Advisory Board, has the responsibility for final review of these activities.

B. In general, the following criteria must be satisfied for UHSRC approval of research projects involving fetuses, pregnant women and human in vitro fertilization:

1. Appropriate studies on animals and nonpregnant individuals must have been completed.

2. The risk to the fetus is minimal.

3. The investigator must have no role in determining viability of the fetus or decision-making at the termination of the pregnancy.

4. No inducements may be made for pregnancy termination.

5. Maternal and paternal informed consent is required, except that the paternal consent need not be secured if:
   a. the identity or whereabouts of the father cannot reasonably be ascertained,
   b. the father is not reasonably available, or
   c. the pregnancy resulted from rape.

6. Ex utero fetuses may be involved if no added risks results from the activity and if the purpose of the activity is to obtain knowledge which
cannot be obtained by other methods or to enhance the possibility of survival of the fetus.

7. Non-viable ex utero fetuses can be involved only if the activity does not affect vital functions and there is no way to obtain the knowledge in any other way.

8. Dead fetal material may be included in studies in accordance with state and local law.

C. Upon the request of an applicant and with UHSRC approval, the Secretary of HHS may modify or waive these criteria, with the approval of the Ethical Advisory Board. This will be done after an appropriate opportunity for public comment, and consideration will be given to whether the risk to the subject are so outweighed by the sum of the benefit as to warrant such action.

V.

SPECIAL REQUIREMENTS - RESEARCH INVOLVING CHILDREN

A. For purposes of this part of the procedures, the following definitions shall apply:

1. "Children" are persons who have not attained the legal age for consent to treatments or procedures involved in the research, which under the law of the State of Alabama at the time of the execution of these procedures is nineteen (19) years of age.

2. "Assent" means a child's affirmative agreement to participate in research. Mere failure to object should not, absent affirmative agreement, be construed as assent.

3. "Permission" means the agreement of parent(s) or guardian to the participation of their child or ward in research.

4. "Parent" means a child's biological or adoptive parent.

5. "Guardian" means an individual who is authorized under the law of this state to consent on behalf of a child to general medical care.

B. The UHSRC will approve research not involving greater than minimal risk to children only if the UHSRC finds that adequate provisions are made for soliciting the assent of the children and the permission of their parents or guardians as described below.

C. The UHSRC will approve research in which the UHSRC finds that more than minimal risk to children is presented by an intervention or procedure that holds out the prospect of direct benefit for the individual subject, or by a monitoring procedure that is likely to contribute to the subject's well-being, only if the UHSRC finds that:

1. The risk is justified by the anticipated benefit to the subject;
2. The relation of the anticipated benefit to the risk is at least as favorable to the subjects as that presented by available alternative approaches; and

3. Adequate provisions are made for soliciting the assent of the children and permission of their parents or guardians as set forth below.

D. The UHSRC will approve research involving greater than minimal risks and no prospect of direct benefit to individual subjects, but likely to yield generalizable knowledge about the subject's disorder or condition, only if the UHSRC finds that:

1. The risk represents a minor increase over minimal risk;

2. The intervention or procedure presents experiences to subjects that are reasonably commensurate with those inherent in their actual or expected medical, dental, psychological, social, or educational situations;

3. The intervention or procedure is likely to yield generalizable knowledge about the subject's disorder or condition which is of vital importance for the understanding amelioration of the subject's disorder or condition; and

4. Adequate provisions are made for soliciting assent of the children and permission of their parents or guardians as set forth below.

E. If research is not otherwise approvable pursuant to the provisions of Sections V(B)-(D), then the UHSRC will approve the proposed research only if:

1. The UHSRC finds that the research presents a reasonable opportunity to further the understanding, prevention, or alleviation of a serious problem affecting the health or welfare of children; and

2. The proposed research has been approved by the Secretary of HHS.

F. Requirements for permission by parents or guardian and for assent by children.

1. In addition to the determinations required under other applicable sections of these procedures, the UHSRC shall determine that adequate provisions are made for soliciting the assent of the children, when in the judgment of the UHSRC the children are capable of providing assent. In determining whether children are capable of assenting, the UHSRC shall take into account the ages, maturity, and psychological state of the children involved. This judgment may be made for all children to be involved in research under a particular protocol, or for each child, as the UHSRC deems appropriate. If the UHSRC determines that the capability of some or all of the children is so limited that they cannot reasonably be consulted without the interventional or procedure involved in the research holds out a prospect of direct benefit that is important to the health or well-being of the children and is available only in the context of the research, the assent of the children is not a necessary condition for proceeding with the research. Even where the UHSRC determines that the subjects are capable of assenting,
the UHSRC may still waive the assent requirements under circumstances in which consent may be waived in accordance with Section __________.

2. In addition to the determinations required under other applicable sections of these procedures, the UHSRC shall determine, in accordance with and to the extent that consent is required by Section __________, that adequate provisions are made for soliciting the permission of each child's parents or guardian. Where parental permission is to be obtained, the UHSRC may find that the permission of one parent is sufficient for research to be conducted under Sections V(B) or V(C). Where research is covered by Section V(D) and V(E) and permission is to be obtained from parents, both parents must give their permission unless one parent is deceased, unknown, incompetent, or not reasonably available, or when only one parent has legal responsibility for the care and custody of the child.

3. In addition to the provisions for waiver contained in Section __________, if the UHSRC determines that a research protocol is designed for conditions or for a subject population for which parental or guardian permission is not a reasonable requirement to protect the subjects (for example, neglected or abused children), it may waive the consent requirements, provided an appropriate mechanism for protecting the children who will participate as subjects in the research is substituted, and provided further that the waiver is not inconsistent with federal, state or local law. The choice of an appropriate mechanism would depend upon the nature and purpose of the activities described in the protocol, the risk and anticipated benefit to the research subjects, and their age, maturity, status and condition.

4. Permission by parents or guardians shall be documented in accordance with and to the extent required by Section __________.

5. When the UHSRC determines that assent is required, it shall also determine whether and how assent must be documented.
**Duke-UNC Health Profile**

**Instructions:**
Here are a number of questions about your health and feelings. Please read each question carefully and check (✓) your best answer. You should answer the questions in your own way. There are no right or wrong answers.

---

### DURING THE PAST WEEK: How much trouble have you had with:

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Some</th>
<th>A Lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Eyesight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Hearing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Talking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Tasting food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) Appetite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) Chewing food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7) Swallowing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8) Breathing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9) Sleeping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10) Moving your bowels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11) Passing water/urinating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12) Headache</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13) Hurting or aching in any part of your body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14) Itching in any part of your body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15) Indigestion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16) Fever</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17) Getting tired easily</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18) Fainting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19) Poor memory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20) Weakness in any part of your body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21) Feeling depressed or sad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22) Nervousness</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DURING THE PAST MONTH: how much trouble have you had with:

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Some</th>
<th>A Lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>23) Undesired weight loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24) Undesired weight gain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25) Unusual bleeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26) Sexual performance (Having sex)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---
**DURING THE PAST WEEK** how often did you:

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at All</th>
<th>1-4 Days</th>
<th>5-7 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>27) Do your usual work (either inside or outside the home) ..................</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28) Get your work done as carefully and accurately as usual ................</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29) Socialize with other people (talk or visit with friends or relatives)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30) Take part in social, religious or recreation activities (meetings,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>church, movies, sports, parties)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31) Care for yourself (bathe, dress, feed yourself)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DURING THE PAST WEEK:**

<table>
<thead>
<tr>
<th>Question</th>
<th>None</th>
<th>1-4 Days</th>
<th>5-7 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>32) How many days did you stay <em>in your home</em> because of sickness, injury</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>or health problems?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33) How many days were you <em>in bed</em> most of the day because of sickness,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>injury or health problems?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TODAY** would you have any physical trouble or difficulty:

<table>
<thead>
<tr>
<th>Question</th>
<th>None</th>
<th>Some</th>
<th>A Lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>34) Peeling an apple</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35) Combing your hair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36) Walking to the bathroom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37) Walking up a flight of stairs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38) Running the length of a football field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39) Running a mile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40) Running 5 miles</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Instructions:
Here are some statements you could use to describe how you feel about yourself. Please read each statement carefully and place a check (✓) in the blank that best fits how the statement describes you.
Here is an example:

I like T.V. soap operas ........................................... ✓
(If you put a check where we have, it means that liking T.V. soap operas describes you more than "somewhat" but not "exactly".)
Answer each item as best you can. There are NO right or wrong answers.

<table>
<thead>
<tr>
<th>Yes, describes me exactly</th>
<th>Somewhat describes me</th>
<th>No, doesn't describe me at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>41) I am a pleasant person ...........................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42) I don't feel useful ..................................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43) I get on well with people of the opposite sex ..................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44) My family doesn't understand me ..................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45) I like who I am ..........................................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46) I feel hopeful about the future .....................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47) I try to look my best ....................................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48) I am a clumsy person ....................................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49) I have difficulty making decisions .................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50) I like meeting new people ..............................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51) I'm not an easy person to get along with ...........................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52) I'm a failure at everything I try to do .............................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53) I'm basically a healthy person ........................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54) I wish I had more sex appeal ..........................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55) I give up too easily ......................................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56) I like the way I look .....................................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>57) I'm not as smart as most people ......................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>58) I have difficulty concentrating ......................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>59) I'm satisfied with my sexual relationships ........................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60) I am happy with my family relationships ...........................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>61) I don't treat other people well .......................................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>62) I am comfortable being around people ..............................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>63) I can take care of myself in most situations ........................</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DAILY HEALTH RECORD

DAY # 1

An example Health Record is included in your folder.

DAY OF THE WEEK ____________________________
DATE ____________________________
TIME ____________________________

How did you feel physically today? (Put an 'X' in the box which best describes how you felt)

1 2 3 4 5 6 7 8 9 10

TERrible WONDERFUL
2. Did you have any symptoms or discomforts today? (Fill out the chart below from left to right for each symptom or set of symptoms)

<table>
<thead>
<tr>
<th>NUMBERS BELOW CAN BE USED IN Qs 3 AND 4</th>
<th>2a SYMPTOMS &amp; DISCOMFORTS</th>
<th>2b CAUSE</th>
<th>Not illness or injury</th>
<th>2c SERIOUSNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Write symptoms of the same health problem in one box.</td>
<td>Illness, name the illness</td>
<td>write what you think caused the symptoms</td>
<td>In your opinion, how serious was this condition or set of symptoms today?</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 1. Very Serious
- 3. Somewhat Serious
- 5. Not Very Serious

Go to Question 6
3. Because of today's symptoms, did you cut down on the things you usually do?

☐ 1 Yes ☐ 5 No   Go to Question 4

Answer 3a through 3e

3a. Did you stay in bed? ☐ No ☐ Yes
3b. Did you cut down on household chores or errands? ☐ No ☐ Yes
3c. Did you miss work? ☐ No ☐ Yes
3d. Did you miss school? ☐ No ☐ Yes
3e. Did you cut down on other activities you planned to do (sports, clubs, church, etc.)? ☐ No ☐ Yes

For which symptom, illness, or injury? (Write in number from symptom chart, question 2)

4. Did you seek medical or dental help about today's symptoms?

☐ 1 Yes ☐ 5 No   Go to Question 5

Answer 4a through 4e

4a. Did you make an appointment with a doctor or dentist? ☐ No ☐ Yes
4b. Did you telephone a clinic, doctor's office or dentist's office and get advice? ☐ No ☐ Yes
4c. Did you visit a clinic, doctor's or dentist's office or an emergency room? ☐ No ☐ Yes
4d. Did you get admitted to a hospital? ☐ No ☐ Yes
4e. Was there anything else you did? (If YES: What was that?) ☐ No ☐ Yes
5 Did you talk with anyone else today — such as relatives, neighbors, friends — about your symptoms?

☐ 1 Yes
☐ 5. No ☐ Go to Question 6

5a. Who did you talk with? (Check all boxes that apply)

☐ A. Your husband/wife
☐ B. Other member of your household
☐ C. Relative not living with you
☐ D. Neighbor, coworker, friend (who is not a relative or household member)
☐ E. Other person (druggist, minister, priest, etc.)

Who did you speak with? ____________________________

6 Did you visit or telephone a clinic, doctor or dentist's office, or hospital today for any reason besides symptoms you might have had today?

☐ 1. Yes
☐ 5. No ☐ Go to Question 7

6a. For what reasons?

______________________________

______________________________

______________________________

______________________________

ORIGINAL PAGE IS OF POOR QUALITY
Did you take any pills, medicine, or treatments for your health today — to treat a symptom, prevent illness, or to become more healthy in general? (Fill out the chart below from left to right)

<table>
<thead>
<tr>
<th>7a PILLS, MEDICINE, TREATMENTS</th>
<th>7b REASONS FOR TAKING PILLS, MEDICINE, TREATMENTS</th>
<th>7c SYMPTOM OR CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>If pills or medicine, write the brand name from the label and the type of drug. Use one box for each pill, medicine or treatment.</td>
<td>(Check all boxes that apply)</td>
<td>What was the symptom, health problem, or other reason for taking pills, medicine, or treatment?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
<td>□ A □ B □ C □ D</td>
</tr>
</tbody>
</table>

Go to 7c

Go to 7c

Go to 7c

Go to 7c

Go to 7c
8 How were your spirits today? (Put an "X" in the box which best describes how you felt today)

1 2 3 4 5 6 7 8 9 10
TERRIBLE WONDERFUL

9 Did anything happen — for better or worse — to make today different than usual?

☐ 1 Yes ☐ 5 No Go to Question 10

9a. What happened? (Check all boxes that apply)

☐ A Birthday, holiday, or special social event
☐ B Trip or vacation
☐ C Emergency
☐ D Trouble with family or friends
☐ E Something extra nice with family or friends
☐ F A lot of extra work
☐ G Guests
☐ H Other What happened?

________________________________________________________________________

10 Any other comments:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

REMINDER:

IF you had any symptoms today
Be sure you answered Questions 1, 2, 3, 4, 5, 6, 7, 8, and 9

IF you had no symptoms today
Be sure you answered Questions 1, 2, 6, 7, 8, and 9.
APPENDIX D
MEDICAL EVALUATION, SUBJECTS
FOR WATER RECOVERY TEST, MSFC

NAME: ____________________________

LAST   FIRST   MIDDLE

ADDRESS: ____________________________________________________

______________________________________________________________

AGE_____   DATE OF BIRTH__________

WORK AREA: ________________________ WORK PHONE: ____________

HOME PHONE: ________________ MAIL CODE: ______________

IN CASE OF EMERGENCY, CONTACT: ________________________________

______________________________________________________________

PHONE: __________________________

PERSONAL PHYSICIAN: ________________________________

ADDRESS: __________________________________ PHONE: __________

INITIAL EVALUATION

<table>
<thead>
<tr>
<th></th>
<th>NL</th>
<th>ABNL</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHRONIC ILLNESSES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MENSTRUAL HISTORY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RECENT ILLNESSES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOPICAL USE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HABITS (D, T, A)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SKIN/HAIR DISORDER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MINOR ILLNESS FREQUENCY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICAL EXAM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SKIN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEENT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LUNGS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEART</td>
<td>NL</td>
<td>ABNL</td>
<td>COMMENTS</td>
</tr>
<tr>
<td>-------</td>
<td>----</td>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>ABD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEURO/MS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEALTH PROFILE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LABORATORY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROUTINE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECIAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SKIN TEST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANERGY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYMPTOM DIARY</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I have examined the above named subject and believe he/she (is) (is not) qualified to be involved in the water recovery test at MSFC.

_________________________ M.D.  __/__/____

DATE
APPENDIX D
MEDICAL EVALUATION, SUBJECTS
FOR WATER RECOVERY TEST, MSFC

NAME: ___________________ LAST ________ FIRST ________ MIDDLE ________

ADDRESS_____________________________________________________________

____________________________________________________________________

AGE____ DATE OF BIRTH________

WORK AREA_________________________ WORK PHONE________

HOME PHONE________________________ MAIL CODE_____________________

IN CASE OF EMERGENCY, CONTACT:_____________________________________

____________________________________________________________________

PHONE_________________________________ PHONE_____________________

PERSONAL PHYSICIAN_________________________________________________

ADDRESS___________________________________________________________

PHONE________________________

PRE-TEST EVALUATION

<table>
<thead>
<tr>
<th>NL</th>
<th>ABNL</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>___</td>
<td>___</td>
<td>___</td>
</tr>
</tbody>
</table>

SYMPTOM DIARY

MENSTRUAL HISTORY

TOPICAL USE

PHYSICAL EXAM

_________________________  
|___ | ___  | ___       |

LABORATORY

ROUTINE

SPECIAL

I have examined the previous named subject and believe he/she (is) (is not) qualified to be involved in the water recovery test at MSFC.

_________________________________ M.D. ______/___/____

DATE
APPENDIX E

2.12 Disqualification Criteria for Initial Evaluation

2.121 No personal physician

2.122 Any chronic illness or regular medicine intake

2.123 Frequent minor illnesses
   2.1231 > 4 colds/yr
   2.1232 > 2 GE/yr
   2.1233 > 1 UTI/yr
   2.1234 > 2 Vaginitis/yr
   2.1235 > 1 Active Skin Infection/yr

2.124 Abnormal physical finding

2.14 Disqualification Criteria for Pre-test Evaluation

2.141 Significant new symptoms of infection

2.142 Testing likely to occur during menses (phase dependent)

2.143 Any topical use (phase dependent)

2.144 Abnormal physical finding

2.145 Positive urine culture ( >10,000/ml of each organism)

2.146 Positive wet prep/GM stain

2.147 Positive or indeterminate serum pregnancy test

2.148 Positive urine drug screen
APPENDIX G
Presentation Material
Presentation made on April 4, 1988
CURRENT KEY ISSUES

1. DETERMINATION OF RISK BY SKIN/M.M. EXPOSURE TO:
   a) CHEMICAL CONTAMINANTS
   b) MICROBIAL CONTAMINANTS (unusual pathogens)
   c) URINARY METABOLITES AFTER PRE-TREATMENT

2. DETERMINATION OF RISK BY INGESTION

3. SAMPLING ALGORITHMS
   a) SAMPLE SIZE & PROBABILITY
   b) TYPE II (β) ERROR

4. MASS BALANCE
   a) GAIN AND LOSS
   b) SAMPLING LOSS
2.15 Post-Test Evaluation

2.151 Review symptom diary

2.152 Review menstrual history

2.153 Brief physical exam

2.154 Repeat health profile (DUHP)

2.155 Laboratory

2.1551 U/A and culture

2.1552 Wet prep/GM stain (if indicated)

2.1553 Serum pregnancy test

2.1554 Stool culture

2.1555 Special studies

2.16 Detection of Sick Subjects

2.161 Continue symptom diary

2.162 Monitor visits to personal physician (by permission)

2.163 Subject notifies
CURRENT KEY ISSUES

5. LEGAL RISK
   a) SUBJECT POOL SIZE
   b) FEDERAL VS. PRIVATE TORT SYSTEM

6. MONITORING ILLEGAL DRUGS

7. INCLUDING MENSTRUATING SUBJECTS

8. INCLUDING PREGNANT SUBJECTS

9. MANAGEMENT OF INJURED SUBJECTS

CLEAN SYSTEM
ALLOWED MEDICATION LIST
INSTITUTIONAL REVIEW BOARD - COMPOSITION

1. The use of human subjects in research committee (UHSRC) shall be composed of at least five (5) members, with diverse backgrounds possessing the professional competence to promote complete and adequate review of research activities and ascertain acceptability in terms of institutional commitments and regulations, applicable law and standards of professional conduct and practice.

2. Representation on the UHSRC shall include:
   a. Men and women.
   b. Representation of more than one profession.
   c. At least one member whose primary concerns are non-scientific, i.e., lawyer, ethicist, clergy member.
   d. At least one member who is not affiliated with the institution, either personally or by immediate familial relationship.

3. No person shall serve as a member of the UHSRC where such service would constitute a conflict of interest involving the proposed research project under review.

4. The UHSRC will invite individuals with specific competencies to assist in its review of complex issues. Within the scope of their invitation, these invited individuals will serve as full members of the UHSRC, except that they shall not have a vote.

W. J. Crump, M.D.
3/28/88
CONSENT FORM
FOR APPROVED NASA HUMAN RESEARCH

1. I, the undersigned, do voluntarily give my informed consent for my participation as a test subject in the following test, experiment, or other evaluative procedure:

NAME OF EXPERIMENT ____________________________________________

FLIGHT TO WHICH ASSIGNED ______________________________________

NAME OF DESIGNATED PRINCIPAL INVESTIGATOR ________________________

NAME OF RESPONSIBLE NASA PROJECT SCIENTIST _______________________

I understand that:

(a) This procedure is part of an experiment approved by NASA.

(b) I am performing these duties as a part of my employment, with ___________________________.

(c) This procedure has been reviewed and approved by the JSC Human Research Policy and Procedures Committee (HRPPC) and determined that the procedure involves reasonable risk to the subject.

(d) "Reasonable risk" means that the risks of harm anticipated in the proposed research are greater than those ordinarily encountered in daily life or during the performance of routine tests, but considered to be proper when weighing the anticipated benefits and the importance of the knowledge to be gained from the research.

(e) The procedure has been explained to me prior to the execution of this form. I was afforded an opportunity to ask questions, and all questions asked were answered.

(f) I am medically qualified to participate in the procedure.

(g) I may withdraw from the procedure at any time unless, as recommended by the Principal Investigator, or his/her designee, the withdrawal is dangerous or impossible.

(h) In the event of physical injury resulting from the procedure and calling for immediate action or attention that NASA will provide, or cause to be provided, the necessary treatment. I also understand that NASA will pay for any claims of injury, loss of life or property damage to the extent required by the Federal Employees' Compensation Act or the Federal Tort Claims Act. My agreement to participate shall not be construed as a release of NASA or any third party from any future liability which may arise from, or in connection with, the above procedures.
22

2. I, the undersigned, the Principal Investigator of the experiment designated above, certify that:

   (a) I have accurately described the procedure to the test subject.

   (b) The test set-up involves reasonable risk to the test subject. All equipment used has been inspected and certified for safe and proper operation.

   (c) The test subject is medically qualified to participate.

   (d) The test protocol has not been changed from that approved by the JSC Human Research Policy and Procedures Committee (HRPPC).

   APPROVED:

   ____________________________________________  ________________________________
   Test Subject                                  Date

   ____________________________________________  ________________________________
   Principal Investigator                        Date

   ____________________________________________  ________________________________
   Project Scientist                             Date

This consent form is valid for a 60-day period from the date of signature by the subject and the Principal Investigator (which dates should be identical). A signed, dated copy of the form should be forwarded to the JSC Human Research Policy and Procedures Committee, Mail Code SA, Lyndon B. Johnson Space Center, Houston, Texas 77058.
2.11 Initial Evaluation

2.111 Name of personal physician

2.112 Recent illnesses

2.113 Past medical history
   2.1131 Chronic illnesses (Hypertension, Diabetes, etc.)
   2.1132 Regular medicines, including OCP's and OTC
   2.1133 Menstrual history
   2.1134 Regular cream, ointment, oil use
   2.1135 Other drugs, alcohol, tobacco
   2.1136 Active skin or hair disorder
   2.1137 Frequency of minor infectious diseases

2.114 Physical Exam

2.115 Health Profile (DUHP)

2.116 Laboratory
   2.1161 CBC
   2.1162 U/A and culture
   2.1163 Wet prep/GM Stain (if indicated)
   2.1164 Serum pregnancy test
   2.1165 Stool culture
   2.1166 Special studies

2.117 Skin test anergy pack and PPD (Reading required in 48 hours)

2.118 Begin symptom diary
2.12 Disqualification Criteria for Initial Evaluation

2.121 No personal physician

2.122 Any chronic illness or regular medicine intake

2.123 Frequent minor illnesses
   2.1231 > 4 colds/yr
   2.1232 > 2 GE/yr
   2.1233 > 1 UTI/yr
   2.1234 > 2 Vaginitis/yr
   2.1235 > 1 Active Skin Infection/yr

2.124 Abnormal physical finding

2.125 Poor DUHP score

2.126 Abnormal lab
2.13 Pre-Test Evaluation

2.131 Review symptom diary
2.132 Review recent menstrual history
2.133 Review recent topical use
2.134 Brief physical exam

2.135 Laboratory

2.1351 U/A and culture
2.1352 Wet prep/GM stain (if indicated)
2.1353 Serum pregnancy test
2.1354 Urine drug screen (legal ramifications)
2.1355 Special Studies
2.14 Disqualification Criteria for Pre-test Evaluation

2.141 Significant new symptoms of infection

2.142 Testing likely to occur during menses (policy decision)

2.143 Any topical use on prohibited list

2.144 Abnormal physical finding

2.145 Positive urine culture (>10,000/ml of each organism)

2.146 Positive wet prep/GM stain

2.147 Positive or indeterminate serum pregnancy test

2.148 Positive urine drug screen (legal)
Presentation made on April 4, 1988
<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>POTABLE LIMIT</th>
<th>HYGIENE LIMIT</th>
<th>NIOSH LIMIT</th>
<th>EPA LIMIT</th>
<th>POTABLE LIMIT (Ala)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>color</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>conductivity</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gas, dissolved</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gas, free</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>particulates</td>
<td>40</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>6.0-8.0</td>
<td>5.0-8.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>solids, total</td>
<td>&lt;100</td>
<td>&lt;500</td>
<td></td>
<td></td>
<td>500</td>
</tr>
<tr>
<td>solids, diss.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>surfactants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>taste, odor</td>
<td>&lt;3</td>
<td>&lt;3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>turbidity</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td>&lt;5</td>
</tr>
<tr>
<td>AESTHETICS (minimum) (mg/L)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cations</td>
<td>TBD&lt;30</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anions</td>
<td>TBD&lt;30</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO₂</td>
<td>TBD&lt;15</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INORGANIC METALLICS (ppm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimony</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Barium</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>Beryllium</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boron</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
<td></td>
<td>0.01</td>
</tr>
<tr>
<td>Calcium</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Cobalt</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>Iron</td>
<td>0.30</td>
<td>0.30</td>
<td></td>
<td></td>
<td>0.30</td>
</tr>
<tr>
<td>Lead</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.002</td>
<td>0.002</td>
<td></td>
<td></td>
<td>0.002</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selenium</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
<td></td>
<td>0.01</td>
</tr>
<tr>
<td>Silver</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Thallium</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tin</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Titanium</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>5.00</td>
<td>5.00</td>
<td></td>
<td></td>
<td>5.00</td>
</tr>
</tbody>
</table>

ORIGINAL PAGE IS OF POOR QUALITY
DONOR SAFEGUARDS

Exposure and Risk

Sources
Hygiene Wastes
  Shower
  Clothes Washing
  Dish Washing
Urine
Humidity Condensate

Routes
Skin Contact including mucous membranes
Transdermal
Inhalation
Ingestion

Exposure
Intermittent
Continual

Risks
Chemical
Biological
**TABLE 3-4**

**RECOMMENDATIONS FOR MONITORING**

**PHYSICAL**

- Conductivity
- Color
- pH
- Turbidity

**INORGANIC**

- Non-Metals
  - Ammonia
  - Chloride
  - Bromide
  - Iodide
  - Nitrate
  - Phosphate
  - Sulfate

- Metals
  - Arsenic
  - Barium
  - Cadmium
  - Calcium
  - Chromium
  - Copper
  - Iron
  - Lead
  - Magnesium
  - Manganese
  - Mercury
  - Nickel
  - Potassium
  - Selenium
  - Silver
  - Zinc

**ORGANICS**

- Cyanide
- TOC
- Total Toxic Organics (TTO)

**MICROBIOLOGICAL**

- Total Bacteria
- Total Coliforms
- Heterotrophs
- Non-Saprophytic
- Legionellae
<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>METHOD</th>
<th>INSTRUMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PHYSICAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td>EPA 120.1</td>
<td>Cond. Meter</td>
</tr>
<tr>
<td>Color</td>
<td>EPA 110.3</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>pH</td>
<td>EPA 150</td>
<td>pH Meter</td>
</tr>
<tr>
<td>Turbidity</td>
<td>EPA 180</td>
<td>Nephelometer</td>
</tr>
<tr>
<td><strong>INORGANIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Non-Metals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>EPA 350.2</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Chloride</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Bromide</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Iodide</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Nitrate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Nitrogen, Total</td>
<td>EPA 351.3</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Phosphate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Sulfate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td><strong>Metals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>EPA 206.3</td>
<td>AAH</td>
</tr>
<tr>
<td>Barium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Cadmium</td>
<td>EPA 213.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Chromium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Copper</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Iron</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Lead</td>
<td>EPA 239.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Magnesium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Manganese</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Mercury</td>
<td>EPA 245.1</td>
<td>Mg Analyzer</td>
</tr>
<tr>
<td>Nickel</td>
<td>EPA 249.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Potassium</td>
<td>EPA 258.1</td>
<td>AAP</td>
</tr>
<tr>
<td>Selenium</td>
<td>EPA 270.3</td>
<td>AAH</td>
</tr>
<tr>
<td>Silver</td>
<td>EPA 272.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Zinc</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td><strong>ORGANICS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>EPA 335.2</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Halogenated Hydrocarbon</td>
<td>EPA 612</td>
<td>GC/ECD</td>
</tr>
<tr>
<td>Organic Acids</td>
<td></td>
<td>HPLC</td>
</tr>
<tr>
<td>Organic Alcohols</td>
<td></td>
<td>HPLC</td>
</tr>
<tr>
<td>Pesticides</td>
<td>EPA 608</td>
<td>GC/ECD</td>
</tr>
<tr>
<td>Phenols</td>
<td>EPA 604</td>
<td>GC/FID</td>
</tr>
<tr>
<td>TOC</td>
<td>EPA 415.2</td>
<td>TOC Analyzer</td>
</tr>
<tr>
<td>Total Toxic Organics</td>
<td>EPA 624, 625</td>
<td>GC/MS</td>
</tr>
<tr>
<td>Compound</td>
<td>Source</td>
<td>Amt.</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>palmitic acid</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>pentane, 2,3-dimethyl-</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>pentane, 2,2,4-trimethyl-</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>4-methyl-2-pentanone</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>2-methyl-2,4-pentanediol</td>
<td>1</td>
<td>410</td>
</tr>
<tr>
<td>pentene, 4,4-dimethyl-1-phosphate, diethyl pentyl-phosphate, triethyl-phosphate, tertamethylpyro-phosphate, tetramethylpyro-</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1-propane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>propionic acid</td>
<td>1</td>
<td>6,000-17,222</td>
</tr>
<tr>
<td>propylene glycol</td>
<td>1</td>
<td>300</td>
</tr>
<tr>
<td>Pyrrolidine</td>
<td>pyrrolidine, N-methyl-pyrrolidone</td>
<td>1</td>
</tr>
<tr>
<td>styrene</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>salicylic acid</td>
<td>1</td>
<td>350000</td>
</tr>
<tr>
<td>thiophene, tetrahydro-1,1-dioxide</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>thiourea</td>
<td>1</td>
<td>300-500</td>
</tr>
<tr>
<td>thiourea, tetramethyl</td>
<td>1</td>
<td>35</td>
</tr>
<tr>
<td>urea</td>
<td>1</td>
<td>&lt;16,000</td>
</tr>
<tr>
<td>Undecanoic Acid</td>
<td>n-undecane</td>
<td>4</td>
</tr>
<tr>
<td>vanillin</td>
<td>6</td>
<td>200</td>
</tr>
<tr>
<td>Xylenol</td>
<td>xylenes, total</td>
<td>1</td>
</tr>
</tbody>
</table>

ORIGINAL PAGE IS OF POOR QUALITY
## Secondary Requirements (Cont.)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt.</th>
<th>Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>caprylic acid</td>
<td>1</td>
<td>273ppb</td>
<td>ivn mus (LD_{50}) 600mg</td>
</tr>
<tr>
<td>cyanurate, triallyliso-</td>
<td>1</td>
<td>12ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acids (4)</td>
<td>4</td>
<td>40,800ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acids (2)</td>
<td>2</td>
<td>92,210ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acids (3)</td>
<td>3</td>
<td>81,500ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acids (5)</td>
<td>7</td>
<td>3,500ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acid cmpds (4)</td>
<td>6</td>
<td>52,000ppb</td>
<td></td>
</tr>
<tr>
<td>carboxylic acid (5)</td>
<td>1</td>
<td>43,000ppb</td>
<td></td>
</tr>
<tr>
<td>unknown carboxylic acids</td>
<td>1</td>
<td>2,633ppb</td>
<td></td>
</tr>
<tr>
<td>Caproic Acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>caprolactam</td>
<td>1</td>
<td>15,000ppb</td>
<td></td>
</tr>
<tr>
<td>carbon disulfide</td>
<td>1</td>
<td>14-722ppb</td>
<td></td>
</tr>
<tr>
<td>Decanal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>decan cmpds (2)</td>
<td>4</td>
<td>280ppb</td>
<td>ivr rat (LD_{50}) 3730mg</td>
</tr>
<tr>
<td>Dodecyl alcohol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dodecan</td>
<td>3</td>
<td>100ppb</td>
<td>ispr rat (LD_{50}) 800mg</td>
</tr>
<tr>
<td>dibenzofuran</td>
<td>1</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>dimethyl-benzene methanol</td>
<td>1</td>
<td>16ppb</td>
<td></td>
</tr>
<tr>
<td>diexalene cmpds</td>
<td>3</td>
<td>600ppb</td>
<td></td>
</tr>
<tr>
<td>ether, ethyl propyl</td>
<td>1</td>
<td>34ppb</td>
<td></td>
</tr>
<tr>
<td>ether, ethylene glycol monobutyl-1</td>
<td>1</td>
<td>100ppb</td>
<td></td>
</tr>
<tr>
<td>ether, p-chlorophenyl methoxyisobutyl 4</td>
<td>4</td>
<td>400ppb</td>
<td></td>
</tr>
<tr>
<td>ethers, glycol (2)</td>
<td>1</td>
<td>550ppb</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>900ppb</td>
<td></td>
</tr>
<tr>
<td>furfuryl alcohol</td>
<td>5</td>
<td>200</td>
<td>orr rat (LD_{50}) 275mg</td>
</tr>
<tr>
<td>Heptanoic Acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-heptanone</td>
<td>6</td>
<td>100ppb</td>
<td>orr mus (LD_{50}) 160mg</td>
</tr>
<tr>
<td>heptanone cmpds (2)</td>
<td>4</td>
<td>60ppb</td>
<td>orr rat (LD_{50}) 720mg</td>
</tr>
<tr>
<td>Hexanol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hexanol, 2-ethyl-1-</td>
<td>6</td>
<td>100ppb</td>
<td></td>
</tr>
<tr>
<td>hexanol, 5-methyl-1-</td>
<td>1</td>
<td>150ppb</td>
<td></td>
</tr>
<tr>
<td>2-hexanone</td>
<td>1</td>
<td>50ppb</td>
<td></td>
</tr>
<tr>
<td>cyclohexanone</td>
<td>1</td>
<td>35ppb</td>
<td></td>
</tr>
<tr>
<td>isophorone</td>
<td>1</td>
<td>3ppb</td>
<td></td>
</tr>
<tr>
<td>lactone cmpds</td>
<td>3</td>
<td>130ppb</td>
<td></td>
</tr>
<tr>
<td>morpholine, 4-ethyl</td>
<td>1</td>
<td>470ppb</td>
<td></td>
</tr>
<tr>
<td>morpholine, n-ethyl</td>
<td>1</td>
<td>400ppb</td>
<td></td>
</tr>
<tr>
<td>nonanedioate, bis(2-ethyl hexyl)-</td>
<td>1</td>
<td>1,100ppb</td>
<td></td>
</tr>
<tr>
<td>nonanedioate acid</td>
<td>1</td>
<td>6ppb</td>
<td></td>
</tr>
<tr>
<td>octaneate, methyl-</td>
<td>3</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>Compound</td>
<td>Source</td>
<td>Amt.</td>
<td>Toxicity</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>------</td>
<td>----------</td>
</tr>
</tbody>
</table>
| Acetic Acid | 5 - | 300 | orl ham TDL 1470 ug 61T  
1 h ham TDL 816ppm/3min |
| acetic acid, phenyl | 4 | 400 |  
| acetic acid, ethanol ethoxy | 1 | 180 |  
| acetic acid, vinyl | 1 | 50 |  
| acetone | 3 | 3300 | orl ham TDL 500ppm Eye  
| diacetylene alcohol | 1 | 19ppb |  
| acetone cmpds (2) | 4 | 250ppb |  
| acrylate, 3-methoxy-butyl | 3 | 130ppm |  
| azepin-2-one, hexahydro | 1 SL1 | 73ppb |  
| 1 SL3 | 4.3ppm |  
| aniline | 1 | 20ppb |  
| 2-nitroaniline | 1 | 200ppb |  
| 3-nitroaniline | 1 | 200ppb |  
| 4-nitroaniline | 1 | 200ppb |  
| Adipic Acid | | | orl rat LD 3600mg |
| adipate, tetramethylene | 1 | 6ppb |  
| amide, butyl benzenesulfen | 1 | 6ppb |  
| amide, 2-n-d-n-butyIform- | 1 | 60ppb |  
| amide, 4-methyl-4-ethyl form-1 | 1,193ppb |  
| 4-chloroaniline | 1 | 100ppb |  
| amide, 2-n-dimethyl form-1 | 541ppb |  
| amides (4) | 1 | 3190ppb |  
| amides (2) | 2 | 400ppb |  
| amine, dimethyl | | | orl rat LD 698mg |
| amine, 2-n-dimethyl benzyl- | 1 | 80ppb |  
| amine, di-n-butyl | 1 | 74ppb |  
| amines (2) | 1 | 200ppb |  
| alcohol cmpds (2) | 3 | 5000ppb |  
| alkene (C2H5)3 | 3 | 10ppb |  
| Butyric Acid | | | orl rat LD 2940mg |
| butyrates, 3-hydroxy | | |  
| -trimethylpentyliso | 1 | 300ppb |  
| 1-butanamine, n-butyl- | 1 | 180ppb |  
| butanoate, 2 methoxymethyl-2- | 1 | 55ppb |  
| 2-butanone | 1 | 900ppb |  
| butanone, 3-methyl-2- | 1 | 60ppb |  
| benzoic acid | 1 | 500ppb | orl rat LD 3040mg  
| benzoic acid cmpds (2) | 4 | 3000ppb |  
| 6 | 150ppb |  
| benzenaldehyde | 3 | 1000ppb | orl rat LD 1300mg  
| benzenaldehyde cmpds (3) | 4 | 150ppb |  
| benzyl alcohol | 1 | 4700ppb | orl rat LD 1330mg  
| benzoisoxazole | 1 | 100ppb |  

ORIGINAL DATA IS OF POOR QUALITY
<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt Det.</th>
</tr>
</thead>
<tbody>
<tr>
<td>acenaphthene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>acenaphthylene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>anthracene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo[a]anthracene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo[a]pyrene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo[b]fluoranthene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>3,4-benzofluoranthene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo[g,h,i]perylene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo[k]fluoranthene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>bis(2-chloro ethoxy)methane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>bis(2-chloroethyl)ether</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>bis(2-chloroisopropyl)ether</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>bis(2-ethylhexyl)phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>4-bromophenyl phenyl ether</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>butylbenzyl phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2-chloro naphthalene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>4-chlorophenyl phenyl ether</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>chrysene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>dibenzo[a,h]anthracene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,2-dichlorobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,3-dichlorobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,4-dichlorobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>3,3'-dichlorobenzidine</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>diethyl phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>dimethyl phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>di-n-butyl phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2,4-dinitro toluene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2,6-dinitro toluene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>di-n-octyl phthalate</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,2-diphenylhydrazine (as azobenzene)</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>fluorene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>hexachlorobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>hexachlorobutadiene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>hexachlorocyclopentadiene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>hexachloroethane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>indeno[1,2,3-cd]pyrene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>isophorone</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2-methyl naphthalene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>naphthalene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>nitrobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>N-nitrosodimethylamine</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>N-nitrosodi-n-propylamine</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>N-nitrosodiphenylamine</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>phenanthrene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>phthalate, diethyl pentyl-</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>phthalate esters (2)</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>phthalate esters</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>phthalate, bis(2-ethylhexyl)-</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>pyrene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,2,4-trichlorobenzene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2,3,7,8-tetrachlorodibenzo-p-dioxin</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Compound</td>
<td>Source</td>
<td>Amt detected</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------</td>
<td>--------------</td>
</tr>
<tr>
<td>p-chloro-m-cresol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4,6-dinitrocresol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>phenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-chlorophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4-dichlorophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4,6-trichlorophenol</td>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>pentachlorophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-chloro-3-methylphenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4-dimethylphenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-nitrophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-nitrophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4-dinitrophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-methyl dinitrophenol</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>2-methyl phenol</td>
<td>1</td>
<td>650</td>
</tr>
<tr>
<td>4-methyl phenol</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>phenol, 2,6-dimethylphenol, t-butyl-4-methyl-</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>phenol, 4-(1,1-dimethylethyl)</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>phenol camds (4)</td>
<td>4</td>
<td>2,200</td>
</tr>
<tr>
<td>phenol camds (6)</td>
<td>6</td>
<td>600</td>
</tr>
<tr>
<td>phenol camds (6)</td>
<td>2</td>
<td>275</td>
</tr>
<tr>
<td>phenol, 2,6-di</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-t-butyl-4-methyl</td>
<td>8</td>
<td>150</td>
</tr>
</tbody>
</table>

**ACID COMPOUNDS**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,4-dichlorophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4,6-trichlorophenol</td>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>pentachlorophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-chloro-3-methylphenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4-dimethylphenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-nitrophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-nitrophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4-dinitrophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-methyl dinitrophenol</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>2-methyl phenol</td>
<td>1</td>
<td>650</td>
</tr>
<tr>
<td>4-methyl phenol</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>phenol, 2,6-dimethylphenol, t-butyl-4-methyl-</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>phenol, 4-(1,1-dimethylethyl)</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>phenol camds (4)</td>
<td>4</td>
<td>2,200</td>
</tr>
<tr>
<td>phenol camds (6)</td>
<td>6</td>
<td>600</td>
</tr>
<tr>
<td>phenol camds (6)</td>
<td>2</td>
<td>275</td>
</tr>
<tr>
<td>phenol, 2,6-di</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-t-butyl-4-methyl</td>
<td>8</td>
<td>150</td>
</tr>
</tbody>
</table>

**ORIGINAL PAGE IS OF POOR QUALITY**
<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOLATILES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetyl benzene</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>Acrolein</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromochloromethane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>Bromochloropropene</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>Bromoform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromomethane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorodibromomethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-chloroethyl vinyl ether</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloroform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloromethane</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Dibromochloromethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichlorobutane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>1,1-dichloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-dichloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1-dichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trans 1,2-dichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichlorofluoromethane</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>1,2-dichloropropene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,3-dichloropropene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-dichloropropylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimethylbenzene-methanamine</td>
<td>1</td>
<td>230</td>
</tr>
<tr>
<td>ethyl benzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methyl bromide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methyl chloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methylene chloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1,2,2-tetrachloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tetrachloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>toluene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-trans-dichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1,1-trichloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trichlorofluoromethane</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>vinyl chloride</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SPECIFIC TOXICANTS

Definition:

Primary
- EPA Priority Pollutants and related compounds
  - Volatiles
  - Acid Extractables
  - Base/Neutral Extractables
- Pharmaceuticals
  - Metabolites
  - Oxidation Products
- Illicit Drugs

Secondary
- All Other

Mission Specific
<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>POTABLE LIMIT (ppm)</th>
<th>HYGIENE LIMIT</th>
<th>NIOSH</th>
<th>EPA LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INORGANIC NONMETALLICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromide</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>250</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorine</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluoride</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iodide</td>
<td>15</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrate</td>
<td>10</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrite</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen, total</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphorous</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfate</td>
<td>250</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfide</td>
<td>0.05</td>
<td>0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfite</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ORGANICS (ug/L)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>200</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malegenated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>TBD&lt;10</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil &amp; Grease</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic Alc.</td>
<td>TBD&lt;500</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic acids</td>
<td>TBD&lt;500</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phenols</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific Toxictants</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOC</td>
<td>TBD&lt;500</td>
<td>TBD&lt;10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TTOC</td>
<td>TBD&lt;100</td>
<td>TBD&lt;1,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOX</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MICROBIAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bacteria</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>&lt;1</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anaerobes</td>
<td>&lt;1</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerobes</td>
<td>&lt;1</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gram positive</td>
<td>&lt;1</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gram negative</td>
<td>&lt;1</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. coli</td>
<td>&lt;1</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enteric</td>
<td>&lt;1</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viruses (PFU)</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yeast, molds</td>
<td>&lt;1</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BACTERICIDE (mg/L)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual halo.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>minimum</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maximum</td>
<td>4.00</td>
<td>6.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RADIOLOGICAL (pCi/L)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>alpha 90 Sr</td>
<td>10</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>alpha 226 Ra</td>
<td>3</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>beta 3H</td>
<td>1,000</td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ORIGINAL PAGE IS OF POOR QUALITY
CURRENT ISSUES
Detection Limits
Accountability
Drugs & Pharmaceuticals
### TABLE 3-9
SAMPLING FREQUENCY REQUIRED FOR WATER QUALITY VERIFICATION

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>REAL-TIME</th>
<th>NEAR REAL TIME</th>
<th>DELAYED (24 HRS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PHYSICAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Color</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>pH</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Turbidity</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><strong>INORGANIC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Metals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromide</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iodide</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrate</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphate</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfate</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barium</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Cadmium</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Chromium</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Copper</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Iron</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Manganese</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Mercury</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Selenium</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Silver</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ORGANICS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOC</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>BACTERIA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Bacteria</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Total Coliforms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterotrophs</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Non-Saprophytic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legionellae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FUNGI AND YEAST</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Presentation made on May 19, 1988
ECLSS WATER RECOVERY TEST REVIEW

May 19, 1988
Building 4610, Room 2081

Agenda

- INTRODUCTION DR. HUMPHRIES 9:30-9:45
- ECLSS TEST OVERVIEW MR. SCHUNK 9:45-10:15
- WATER RECOVERY TEST OVERVIEW DR. HUMPHRIES 10:15-10:45
- BREAK 10:45-11:00
- WATER RECOVERY TEST DESCRIPTION MR. BAGDIGIAN MS. MORTAZAVI MS. MCGRIFF 11:00-12:00
- LUNCH 12:00-1:00
- MAN SYSTEMS SIMULATOR PROTOCOLS MR. WHITMAN 1:00-1:45
- MAN SYSTEMS SIMULATOR EQUIPMENT MS. TRAWECK 1:45-2:30
- CHEMICAL SAMPLING AND ANALYSIS MS. SERR 2:30-2:45
- MICROBIAL SAMPLING AND ANALYSIS MS. RICHARD 2:45-3:00
- BREAK 3:00-3:15
- TEST SUBJECT SAFEGUARDS MR. KILGORE 3:15-4:00
- SUMMARY/ACTIONS DR. HUMPHRIES 4:00-4:15
ECLSS WATER RECOVERY TEST REVIEW

May 20, 1988
Building 4610, Room 5025

Agenda

- Introduction DR. HUMPHRIES 8:30-8:40
- Medical/Legal Aspects DR. CRUMP 8:40-9:45
- Break 9:45-10:00
- MSFC/JSC Interface Discussion DR. HUMPHRIES 10:00-10:30
- Technology Demonstration Program Plans MR. RAY 10:30-10:45
- FAST (Phase II) Test Results MR. WHITLEY 10:45-11:15
- Summary/Actions DR. HUMPHRIES 11:15-11:30
- Test Facility Tour MR. SCHUNK 11:30-12:30
# ECLSS WATER RECOVERY TEST

**TEST SUBJECT SAFEGUARDS**

## RECOMMENDATIONS FOR MONITORING

<table>
<thead>
<tr>
<th>Physical</th>
<th>Organics</th>
<th>Microbiological</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductivity</td>
<td>Cyanide</td>
<td>Total Bacteria</td>
</tr>
<tr>
<td>Color</td>
<td>TOC</td>
<td>Total Coliforms</td>
</tr>
<tr>
<td>pH</td>
<td>TOX</td>
<td>Heterotrophs</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Total Toxic Organics (TTO)</td>
<td>Non-Saprophytic</td>
</tr>
<tr>
<td><strong>Inorganic</strong></td>
<td>Specific Pharmaceuticals</td>
<td><strong>Plants and Yeast</strong></td>
</tr>
<tr>
<td>Non-metals</td>
<td></td>
<td>Legionella</td>
</tr>
<tr>
<td>Ammonia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iodide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manganese</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selenium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### METHODS AND INSTRUMENTATION FOR WATER QUALITY VERIFICATION

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>METHOD</th>
<th>INSTRUMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PHYSICAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td>EPA 120.1</td>
<td>Cond. Meter</td>
</tr>
<tr>
<td>Color</td>
<td>EPA 110.3</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>pH</td>
<td>EPA 150</td>
<td>pH Meter</td>
</tr>
<tr>
<td>Turbidity</td>
<td>EPA 180</td>
<td>Nephelometer</td>
</tr>
<tr>
<td><strong>INORGANIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Metals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>EPA 350.2</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Chloride</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Bromide</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Iodide</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Nitrate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Nitrogen, Total</td>
<td>EPA 351.3</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Phosphate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Sulfate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Metals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>EPA 206.3</td>
<td>AAH</td>
</tr>
<tr>
<td>Barium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Cadmium</td>
<td>EPA 213.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Chromium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Copper</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Iron</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Lead</td>
<td>EPA 239.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Magnesium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Manganese</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Mercury</td>
<td>EPA 245.1</td>
<td>Hg Analyzer</td>
</tr>
<tr>
<td>Nickel</td>
<td>EPA 249.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Potassium</td>
<td>EPA 258.1</td>
<td>AAF</td>
</tr>
<tr>
<td>Selenium</td>
<td>EPA 270.3</td>
<td>AAH</td>
</tr>
<tr>
<td>Silver</td>
<td>EPA 272.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Zinc</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td><strong>ORGANICS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>EPA 335.2</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Halogenated Hydrocarbon</td>
<td>EPA 612</td>
<td>GC/ECD</td>
</tr>
<tr>
<td>Organic Acids</td>
<td></td>
<td>HPLC</td>
</tr>
<tr>
<td>Organic Alcohols</td>
<td></td>
<td>HPLC</td>
</tr>
<tr>
<td>Pesticides</td>
<td>EPA 608</td>
<td>GC/ECD</td>
</tr>
<tr>
<td>Phenols</td>
<td>EPA 604</td>
<td>GC/FID</td>
</tr>
<tr>
<td>TOC</td>
<td>EPA 415.2</td>
<td>TOC Analyzer</td>
</tr>
<tr>
<td>Total Toxic Organics</td>
<td>EPA 624, 625</td>
<td>GC/MS</td>
</tr>
</tbody>
</table>
Microbiological Concerns

MB Requirements & Spec for Space Station

Closed environmental control system
limited ability to remove biological agents
gravity vs microgravity

History -
Gemini Program - decrease in types of microorganisms
- increase in numbers of microorganisms
- microbial transfer reported

Apollo Program - illness not uncommon in early missions
- quarantine measures initiated (Apollo)
- urinary tract infections

Skylab - microbial flora studies
- transfer of pathogens
- microbial simplification for anaerobes
- microbial simplification not evident for aerobes
- air and surface samples showed gross contamination
- cellular immune response studies
- possibility of impairment of immune system
Shuttle orbiter

moderate buildup on orbiter interior surface and air

cross contamination among crew members

Space Station - 90 day rotation
alterations in microbial flow of crew
microbial flow of space station
microbiological monitoring

Health Stabilization Program

Pre-Flight

ORIGINAL PAGE IS OF POOR QUALITY
In flight (crew)

Post flight (crew)

Space Station Subsystems

Pre flight

In flight

Surface samples (15 days)

Air samples (10 days)

Potable water (15 days)

Animal living quarters
Specifications -

<table>
<thead>
<tr>
<th>Medium</th>
<th>CFU/Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>100 CFU/25 cm²</td>
</tr>
<tr>
<td>Air</td>
<td>5,000 CFU/m³</td>
</tr>
<tr>
<td>Water</td>
<td>0 CFU/100 mL</td>
</tr>
</tbody>
</table>

ORIGINAL PAGE IS OF POOR QUALITY.
Microbiology

2) Pseudomonas NTHI growth

3) Swimming pools

4) Air at 1G

5) New presence of MO may not reveal anything about pathogenicity.

Microbiology

OF POOR QUALITY

DATA BASES (Cultures)

FA AND SYSTEM

2 Names Descrip.

No Names

FATTY ACID SYSTEM

Data Bases (References)

More ACC

### METHODS AND INSTRUMENTATION FOR WATER QUALITY VERIFICATION

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>METHOD</th>
<th>INSTRUMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PHYSICAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td>EPA 120.1</td>
<td>Cond. Meter</td>
</tr>
<tr>
<td>Color</td>
<td>EPA 110.3</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>pH</td>
<td>EPA 150</td>
<td>pH Meter</td>
</tr>
<tr>
<td>Turbidity</td>
<td>EPA 180</td>
<td>Nephelometer</td>
</tr>
<tr>
<td><strong>INORGANIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Non-Metals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>EPA 350.2</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Chloride</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Bromide</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Iodide</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Nitrate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Nitrogen, Total</td>
<td>EPA 351.3</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Phosphate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td>Sulfate</td>
<td>EPA 300.0</td>
<td>Ion Chromatograph</td>
</tr>
<tr>
<td><strong>Metals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>EPA 206.3</td>
<td>AAH</td>
</tr>
<tr>
<td>Barium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Cadmium</td>
<td>EPA 213.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Chromium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Copper</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Iron</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Lead</td>
<td>EPA 239.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Magnesium</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Manganese</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td>Mercury</td>
<td>EPA 245.1</td>
<td>Hg Analyzer</td>
</tr>
<tr>
<td>Nickel</td>
<td>EPA 249.2</td>
<td>AAH</td>
</tr>
<tr>
<td>Potassium</td>
<td>EPA 258.1</td>
<td>AAF</td>
</tr>
<tr>
<td>Selenium</td>
<td>EPA 270.3</td>
<td>AAH</td>
</tr>
<tr>
<td>Silver</td>
<td>EPA 272.2</td>
<td>AAG</td>
</tr>
<tr>
<td>Zinc</td>
<td>EPA 200.7</td>
<td>ICP</td>
</tr>
<tr>
<td><strong>ORGANICS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>EPA 335.2</td>
<td>UV-VIS</td>
</tr>
<tr>
<td>Halogenated Hydrocarbon</td>
<td>EPA 612</td>
<td>GC/ECD</td>
</tr>
<tr>
<td>Organic Acids</td>
<td></td>
<td>HPLC</td>
</tr>
<tr>
<td>Organic Alcohols</td>
<td></td>
<td>HPLC</td>
</tr>
<tr>
<td>Pesticides</td>
<td>EPA 608</td>
<td>GC/ECD</td>
</tr>
<tr>
<td>Phenols</td>
<td>EPA 604</td>
<td>GC/FID</td>
</tr>
<tr>
<td>TOC</td>
<td>EPA 415.2</td>
<td>TOC Analyzer</td>
</tr>
<tr>
<td>Total Toxic Organics</td>
<td>EPA 624, 625</td>
<td>GC/MS</td>
</tr>
</tbody>
</table>
Number key for the sources:

HCE 1
HCE BENDS 2
TIMES SHR 3
TIMES URINE RAW DISTILLATE 4
URINE RAW DISTILLATE (same as TIMES urine?) 5
VCD URINE RAW DISTILLATE 6
POST TREATED SHR RAW DISTILLATE 7
POST TREATED VCD/TIMES RAW DISTILLATE 8

Key to abbreviations:

Orl = oral
Ivn = intravenous
Ipr = intraperitoneal
Hmn = human
Mus = mouse

Key to toxicity information:

LDLo = Lowest published lethal dose (mg/Kg)
TCLo = Lowest published toxic concentration (mg/Kg)
TDLo = Lowest published toxic dose (mg/Kg)
<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>octanol</td>
<td>4</td>
<td>1ppb</td>
</tr>
<tr>
<td>octanoate, methyl-</td>
<td>3</td>
<td>200ppb</td>
</tr>
<tr>
<td>oxalic acid</td>
<td>3</td>
<td>370ppb</td>
</tr>
<tr>
<td>octanoic acid</td>
<td>3</td>
<td>20000ppb</td>
</tr>
<tr>
<td>octatetraene, formylcyclo</td>
<td>3</td>
<td>30ppb</td>
</tr>
<tr>
<td>palmitic acid</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ivn mus LD50 57mg</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>30ppb</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>10ppb</td>
</tr>
<tr>
<td>pentane, 2,3-dimethyl-</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>pentane, 2,2,4-trimethyl-</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>4-methyl-2-pentanone</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>2-methyl-2,4-pentanediol</td>
<td>1</td>
<td>410</td>
</tr>
<tr>
<td>pentene, 4,4-dimethyl-1-</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>phosphate, diethyl penty1-</td>
<td>1</td>
<td>67</td>
</tr>
<tr>
<td>phosphate, triethyl-</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>phosphate, tertamethylpyro-</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>phosphate, tetramethylpyro-</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>1-propene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>propionic acid</td>
<td>1</td>
<td>6,000-35,400 orl rat LD50 1510mg</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>1500</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>840</td>
</tr>
<tr>
<td>propylene glycol</td>
<td>1</td>
<td>300</td>
</tr>
<tr>
<td>Pyrrolidine</td>
<td>1</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>styrene</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>salicylic acid</td>
<td>6</td>
<td>350000</td>
</tr>
<tr>
<td>sulfone, methyl-</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>thiopehene</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>tetrahydro-1,1-dioxide</td>
<td>1</td>
<td>300-500</td>
</tr>
<tr>
<td>thiourea</td>
<td>1</td>
<td>35</td>
</tr>
<tr>
<td>thiourea, tetramethyl</td>
<td>1</td>
<td>500 fast amt)</td>
</tr>
<tr>
<td>thiourea compd (m.w. 174)</td>
<td>1</td>
<td>400ppb</td>
</tr>
<tr>
<td>teluonitrile</td>
<td>1</td>
<td>&lt;16,000</td>
</tr>
<tr>
<td>undecanoic acid</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>n-undecane</td>
<td>4</td>
<td>200</td>
</tr>
<tr>
<td>urea</td>
<td>1</td>
<td>&lt;16,000</td>
</tr>
<tr>
<td>vanillan</td>
<td>6</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>Xylenol</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>xylene, total</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>xylene</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Compound</td>
<td>Source</td>
<td>Amt.</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------</td>
<td>--------------</td>
</tr>
<tr>
<td>ethyl alcohol</td>
<td>4</td>
<td>100ppb</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>8600ppb</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5000ppb</td>
</tr>
<tr>
<td>furfuryl alcohol</td>
<td>5</td>
<td>200ppb</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>10ppb</td>
</tr>
<tr>
<td>furan, 2,5-di-methyltetrahydro</td>
<td>4</td>
<td>10ppb</td>
</tr>
<tr>
<td>formic acid</td>
<td>4</td>
<td>2670ppb</td>
</tr>
<tr>
<td>heptanoic acid</td>
<td>3</td>
<td>200ppb</td>
</tr>
<tr>
<td>2-heptanone</td>
<td>4</td>
<td>5ppb</td>
</tr>
<tr>
<td>4-heptanone</td>
<td>6</td>
<td>100ppb</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>25ppb</td>
</tr>
<tr>
<td>heptanone capds (Z)</td>
<td>4</td>
<td>60ppb</td>
</tr>
<tr>
<td>heptyl alcohol</td>
<td>4</td>
<td>1ppb</td>
</tr>
<tr>
<td>Hexanol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hexanol, 2-ethyl-1-</td>
<td>6</td>
<td>100ppb</td>
</tr>
<tr>
<td>hexanol, 5-methyl-1-</td>
<td>1</td>
<td>150ppb</td>
</tr>
<tr>
<td>Hexanal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-hexanone</td>
<td>1</td>
<td>50ppb</td>
</tr>
<tr>
<td>hexanone, cyclo-</td>
<td>1</td>
<td>35ppb</td>
</tr>
<tr>
<td>hexanoic acid</td>
<td>3</td>
<td>2000ppb</td>
</tr>
<tr>
<td>hexanoic acid, 2-ethyl</td>
<td>1</td>
<td>750ppb</td>
</tr>
<tr>
<td>hydrocarbon, unsaturated</td>
<td>4</td>
<td>30ppb</td>
</tr>
<tr>
<td>2,5-hexanediione</td>
<td>3</td>
<td>50ppb</td>
</tr>
<tr>
<td>3-hexane-2,5-dione</td>
<td>3</td>
<td>100ppb</td>
</tr>
<tr>
<td>isophorone</td>
<td>1</td>
<td>3ppb</td>
</tr>
<tr>
<td>lactic acid</td>
<td>3</td>
<td>1000ppb</td>
</tr>
<tr>
<td>lactone capds</td>
<td>3</td>
<td>130ppb</td>
</tr>
<tr>
<td>lactone, delta</td>
<td>3</td>
<td>10ppb</td>
</tr>
<tr>
<td>lactone, gamma</td>
<td>3</td>
<td>60ppb</td>
</tr>
<tr>
<td>lactone, gammahepta</td>
<td>3</td>
<td>30ppb</td>
</tr>
<tr>
<td>levulinic, methyl</td>
<td>3</td>
<td>30ppb</td>
</tr>
<tr>
<td>methyl alcohol</td>
<td>4</td>
<td>14000ppb</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>4000</td>
</tr>
<tr>
<td>morpholine</td>
<td>4</td>
<td>5ppb</td>
</tr>
<tr>
<td>morpholine, 4-ethyl</td>
<td>1</td>
<td>470ppb</td>
</tr>
<tr>
<td>morpholine, n-ethyl</td>
<td>1</td>
<td>400ppb</td>
</tr>
<tr>
<td>myristic acid</td>
<td>8</td>
<td>10ppb</td>
</tr>
<tr>
<td>nonanedioate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-(2-ethyl hexyl)-</td>
<td>1</td>
<td>1100ppb</td>
</tr>
<tr>
<td>nonanedioic acid</td>
<td>1</td>
<td>6ppb</td>
</tr>
<tr>
<td>nonanoic acid</td>
<td>3</td>
<td>2000ppb</td>
</tr>
</tbody>
</table>
### Secondary Requirements (Cont.)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>benzoic acid</td>
<td>3</td>
<td>840ppb</td>
</tr>
<tr>
<td>benzoic acid, 2-hydroxy</td>
<td>4</td>
<td>1000ppb</td>
</tr>
<tr>
<td>benzoic acid capds (2)</td>
<td>6</td>
<td>150ppb</td>
</tr>
<tr>
<td>benzoic acid, 4-methyl</td>
<td>4</td>
<td>100ppb</td>
</tr>
<tr>
<td>benzoic acid capds (3)</td>
<td>4</td>
<td>150ppb</td>
</tr>
<tr>
<td>benzaldehyde</td>
<td>3</td>
<td>1000ppb</td>
</tr>
<tr>
<td>benzyl alcohol</td>
<td>1</td>
<td>4700ppb</td>
</tr>
<tr>
<td>benzisoxazole</td>
<td>1</td>
<td>100ppb</td>
</tr>
<tr>
<td>butyldihydroxybenzene</td>
<td>4</td>
<td>10ppb</td>
</tr>
<tr>
<td>caprylic acid</td>
<td>1</td>
<td>273-410ppb</td>
</tr>
<tr>
<td>cyanurate, triallyliso-carboxylic acids</td>
<td>1</td>
<td>12ppb</td>
</tr>
<tr>
<td>carboxylic acids</td>
<td>4</td>
<td>40,800ppb</td>
</tr>
<tr>
<td>carboxylic acids (5)</td>
<td>7</td>
<td>3,500ppb</td>
</tr>
<tr>
<td>carboxylic acid capd</td>
<td>5</td>
<td>500ppb</td>
</tr>
<tr>
<td>carboxylic acid capds (4)</td>
<td>6</td>
<td>52,000ppb</td>
</tr>
<tr>
<td>unknown carboxylic acids</td>
<td>1</td>
<td>2,633ppb</td>
</tr>
<tr>
<td>Caprolactam</td>
<td>1</td>
<td>15,000ppb</td>
</tr>
<tr>
<td>carbon disulfide</td>
<td>1</td>
<td>14-722ppb</td>
</tr>
<tr>
<td>Decanal</td>
<td>4</td>
<td>150ppb</td>
</tr>
<tr>
<td>n-decane</td>
<td>4</td>
<td>280ppb</td>
</tr>
<tr>
<td>decane capds (2)</td>
<td>3</td>
<td>5000ppb</td>
</tr>
<tr>
<td>Decanol alcohol</td>
<td>3</td>
<td>100ppb</td>
</tr>
<tr>
<td>dodecanol</td>
<td>3</td>
<td>100ppb</td>
</tr>
<tr>
<td>dodecanolic acid</td>
<td>3</td>
<td>5000ppb</td>
</tr>
<tr>
<td>decanol, ethoxy-de-1</td>
<td>5</td>
<td>20ppb</td>
</tr>
<tr>
<td>dodecanol, hexa-</td>
<td>3</td>
<td>20ppb</td>
</tr>
<tr>
<td>dibenzofuran</td>
<td>1</td>
<td>20ppb</td>
</tr>
<tr>
<td>dimethyl-benzene methanol</td>
<td>1</td>
<td>16ppb</td>
</tr>
<tr>
<td>dioxolane capds</td>
<td>3</td>
<td>600ppb</td>
</tr>
<tr>
<td>dioxalane, 2,4-dimethyl-1,3-</td>
<td>3</td>
<td>100ppb</td>
</tr>
<tr>
<td>dioxalane, 2-ethyl-4-methyl-1,3-</td>
<td>3</td>
<td>500ppb</td>
</tr>
<tr>
<td>ether, ethyl propyl</td>
<td>1</td>
<td>34ppb</td>
</tr>
<tr>
<td>ether, ethylene glycol monobutyl</td>
<td>3</td>
<td>100ppb</td>
</tr>
<tr>
<td>ether, p-chlorophenyl methoxysobutyl</td>
<td>4</td>
<td>400ppb</td>
</tr>
<tr>
<td>ethers, glycol (2)</td>
<td>1</td>
<td>550ppb</td>
</tr>
<tr>
<td>ethers, glycol (2)</td>
<td>3</td>
<td>60ppb</td>
</tr>
</tbody>
</table>

**Original Page 13 of Poor Quality**
<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt.</th>
<th>Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaldehyde</td>
<td>4</td>
<td>20</td>
<td>orl rat LD&lt;sub&gt;50&lt;/sub&gt; 1950mg</td>
</tr>
<tr>
<td>acetaldehyde, trichloro-</td>
<td>5</td>
<td>300-31200</td>
<td>orl hmn TDLo 1470 ug GIT</td>
</tr>
<tr>
<td>acetic acid</td>
<td>3</td>
<td>35000</td>
<td></td>
</tr>
<tr>
<td>acetic acid, phenyl</td>
<td>4</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>acetic acid, vinyl</td>
<td>1</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>acetone</td>
<td>3</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>hydroxyacetone</td>
<td>4</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>diacetone alcohol</td>
<td>1</td>
<td>19ppb</td>
<td></td>
</tr>
<tr>
<td>acetic acid, (2)</td>
<td>4</td>
<td>250ppb</td>
<td></td>
</tr>
<tr>
<td>acrylate, 3-methoxy-butyl</td>
<td>3</td>
<td>130ppb</td>
<td></td>
</tr>
<tr>
<td>azepin-2-one, hexahydro</td>
<td>1 SL1</td>
<td>73ppb</td>
<td></td>
</tr>
<tr>
<td>aniline</td>
<td>1</td>
<td>20ppb</td>
<td></td>
</tr>
<tr>
<td>2-nitroaniline</td>
<td>1</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>3-nitroaniline</td>
<td>1</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>4-nitroaniline</td>
<td>1</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>Adipic Acid</td>
<td>1</td>
<td>6ppb</td>
<td>orl rat LD&lt;sub&gt;50&lt;/sub&gt; 3600mg</td>
</tr>
<tr>
<td>adipate, tetramethylene</td>
<td>1</td>
<td>6ppb</td>
<td></td>
</tr>
<tr>
<td>acetate, butyl benzenesulfen</td>
<td>1</td>
<td>6ppb</td>
<td></td>
</tr>
<tr>
<td>acetate, n,n-di-n-butylform-</td>
<td>1</td>
<td>60ppb</td>
<td></td>
</tr>
<tr>
<td>acetate, E-methyl-N-ethyl form-</td>
<td>1</td>
<td>1103ppb</td>
<td></td>
</tr>
<tr>
<td>4-chloroaniline</td>
<td>1</td>
<td>100ppb</td>
<td></td>
</tr>
<tr>
<td>acetate, n,n-dimethyl form-</td>
<td>1</td>
<td>541ppb</td>
<td></td>
</tr>
<tr>
<td>acetates (4)</td>
<td>1</td>
<td>3190ppb</td>
<td></td>
</tr>
<tr>
<td>acetates (2)</td>
<td>2</td>
<td>400ppb</td>
<td></td>
</tr>
<tr>
<td>amine, dimethyl</td>
<td>1</td>
<td>80ppb</td>
<td>orl rat LD&lt;sub&gt;50&lt;/sub&gt; 698mg</td>
</tr>
<tr>
<td>amine, n,n-dimethyl benzyl-</td>
<td>1</td>
<td>74ppb</td>
<td></td>
</tr>
<tr>
<td>amine, di-n-butyl</td>
<td>1</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>amine (2)</td>
<td>1</td>
<td>200ppb</td>
<td></td>
</tr>
<tr>
<td>alcohol compounds (2)</td>
<td>3</td>
<td>5000ppb</td>
<td></td>
</tr>
<tr>
<td>alkene (C&lt;sub&gt;25&lt;/sub&gt;H&lt;sub&gt;56&lt;/sub&gt;)</td>
<td>3</td>
<td>18ppb</td>
<td></td>
</tr>
<tr>
<td>dichloroalkyl</td>
<td>4</td>
<td>100ppb</td>
<td></td>
</tr>
<tr>
<td>Butyric Acid</td>
<td>8</td>
<td>30ppb</td>
<td>orl rat LD&lt;sub&gt;50&lt;/sub&gt; 2940mg</td>
</tr>
<tr>
<td>butyrate, 3-hydroxy-trimethylpentyls</td>
<td>1</td>
<td>300ppb</td>
<td></td>
</tr>
<tr>
<td>1-butanimine, n-butyl-</td>
<td>1</td>
<td>180ppb</td>
<td></td>
</tr>
<tr>
<td>butanoate, 2 methoxymethyl-2-</td>
<td>1</td>
<td>55ppb</td>
<td></td>
</tr>
<tr>
<td>Butyraldehyde</td>
<td>1</td>
<td>900ppb</td>
<td>orl rat LD&lt;sub&gt;50&lt;/sub&gt; 2490mg</td>
</tr>
<tr>
<td>2-butanone</td>
<td>1</td>
<td>60ppb</td>
<td></td>
</tr>
<tr>
<td>butanone, 3-methyl-2-</td>
<td>1</td>
<td>500ppb</td>
<td>orl rat LD&lt;sub&gt;50&lt;/sub&gt; 3040mg</td>
</tr>
<tr>
<td>benzolic acid</td>
<td>4</td>
<td>2000ppb</td>
<td></td>
</tr>
</tbody>
</table>

ORIGINAL PAGE IS OF POOR QUALITY
PRIMARY REQUIREMENTS (CONT.)

BASE/NEUTRALS (CONT.)

* phthalate, diethyl pentyl 1 49
* phthalate esters (2) 6 350
* phthalate esters 1 140-15,000
phthalate ester cmpds (4) 3 75
phthalate ester cmpds (3) 8 20
* phthalate, bis(2-ethyl hexyl) 8 103
* phthalate, bis(2-ethyl hexyl) 1 4600
pyrene
1,2,4-trichlorobenzene
2,3,7,8-tetrachlorodibenzo-p-dioxin

PESTICIDE COMPOUNDS

Aldrin
alpha-BHC
beta-BHC
gamma-BHC
delta-BHC
chlorodane
4,4'-DDD
4,4'-DDE
4,4'-DDD
dieldrin
endosulfan I
endosulfan II
endosulfan sulfate
endrin
endrin aldehyde
heptachlor
heptachlor epoxide
toxaphene
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260

ORIGINAL PAGE IS OF POOR QUALITY
<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt Dct.</th>
</tr>
</thead>
<tbody>
<tr>
<td>acenaphthene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>acenaphthylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>anthracene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>benzidine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>benzo-a-anthracene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>benzo-a-pyrene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>benzo-b-fluoranthene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,4-benzofluoranthene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>benzo(g,h,l)perylene</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>benzo(k)fluoranthene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bis(2-chloro ethoxy)methane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bis(2-chloroethyl)ether</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bis(2-chloroisopropyl)ether</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-bromophenyl phenyl ether</td>
<td></td>
<td></td>
</tr>
<tr>
<td>butylbenzyl phthalate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-chloro naphthalene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-chlorophenyl phenyl ether</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>chrysene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dibenz(a,h)anthracene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-dichlorobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,3-dichlorobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,4-dichlorobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,3'-dichlorobenzidine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>diethyl phthalate</td>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>di-ethyl phthalate</td>
<td>1</td>
<td>240</td>
</tr>
<tr>
<td>di-n-butyl phthalate</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>2,4-dinitro toluene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,6-dinitro toluene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>di-n-octyl phthalate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-diphenylhydrazine (as azobenzene)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fluoranthene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fluorene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hexachlorobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hexachlorobutadiene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hexachlorocyclopentadiene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hexachloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>indeno(1,2,3-cd)pyrene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>isopropene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-methyl naphthalene</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>naphthalene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>nitrobenzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-nitrodimethylamine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-nitrodi-n-propylamine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-nitrodiphenylamine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>phenanthrene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compound</td>
<td>Source</td>
<td>Amt detected</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>0-cresol</td>
<td>8</td>
<td>160</td>
</tr>
<tr>
<td>p-chloro-m-cresol</td>
<td>8</td>
<td>150</td>
</tr>
<tr>
<td>4,6-dinitrocresol phenol</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>2-chlorophenol</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>dichlorophenol</td>
<td>4</td>
<td>55</td>
</tr>
<tr>
<td>2,4-dichlorophenol</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2,4,6-trichlorophenol</td>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>2,4,6-trichlorophenol</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>pentachlorophenol</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>chloromethylphenol</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>4-chloro-3-methylphenol</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2,4-dimethylphenol</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2-nitrophenol</td>
<td>4</td>
<td>265</td>
</tr>
<tr>
<td>4-nitrophenol</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2,4-dinitrophenol</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2-methylidinitrophenol</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>methylphenol</td>
<td>4</td>
<td>1000</td>
</tr>
<tr>
<td>2-methyl phenol</td>
<td>1</td>
<td>650</td>
</tr>
<tr>
<td>4-methyl phenol</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>phenol, 2,6-di</td>
<td>1</td>
<td>16 (20ppb est amt)</td>
</tr>
<tr>
<td>4-(1,1-dimethylethyl)phenol</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>phenol capds</td>
<td>4</td>
<td>2,200</td>
</tr>
<tr>
<td>phenol capds (8)</td>
<td>6</td>
<td>600</td>
</tr>
<tr>
<td>phenol capds (6)</td>
<td>2</td>
<td>275</td>
</tr>
<tr>
<td>phenol,2,6-di</td>
<td>8</td>
<td>150</td>
</tr>
<tr>
<td>phenol (carbolic acid)</td>
<td>4</td>
<td>460</td>
</tr>
<tr>
<td>phenol, chloro- adduct</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>phenol, dichloromethyl</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>phenol, t-butyl</td>
<td>4</td>
<td>150</td>
</tr>
</tbody>
</table>
## SPECIFIC TOXICANTS
### PRIMARY REQUIREMENTS

<table>
<thead>
<tr>
<th>Compound</th>
<th>Source</th>
<th>Amt detected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VOLATILES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetyl benzene</td>
<td>1</td>
<td>16 (20ppb est amt)</td>
</tr>
<tr>
<td>Acrolein</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>Alkylbenzene</td>
<td>1,500</td>
<td>500</td>
</tr>
<tr>
<td>Benzene</td>
<td>1,500</td>
<td>500</td>
</tr>
<tr>
<td>Bromochloromethane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>Bromochloropropene</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>Bromoform</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Dibromomethane</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbontetrachloride</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Chlorodichloromethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloroethane</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>2-chloroethyl vinyl ether</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Chloroform</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Dibromoacetane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>1,1-dichloroethane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>1,2-dichloroethane</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>1,1-dichloroethylene</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>trans 1,2-dichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichlorofluoromethane</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>1,2-dichloropropene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,3-dichloropropene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>1,2-dichloropropylene</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Dimethylbenzene-methane</td>
<td>1</td>
<td>230</td>
</tr>
<tr>
<td>ethyl benzene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methyl bromide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>methyl chloride</td>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>methylene chloride</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>propa-diene chloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1,2,2-tetrachloroethene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tetrachloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>toluene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-trans-dichloroethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1,1-trichloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trichloroethylene</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>vinyl chloride</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Proposed Water Quality Requirements (cont'd)

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>POTABLE LIMIT (mg/L)</th>
<th>HYGIENE LIMIT (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INORGANIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NONMETALLICS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Bromide</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Chloride</td>
<td>250</td>
<td>TBD</td>
</tr>
<tr>
<td>*Chlorine</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Fluoride</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Iodide</td>
<td>15</td>
<td>TBD</td>
</tr>
<tr>
<td>Nitrate</td>
<td>10</td>
<td>TBD</td>
</tr>
<tr>
<td>*Nitrate</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td><strong>Nitrogen, total</strong></td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>*Phosphorous</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Sulfate</td>
<td>250</td>
<td>TBD</td>
</tr>
<tr>
<td>Sulfide</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>*Sulfide</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>ORGANICS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>200</td>
<td>TBD</td>
</tr>
<tr>
<td>Halogenated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>TBD&lt;10</td>
<td>TBD</td>
</tr>
<tr>
<td>Oil &amp; Grease</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Organic Alc.</td>
<td>TBD&lt;500</td>
<td>TBD</td>
</tr>
<tr>
<td>Organic acids</td>
<td>TBD&lt;500</td>
<td>TBD</td>
</tr>
<tr>
<td>Phenols</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Specific Toxicants</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>TSC</td>
<td>TBD&lt;500</td>
<td>TBD&lt;10,000</td>
</tr>
<tr>
<td>TTC</td>
<td>TBD&lt;100</td>
<td>TBD&lt;1,000</td>
</tr>
<tr>
<td>*Trihalomethanes</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td><strong>MICROBIAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bacteria</td>
<td>(CFU/dL)</td>
<td>(CFU/dL)</td>
</tr>
<tr>
<td>Total</td>
<td>&lt;1</td>
<td>TBD</td>
</tr>
<tr>
<td>Anaerobes</td>
<td>&lt;1</td>
<td>TBD</td>
</tr>
<tr>
<td>Aerobes</td>
<td>&lt;1</td>
<td>TBD</td>
</tr>
<tr>
<td>Gram positive</td>
<td>&lt;1</td>
<td>TBD</td>
</tr>
<tr>
<td>Gram negative</td>
<td>&lt;1</td>
<td>TBD</td>
</tr>
<tr>
<td>E. coli</td>
<td>&lt;1</td>
<td>TBD</td>
</tr>
<tr>
<td>Enteric</td>
<td>&lt;1</td>
<td>TBD</td>
</tr>
<tr>
<td>Viruses (PFU)</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Yeast, molds</td>
<td>&lt;1</td>
<td>TBD</td>
</tr>
<tr>
<td><strong>BACTERICIDE</strong></td>
<td>(mg/L)</td>
<td>(mg/L)</td>
</tr>
<tr>
<td>Residual halo.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>minimum</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>maximum</td>
<td>4.00</td>
<td>6.00</td>
</tr>
<tr>
<td><strong>RADIOLOGICAL</strong></td>
<td>(pCi/L)</td>
<td>(pCi/L)</td>
</tr>
<tr>
<td>alpha 90 Sr</td>
<td>10</td>
<td>TBD</td>
</tr>
<tr>
<td>alpha 226 Ra</td>
<td>3</td>
<td>TBD</td>
</tr>
<tr>
<td>beta 3H</td>
<td>1,000</td>
<td>TBD</td>
</tr>
</tbody>
</table>

*Original page is of poor quality*
## Proposed Water Quality Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>Potable Limit</th>
<th>Hygiene Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>color</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>conductivity</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>gas, dissolved</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>gas, free</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>particulates</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>pH</td>
<td>6.0-8.0</td>
<td>5.0-8.0</td>
</tr>
<tr>
<td>solids, total</td>
<td>&lt;100</td>
<td>&lt;500</td>
</tr>
<tr>
<td>solids, diss.</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>surfactants</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>taste, odor</td>
<td>&lt;3</td>
<td>&lt;3</td>
</tr>
<tr>
<td>turbidity</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td><strong>Aesthetics</strong></td>
<td>(mg/L)</td>
<td>(mg/L)</td>
</tr>
<tr>
<td>Cations</td>
<td>TBD&lt;30</td>
<td>NA</td>
</tr>
<tr>
<td>Anions</td>
<td>TBD&lt;30</td>
<td>NA</td>
</tr>
<tr>
<td>O&lt;sub&gt;2&lt;/sub&gt;</td>
<td>TBD&lt;15</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Inorganic</strong></td>
<td>(mg/L)</td>
<td>(mg/L)</td>
</tr>
<tr>
<td>*Aluminum</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>*Antimony</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Barium</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>*Beryllium</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>*Boron</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Calcium</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Chromium</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>*Cobalt</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>*Copper</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Iron</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>Lead</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>*Molybdenum</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Potassium</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Silver</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>*Thallium</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>*Tin</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>*Titanium</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Zinc</td>
<td>5.00</td>
<td>5.00</td>
</tr>
</tbody>
</table>
Presentation made on May 20, 1988
NASA INSTITUTIONAL REVIEW BOARD - COMPOSITION

At least:

1. One NASA-employed Physician.
2. One NASA member of Chief Counsel's Office.
3. One NASA member of local Safety office.
4. One member with non-scientific expertise.
5. One member not affiliated with NASA.

Senior level NASA employee appointed as Chairperson.
APPENDIX 6

CONSENT FORM
FOR APPROVED NASA HUMAN RESEARCH

1. I, the undersigned, do voluntarily give my informed consent for my participation as a test subject in the following test, experiment, or other evaluative procedure:

NAME OF EXPERIMENT

FLIGHT TO WHICH ASSIGNED

NAME OF DESIGNATED PRINCIPAL INVESTIGATOR

NAME OF RESPONSIBLE NASA PROJECT SCIENTIST

I understand that:

(a) This procedure is part of an experiment approved by NASA.

(b) I am performing these duties as a part of my employment, with

(c) This procedure has been reviewed and approved by the JSC Human Research Policy and Procedures Committee (HRPPC) and determined that the procedure involves reasonable risk to the subject.

(d) "Reasonable risk" means that the risks of harm anticipated in the proposed research are greater than those ordinarily encountered in daily life or during the performance of routine tests, but considered to be proper when weighing the anticipated benefits and the importance of the knowledge to be gained from the research.

(e) The procedure has been explained to me prior to the execution of this form. I was afforded an opportunity to ask questions, and all questions asked were answered.

(f) I am medically qualified to participate in the procedure.

(g) I may withdraw from the procedure at any time unless, as recommended by the Principal Investigator, or his/her designee, the withdrawal is dangerous or impossible.

(h) In the event of physical injury resulting from the procedure and calling for immediate action or attention that NASA will provide, or cause to be provided, the necessary treatment. I also understand that NASA will pay for any claims of injury, loss of life or property damage to the extent required by the Federal Employees' Compensation Act or the Federal Tort Claims Act. My agreement to participate shall not be construed as a release of NASA or any third party from any future liability which may arise from, or in connection with, the above procedures.
2. I, the undersigned, the Principal Investigator of the experiment designated above, certify that:

(a) I have accurately described the procedure to the test subject.

(b) The test set-up involves reasonable risk to the test subject. All equipment used has been inspected and certified for safe and proper operation.

(c) The test subject is medically qualified to participate.

(d) The test protocol has not been changed from that approved by the JSC Human Research Policy and Procedures Committee (HRPPC).

APPROVED:

Test Subject _______________________________ Date _______________________________

Principal Investigator _______________________________ Date _______________________________

Project Scientist _______________________________ Date _______________________________

This consent form is valid for a 60-day period from the date of signature by the subject and the Principal Investigator (which dates should be identical). A signed, dated copy of the form should be forwarded to the JSC Human Research Policy and Procedures Committee, Mail Code SA, Lyndon B. Johnson Space Center, Houston, Texas 77058.
TEST SUBJECT PROTOCOL OUTLINE

2.11 INITIAL EVALUATION

2.111 NAME OF PERSONAL PHYSICIAN
2.112 RECENT ILLNESSES
2.113 PAST MEDICAL HISTORY
   2.1131 CHRONIC ILLNESSES
      (HYPERTENSION, DIABETES, ETC.)
   2.1132 REGULAR MEDICINES,
      INCLUDING OCP’S AND OTC
   2.1133 MENSTRUAL HISTORY
   2.1134 REGULAR CREAM, OINTMENT, OIL USE
   2.1135 OTHER DRUGS, ALCOHOL, TOBACCO
   2.1136 ACTIVE SKIN OR HAIR DISORDER
   2.1137 FREQUENCY OF MINOR INFECTIONS
      AND DISEASES

2.114 PHYSICAL EXAM
2.115 HEALTH PROFILE (DHWP)
2.116 LABORATORY
   2.1161 EOC
   2.1162 U/A AND CULTURE
   2.1163 WET PREP/GM STAIN (IF INDICATED)
   2.1164 SERUM PREGNANCY TEST
   2.1165 STOOL CULTURE
   2.1166 SPECIAL STUDIES
2.117 SKIN TEST ANERGY PACK AND PPD (READING REG’D IN 48 HRS)
2.118 BEGIN SYMPTOM DIARY

2.12 DISQUALIFICATION CRITERIA FOR INITIAL EVALUATION

2.121 NO PERSONAL PHYSICIAN
2.122 ANY CHRONIC ILLNESS OR REGULAR MEDICINE INTAKE
   (OCP, OTC MEDS)
2.123 FREQUENT MINOR ILLNESSES
   2.1231 >4 COLDs/YR
   2.1232 >2 UTI/YR
   2.1233 >1 UG/TVS/YR
   2.1234 >2 VAPORISTIS/TVS
   2.1235 >1 ACTIVE SKIN INFECTION/YR
2.124 ABNORMAL PHYSICAL FINDING
2.125 POOR DUMP SCORE
2.126 ABNORMAL LAB
2.127 PREGNANCY
2.128 ANEMIC
TEST SUBJECT PROTOCOL OUTLINE (cont'd)

2.13 IMMEDIATE PRETEST EVALUATION

2.131 REVIEW SYMPTOM DIARY
2.132 REVIEW RECENT MENSTRUAL HISTORY
2.133 REVIEW RECENT TOPICAL USE
2.134 BRIEF PHYSICAL EXAM
2.135 LABORATORY
   2.1351 U/A AND CULTURE
   2.1352 WET PREP/SM STRAIN (IF INDICATED)
   2.1353 SERUM PREGNANCY TEST
   2.1354 URINE DRUG SCREEN (LEGAL RAMIFICATIONS)
   2.1355 SPECIAL STUDIES

2.14 DISQUALIFICATION CRITERIA FOR PRETEST EVALUATION

2.141 SIGNIFICANT NEW SYMPTOMS OF INFECTION
2.142 TESTING LIKELY TO OCCUR DURING MENSES
   (POLICY DECISION)
2.143 ANY TOPICAL USE ON PROHIBITED LIST
2.144 ABNORMAL PHYSICAL FINDINGS
2.145 POSITIVE URINE CULTURE (>10000/MUl OF EACH
   ORGANISM)
2.146 POSITIVE WET PREP/SM STRAIN
2.147 POSITIVE OR INDETERMINATE SERUM PREGNANCY TEST
2.148 POSITIVE URINE DRUG SCREEN (LEGAL)
ECLSS WATER RECOVERY TEST
MEDICAL ASPECTS

TEST SUBJECT PROTOCOL OUTLINE (cont'd)

2.15 POST TEST EVALUATION

2.151 REVIEW SYMPTOM DIARY
2.152 REVIEW MENSTRUAL HISTORY
2.153 BRIEF PHYSICAL EXAM
2.154 REPEAT HEALTH PROFILE (HMP)
2.155 LABORATORY
    2.1551 U/B AND CULTURE
    2.1552 WET PREP /GM STRAIN (IF INDICATED)
    2.1553 SERUM PREGNANCY TEST
    2.1554 STOOL CULTURE

2.16 DETECTION OF SICK SUBJECTS

2.161 CONTINUE SYMPTOM DIARY
2.162 MONITOR VISITS TO PERSONAL PHYSICIAN (BY PERMISSION)
2.163 SUBJECT NOTIFIED
Presentation made to Luther Powell
IMPORTANCE OF "MÄN IN LOOP" TESTING

- Hard to separate input/output
- Biological Variability
- Maintains high standard of research at all times
- Never before accomplished
ADDITIONAL REQUIREMENTS FOR "MAN IN LOOP" TESTING

- Test Subject Safeguards
- Expanded Medical Support Program
- Increased Sampling and Analysis
- New Research Areas
EXPOSURE AND RISK

SOURCES

HYGIENE WASTES
  SHOWER
  CLOTHES WASHING
  DISH WASHING

URINE

HUMIDITY CONDENSATE

ROUTES

SKIN CONTACT INCLUDING MUCOUS MEMBRANES
  TRANSDERMAL

INHALATION

INGESTION

EXPOSURE

INTERMITTENT (FOR GROUND TESTING)

RISK

CHEMICAL

BIOLOGICAL
SPECIFIC TOXICANTS

DEFINITION

PRIMARY

EPA PRIORITY POLLUTANTS AND RELATED COMPOUNDS

VOLATILES

ACID EXTRACTABLES

BASE/NEUTRAL EXTRACTABLES

PHARMACEUTICALS

METABOLITES

OXIDATION PRODUCTS

SECONDARY

ALL OTHER
TIME REQUIREMENTS FOR MONITORING WATER QUALITY PARAMETERS

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>REAL-TIME (On Line)</th>
<th>NEAR REAL TIME (8 HRS)</th>
<th>DELAYED (24 HRS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Color</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Turbidity</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>INORGANIC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Metals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chloride</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bromide</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Iodide</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Nitrate</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Phosphate</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sulfate</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Metals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Barium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cadmium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chromium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Copper</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Iron</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lead</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Manganese</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Mercury</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Selenium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Silver</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Zinc</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ORGANICS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Phenols</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOC</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>TOX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Toxic Organics (TTO)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>MICROBIOLOGICAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Bacteria</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Total Coliforms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterotrophs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Saprophytic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legionellae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fungi (Yeast &amp; Molds)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viruses (TBD)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CURRENT ISSUES

DETECTION LIMITS
SPECIFIC METHODS
TURNAROUND TIME

ACCOUNTABILITY

DRUGS AND PHARMACEUTICALS
MEDICAL ISSUES

- DETERMINATION OF ACTUAL HUMAN RISK OF SKIN, MUCOUS MEMBRANE, AND INGESTION EXPOSURE TO:
  - CHEMICAL CONTAMINANTS
  - MICROBIAL CONTAMINANTS (UNUSUAL PATHOGENS)
  - URINARY METABOLITES OF PHARMACEUTICALS AFTER PRETREATMENT

- SAMPLING PROBABILITIES
  - NECESSARY AND SUFFICIENT DATA POINTS
  - TYPE II ERROR (FALSE NEGATIVE)

- GROUND TESTING STRATEGY FOR PHARMACEUTICALS
  - ALL DRUG INTAKE BY SUBJECTS PROHIBITED, OR
  - ONLY HMF FORMULARY ALLOWED
    - SUBJECT POPULATION SIZE
    - FEDERAL VS. PRIVATE TORT SYSTEM
1. The use of human subjects in research committee (UHSRC) shall be composed of at least five (5) members, with diverse backgrounds possessing the professional competence to promote complete and adequate review of research activities and ascertain acceptability in terms of institutional commitments and regulations, applicable law and standards or professional conduct and practice.

2. Representation on the UHSRC shall include:
   a. Men and women.
   b. Representation of more than one profession.
   c. At least one member whose primary concerns are non-scientific, i.e., lawyer, ethicist, clergy member.
   d. At least one member who is not affiliated with the institution, either personally or by immediate familial relationship.

3. No person shall serve as a member of the UHSRC where such service would constitute a conflict of interest involving the proposed research project under review.

4. The UHSRC will invite individuals with specific competencies to assist in its review of complex issues. Within the scope of their invitation, these invited individuals will serve as full members of the UHSRC, except that they shall not have a vote.

Model Federal Policy
Office of Science and Technology Policy (OSTP)
6/86
ECLSS WATER RECOVERY TEST
MEDICAL ASPECTS

RECIPIENT CRITICALITY
EXAMPLE - DENEINE

DONOR ONLY

SHOWER EFFLUENT
URINE

10PPB
10PPB

"SYSTEM MEETS SPECS" → TESTING
1PPB

"SYSTEM DOES NOT MEET SPECS" → TESTING

RECPIENT

SHOWER EFFLUENT
URINE

PPB

"SYSTEM MEETS SPECS" → TESTING

"SYSTEM DOES NOT MEET SPECS" → TESTING

BIOACCUMULATION
ECLSS WATER RECOVERY TEST
MEDICAL ASPECTS

RECIPIENT CRITICALITY
EXAMPLE - BENZENE

DONOR ONLY

SHOWER

URINE

10PPB

10PPB

SUBSYSTEMS

"SYSTEM MEETS SPECS"

TESTING

1PPB

SUBSYSTEMS

TESTING

RECIPIENT

SHOWER

URINE

PPB

PPB

SUBSYSTEMS

"SYSTEM DOES NOT MEET SPECS"

TESTING

PPB

SUBSYSTEMS

TESTING

BIOACCUMULATION
### Phased Human Subject Water Recovery Test

<table>
<thead>
<tr>
<th>DONOR</th>
<th>HYGIENE</th>
<th>URINE</th>
<th>RECIPIENT</th>
<th>HYGIENE</th>
<th>POTABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHASE 1 DATA</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE 2 DATA</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HUMAN SUBJECTS REVIEW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE 3 DATA</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>HUMAN SUBJECTS REVIEW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE 4 DATA</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>KNOWN SYSTEM PERFORMANCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# ECLSS WATER RECOVERY TEST

## MEDICAL ASPECTS

### PHASED HUMAN SUBJECT WATER RECOVERY TEST

<table>
<thead>
<tr>
<th>Phase</th>
<th>Donor</th>
<th>Recipient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1 Data</td>
<td>HYGIENE X</td>
<td>URINE</td>
</tr>
<tr>
<td>Phase 2 Data</td>
<td>HYGIENE X, URINE X</td>
<td></td>
</tr>
<tr>
<td>Human Subjects Review</td>
<td>HYGIENE</td>
<td></td>
</tr>
<tr>
<td>Phase 3 Data</td>
<td>HYGIENE X, URINE X</td>
<td>POTABLE X</td>
</tr>
<tr>
<td>Human Subjects Review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 4 Data</td>
<td>HYGIENE X, URINE X</td>
<td>POTABLE X</td>
</tr>
<tr>
<td>Known System Performance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The table indicates the phases of the water recovery test, with specific data points for donor and recipient aspects. The symbols X signify the presence of data or observations.
ECLSS WATER RECOVERY TEST
MEDICAL ASPECTS

RECIPIENT CRITICALITY
EXAMPLE - BENZENE

DONOR ONLY

SHOWER EFFLUENT
10PPB

URINE
10PPB

"SYSTEM MEETS SPECS" → TESTING
1PPB → SUBSYSTEMS → TESTING

"SYSTEM DOES NOT MEET SPECS" → TESTING

SHOWER EFFLUENT
PPB

URINE
PPB

SUBSYSTEMS

RECIPIENT

SHOWER

URINE

SUBSYSTEMS

BIOACCUMULATION
Presentation made on June 30, 1988 and July 5, 1988
ECLSS WATER RECOVERY TEST
MEDICAL ASPECTS

RECIPIENT CRITICALITY
EXAMPLE - BENZENE

DONOR ONLY

SHOWER
URINE

10PPB
10PPB

SUBSYSTEMS

"SYSTEM MEETS SPECS"

1PPB

SUBSYSTEMS

TESTING

"SYSTEM DOES NOT MEET SPECS"

RECIPIENT

SHOWER
URINE

PPB

SUBSYSTEMS

PPB

TESTING

BIOACCUMULATION

BIOTRANSFORMATION
PHASED HUMAN SUBJECT WATER RECOVERY TEST

<table>
<thead>
<tr>
<th>PHASE 1 DATA</th>
<th>PHASE 2 DATA</th>
<th>PHASE 3 DATA</th>
<th>PHASE 4 DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>DONOR</td>
<td>HYGIENE</td>
<td>URINE</td>
<td>HYGIENE</td>
</tr>
<tr>
<td>RECIPENT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYGIENE</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>URINE</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HYGIENE</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>POTABLE</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

HUMAN SUBJECTS REVIEW

KNOWN SYSTEM PERFORMANCE
Specific Toxicants

Definition

- Demonstrated toxicity
- Demonstrated occurrence in water (air)
- Known industrial product or degradation product

Primary

- EPA Priority Pollutants and related compounds (60)

Secondary (170)

Pharmaceuticals

- Metabolites
- Oxidation Products
- Illicit Drugs
Exposure and Risk

Sources

Hygiene Wastes

Shower

Clothes Washing

Dish Washing

Urine

Humidity Condensate

Routes

Skin Contact including mucous membranes

Transdermal

Inhalation

Ingestion

Exposure

Intermittent (for ground testing)

Risks

Chemical

Biological

Liability Exposure
Presentation made on September 7, 1988
INITIAL SCREENING (R.N.)

1) Informed consent
2) Health questionnaire (HQ)
3) Health profile (DUHP)
4) Begin symptom dairy
5) Appointment with examining physician (EP)
INITIAL EXAM (M.D.)

1) History and physical
2) Lab drawn
3) Skin tests placed
4) EP indicates opinion to environmental health physician (EHP) - 48 hour delay
SUBJECT LAB

Complete Blood Count
Urinalysis
Wet Preparation
Serum Pregnancy
Stool
Urine Drug Screening
  (Qualitative)
HIV
HEP Profile
APPENDIX E

2.12 Disqualification Criteria for Initial Evaluation

2.121 No personal physician

2.122 Any chronic illness or regular medicine intake

2.123 Frequent minor illnesses

2.1231 > 4 colds/yr

2.1232 > 2 GE/yr

2.1233 > 1 UTI/yr

2.1234 > 2 Vaginitis/yr

2.1235 > 1 Active Skin Infection/yr

2.124 Abnormal physical finding

2.14 Disqualification Criteria for Pre-test Evaluation

2.141 Significant new symptoms of infection

2.142 Testing likely to occur during menses (phase dependent)

2.143 Any topical use (phase dependent)

2.144 Abnormal physical finding

2.145 Positive urine culture ( >10,000/ml of each organism)

2.146 Positive wet prep/GM stain

2.147 Positive or indeterminate serum pregnancy test

2.148 Positive urine drug screen
PRE-TEST EXAM (M.D.)
(ONE-WEEK PRIOR TO INVOLVEMENT)

1) Brief history and physical
2) Lab drawn
3) EP indicates opinion to EMP- 48 hour delay
SUBJECT HEALTH SURVEILLANCE

1) Symptom diary continued

2) Brief history and physical at 1 week, 6 and 12 months after first participation.

3) Monthly review of any MD visits for 24 months by EHP.
<table>
<thead>
<tr>
<th>HEART</th>
<th>NL</th>
<th>ABNL</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEURO/MS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEALTH PROFILE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LABORATORY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROUTINE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECIAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SKIN TEST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANERGY</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I have examined the above named subject and believe he/she (is) (is not) qualified to be involved in the water recovery test at MSFC.

__________________________ M.D.  __/__/___

DATE
APPENDIX D
MEDICAL EVALUATION, SUBJECTS
FOR WATER RECOVERY TEST, MSFC

NAME: ________________________  LAST  ________________________  FIRST  ________________________  MIDDLE

ADDRESS: ____________________________________________

_____________________________________________________

AGE ______  DATE OF BIRTH ______

WORK AREA: ________________________  WORK PHONE: __________

HOME PHONE: ______________  MAIL CODE: __________

IN CASE OF EMERGENCY, CONTACT: ________________________

_____________________________________________________

PERSONAL PHYSICIAN: ________________________

ADDRESS: ______________________________________  PHONE: __________

INITIAL EVALUATION

<table>
<thead>
<tr>
<th>NL</th>
<th>ABNL</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHRONIC ILLNESSES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MENSTRUAL HISTORY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RECENT ILLNESSES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOPICAL USE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HABITS (D, T, A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SKIN/HAIR DISORDER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MINOR ILLNESS FREQUENCY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICAL EXAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SKIN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LUNGS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D
MEDICAL EVALUATION, SUBJECTS
FOR WATER RECOVERY TEST, MSFC

<table>
<thead>
<tr>
<th>NAME:</th>
<th>LAST</th>
<th>FIRST</th>
<th>MIDDLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGE</td>
<td>DATE OF BIRTH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WORK AREA</td>
<td>WORK PHONE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOME PHONE</td>
<td>MAIL CODE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN CASE OF EMERGENCY, CONTACT:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PHONE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERSONAL PHYSICIAN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADDRESS</td>
<td>PHONE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PRE-TEST EVALUATION

<table>
<thead>
<tr>
<th>SYMPTOM DIARY</th>
<th>NL</th>
<th>ABNL</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MENSTRUAL HISTORY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOPICAL USE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICAL EXAM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LABORATORY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROUTINE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECIAL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I have examined the previous named subject and believe he/she (is) (is not) qualified to be involved in the water recovery test at MSFC.

__________________________________ M.D.    ___/___/___

DATE
Detailed Test Activities

1. Insert Microbiological sampling section, including methodologic information similar to Appendix C and D of Garcia Shower Proposal.

2. Insert chemical sampling section, including information similar to Appendix C and D of Garcia Shower Proposal.

3. Insert pharmaceutical sampling section, including information similar to Appendix C and D of Garcia Shower Proposal.

4. Insert overview of sampling schedule, including frequency and volumes necessary with mass balance estimate.

5. Insert section of Human Subject pool selection/evaluation process (Crump’s Outline).

6. Insert incremental plan for adding creams, drugs, menstrual blood.

7. Insert Boeing’s plan for orientation, pre-involvement education.

8. Insert water certification process similar to NASA-JSC SAE Shower Publication, updated for more frequent sampling schedule.
LAST EPISODE - SOME - REMAINING ?'s

LAB DISCUSS LATER

REASON FOR DELAY < LAB "BASIS OF OPINION"

MENSES SCREEN PHASE DEPENDENT

REASON FOR DELAY - LAB

DRUG SCREEN - YES
HIV - YES
HIV PROFILE - YES

FORMS

MY JUINER EC FOR
SECTION 8 OF MASTER

OH

PROTOCOL OUTLINE

INITIAL SCREEN

INITIAL EXAM

DISQUAL CRITERIA

PRE TEST

SURVEILLANCE

SUBJECT LAB

INITIAL EVAL - 1
11 2

PRE TEST

DETERMINED TEST ACTION
APPENDIX H

Budget Summary
### FINANCIAL REPORT SUMMARY

**CONTRACT:** FNAS Environmental Control Medical Support Team  
**ACCOUNT NUMBER:** 5-31806  
**REPORT PERIOD:** 12/7/87 - 9/30/88

<table>
<thead>
<tr>
<th>Category</th>
<th>Budget</th>
<th>Expended</th>
<th>Encumbered</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Salary &amp; Wages</td>
<td>47,889.00</td>
<td>46,651.43</td>
<td>300.00</td>
<td>937.57</td>
</tr>
<tr>
<td>II. Fringe</td>
<td>10,057.00</td>
<td>9,656.89</td>
<td>0.00</td>
<td>400.11</td>
</tr>
<tr>
<td>III. Operating Expenses</td>
<td>1,625.00</td>
<td>5,663.25</td>
<td>0.00</td>
<td>&lt;4,038.25&gt;</td>
</tr>
<tr>
<td>IV. Laboratory Supplies</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>V. Travel</td>
<td>4,754.00</td>
<td>594.23</td>
<td>1,431.00</td>
<td>2,728.77</td>
</tr>
<tr>
<td>VI. Facility Usage</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>VII. Indirect</td>
<td>30,876.00</td>
<td>29,892.26</td>
<td>686.88</td>
<td>296.86</td>
</tr>
</tbody>
</table>

**TOTAL:** 95,201.00  
**92,458.06**  
**2,417.88**  
**325.06**

Date: 10/31/88  
Prepared by: M.V. Kilgore, Jr.