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CR 151819

FINAL REPORT

on

**SPACE LIFE SCIENCES PILOT USER DEVELOPMENT
PROGRAM FOR THE MIDWEST REGION**

Contract No. NAS 9-15504

January 1, 1978 - July 31, 1978

to

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER**

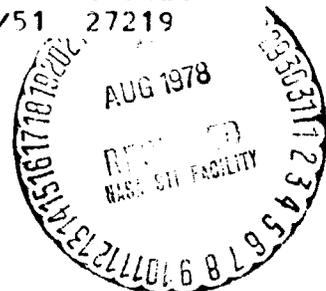
July 27, 1978

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**BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201**



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SPACE LIFE SCIENCES PILOT USER DEVELOPMENT PROGRAM FOR THE MIDWEST REGION

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**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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from

**BATTELLE
Columbus Laboratories**

July 27, 1978

INTRODUCTION

The Biosciences Payloads Office of the Directorate of Life Sciences, Johnson Space Center, has initiated a pilot program in several regions of the United States to promote the use of space for research by the life science community. Battelle Columbus Laboratories (BCL) has participated as a contractor in the midwestern region - covering Ohio and several surrounding states. Battelle has pursued NASA's overall program objective through a series of informal one-day seminars with personal follow-up as circumstances dictated.

The programs were planned to

- Describe the space shuttle vehicle and some of its intended uses
- Discuss problems of manned space flight
- Stimulate ideas for biological research in space
- Discuss costs and potential for industrial and government sponsorship
- Show the researcher or corporate planner how to become an active participant in Life Sciences Research in Space

Two seminars have been held to date at our facilities in Columbus, Ohio.

METHOD

The regional seminar approach was chosen by Battelle as the most cost effective, yet personal way of initiating information exchange with the researcher (or manager).

Drawing upon BCL's experience in STS user development and life sciences research, as well as its familiarity with the interests and activities of other scientists in the midwestern life sciences community, we determined that most potential users were concerned with the following:

- What is the space Transportation system?
- How can it be used for life sciences research?
- What are some relevant experiences?
- How do I obtain sponsorship?
- What are the costs?
- Where do I start?

The regional seminar forms a basis for information exchange designed to provide answers to these questions.

Seminar Topic Plan

First, we established a general program topic plan to inject continuity into the seminar series; the following outline has been used to formulate the first two seminar programs.

- A. Space Transportation System
 - (1) History
 - (2) Payloads
 - (3) Mission plans
 - (4) NASA goals

- B. Man in Space
 - (1) Adaptability
 - (2) Limitations
 - (3) Problems
 - (4) Man/Equipment interface
- C. Research in Space
 - (1) Space environment
 - (2) Accomplishments in the life sciences
 - (a) plant and animal biology
 - (b) biomedical experiments
 - (3) New ideas
- D. Benefits from Space Research
 - (1) to manned spaceflight
 - (2) to life on earth
 - (3) to business
- E. Cost
 - (1) Shuttle payload user charge policy
 - (2) Sponsorship
 - (a) NASA
 - (b) other Government agencies
 - (c) Industry
 - (1) return on investment
 - (2) proprietary rights
 - (d) Cost sharing
- F. How to Begin
 - (1) Define specific research interests and objectives
 - (2) Determine experimental needs and technical problem areas
 - (3) Look closely at separation, transport or growth processes
 - (4) Could these be altered or enhanced by 0 g or other aspects of the space environment?
 - (5) Communicate with persons knowledgeable of space research in your field of interest
 - (6) Use NASA's Space Life Sciences Archival Library (Biomedical and bioengineering info derived from manned space flight programs).

From these topics a series of seminars could be planned, each one somewhat different but repeating a common theme, "Life Sciences Research in Space - the Shuttle Era".

Seminar Organization

Two regional seminars were held at Battelle's Columbus Laboratories, utilizing our Teleconference Facility. This facility, with a capacity of 50 persons, is outfitted with several ceiling-mounted, remote controlled TV cameras, permitting unobtrusive continuous video taping of the seminar proceedings.

Dates for the seminars were chosen so as to avoid conflict with other meetings and society activities, thereby maximizing our attendance. Seminars No. 1 and 2 were carried out on March 9, 1978 and June 15, 1978, respectively. Speakers on specific topics were invited from NASA, other Government agencies, universities and colleges, and from industry-including Battelle. We encouraged the use of audio-visual aids such as slides, view-graphs and films. Additionally, scale models of Space Shuttle Orbiter and Spacelab were brought in as conversation pieces, and selected publications were provided as hand-outs (see Table 1).

The seminars ran for one day only and were planned with ample free time for questions. It was our desire to maintain an air of structured informality and to encourage audience interaction.

All portions of the seminars were video-taped; we plan to have individual talks and edited versions of entire meetings available for distribution (later) on a loan basis if sufficient demand is shown. Programs for these two seminars are included in Appendix A and B.

Regional Contacts

Seminar invitations were offered by phone, mail or personal contact; where genuine interest was shown, follow-up contact continues to be maintained. Invitees included persons from Ohio and several surrounding states, representing:

TABLE 1. FILMS AND PUBLICATIONS UTILIZED

FILMS

- SPACE TRANSPORTATION SYSTEM
 - BIOLOGICAL APPLICATIONS IN SPACE
- PUBLICATIONS
- NASA SP 407 SPACE SHUTTLE
 - ESA SP 1001 SPACELAB USERS GUIDE
 - NASA BIOPROCESSING IN SPACE
 - JSC - 12599 THE SHUTTLE ERA -- SPACE SHUTTLE FACT SHEET
 - BIOSCIENCE OPPORTUNITIES FOR BIOLOGICAL RESEARCH IN SPACE
REPRINT DURING THE 1980's, JOHN A. MASON
 - JSC - 10933 (b) SPACE LIFE SCIENCES ARCHIVAL LIBRARY USER'S GUIDE
 - NASA SMALL SELF-CONTAINED PAYLOAD PROGRAM
 - NASA SPACE TRANSPORTATION SYSTEM USER INFORMATION SERVICES
 - AIAA SPACE - A RESOURCE FOR EARTH
 - NASA-JSC SPACE TRANSPORTATION SYSTEM USER HANDBOOK
(limited distribution)
 - JSC - 13979 BIOSPEX - BIOLOGICAL SPACE EXPERIMENTS
A SUMMARY OF LIFE SCIENCES EXPERIMENTS CARRIED
ON U. S. SPACECRAFT

- AO No. OSS-1-78 ANNOUNCEMENT OF OPPORTUNITY, LIFE SCIENCES INVESTIGATIONS
ON SPACE SHUTTLE/SPACELAB MISSIONS, 1981-1983

- Industrial firms
- Academic institutions
- Research institutions
- Government agencies

An active file of interested researchers and managers was maintained and enlarged continually as new contacts were made through (1) peer referral, (2) displays and informal discussion at meetings, (3) review of source documents (e.g. society membership lists), and (4) referral and screening of relevant mailing lists. The file is computerized and can presently generate either a printed list or mailing labels. On command, it will printout according to either selected status codes or zip codes. Provision has been allowed to select lists later by scientific field, company, agency or university affiliation, or other key phrases.

Peer Referral

Our initial contacts were referred by Battelle research staff in the life sciences as well as by our marketing staff. This group continues to enlarge as new contacts are made in the course of our daily activities.

Meeting Attendance

Posters and hand-out materials were used on several occasions to promote the regional user development program. Also, opportunity was given to present and/or discuss the program at several meetings.

- 4-17-78 Battelle Operations Management Meeting;
Columbus, Ohio
- 4-29-78 International Biomaterials Symposium;
San Antonio, Texas
- 5-12-78 International Conference on Cell and Molecular
Biology in Space; Toledo, Ohio
- 5-16-78 Research Forum - Riverside Methodist Hospital
Columbus, Ohio
- 5-30-78 American Institute of Aeronautics and Astronautics;
Columbus, Ohio
- 6-27-78 Central Ohio Medical Equipment Technicians Assoc;
Columbus, Ohio

Source Documents

Many contacts were established through the use of reference materials obtained from Battelle's Library and Marketing facilities, and from individual researchers. Initially the following were reviewed, in part:

- (1) Barron's Profiles of American Colleges, 10th edition, Vol. 2, Index to Major Areas of Study
- (2) Industrial Research Laboratories of the United States, 14 edition, 1975, R. R. Bowker Publishing Co.
- (3) Membership list, Society for Biomaterials
- (4) Membership list, American Society for Physiologists

Many such publications could be screened for expansion of the mailing list, including Moody's Industrial Manual, NIH Research Grants, the Who's Who (in science) series, and additional professional society listings.

Referred Mailing Lists

Also considered were specific interest groups other than professional societies, such as those attending special meetings on related scientific topics. We were fortunate to obtain from Dr. Bodo Diehn (University of Toledo), the pre-registration list for the International Conference on Cell and Molecular Biology in Space, which took place May 10-12, 1978 in Toledo, Ohio. Many beneficial contacts resulted from the use of that list.

Other Contacts

Several persons now listed in our file were "second generation" contacts, referred by friends/peers who had been informed directly concerning our regional seminars. In essence our promotional program networked itself through word-of-mouth referral.

Follow-up Activities

Once interest is generated (through the seminar program), it must be maintained in order to nurture ideas and to ultimately enlist participation in the space program. This was accomplished by first determining each researchers specific areas of interest, and the depth of their experience

(if any) with NASA and the space life sciences program. A seminar follow-up survey and personal discussion were means for obtaining this information. We asked for information concerning previous space program involvement, present proposal activity, new areas for development, anticipated problems concerning research in space, and information requirements. A survey form (included in the Appendix) was mailed to seminar attendees, along with a registration list, speakers roster, and any specific information requested during the seminar. A prepaid business reply envelope was provided to minimize response effort.

Attendees were encouraged to maintain open communication with Battelle; subsequently, we provided additional background information or referred inquiries to NASA personnel on several occasions. Although funds did not permit during this initial effort, some university and industrial groups have asked for future briefings at their location.

RESULTS

The numerous contacts (222) established during the course of this contract have hopefully stimulated many creative researchers and forward-looking managers into thinking "space" and how they and their organizations can utilize the Space Transportation System to accomplish their goals. Most persons contacted were genuinely interested in the space program, but in some cases there was no fit with the objectives of their organization. As a clear show of interest, 209 persons remain on our mailing list.

We are especially grateful to the invited speakers, who made the two seminar programs an obvious success.

- George T. Brooks - National Institutes of Health
- William J. Clarke - Battelle Columbus Laboratories
- William K. Douglas - McDonnell Douglas Astronautics Co.
- Ronald B. Hoffman - General Electric Company
- Phillip C. Johnson - Baylor College of Medicine
- Paul D. Klimstra - G. D. Searle and Company
- John A. Mason - NASA, Johnson Space Center
- Jack R. McDowell - Battelle, Columbus Laboratories

- Roger L. Merrill - Battelle, Columbus Laboratories
- H. William Scheld - University of Houston
- Robert E. Schwerzel - Battelle, Columbus Laboratories
- Gerald R. Taylor - NASA, Johnson Space Center

Seminar No. 1

Following our general topic plan outlined earlier, the first seminar was structured to cover (1) STS and the Space Shuttle, (2) payloads and user charge policy, (3) man in space, his problems, limitations and contributions, (4) research experience with cellular systems, (5) new ideas for life support in space, (6) industrial sponsorship of space research and, (7) using the Space Shuttle. Full program details are included in Appendix A.

The first seminar, held March 9, 1978, was arranged wholly through telephone contact. Once arrangements for the program and attending speakers were firm, 65 contacts obtained by peer referral were telephoned; the seminar and our objectives were described in detail. From these 65 calls, 44 firm commitments were made, of which 39 actually attended.

Representatives came from:

- (1) Battelle Columbus Labs
- (2) State of Ohio
- (3) Ohio State University Hospitals
- (4) Ohio State University Research Foundation
- (5) Ohio State University
- (6) Nationwide Corporation
- (7) Wright Patterson Air Force Base
- (8) Antioch College
- (9) University of Cincinnati
- (10) Charles F. Kettering Research Lab
- (11) Adria Labs.
- (12) Ross Labs.

(see full attendance list, Appendix A).

Seminar No. 2

Bearing some similarity to the first seminar, the second program, held June 15, 1978, was modified to include (1) STS and the Space Shuttle, (2) payloads and user charge policy, (3) experimental equipment for use in space (4) man in space, his physiological response, (5) experience with plant physiology experiments for Spacelab, (6) potential for sponsorship of space research by the National Institutes of Health, and (7) using the Space Shuttle. Again, full program details are included in Appendix B.

Invitations for the second seminar were mailed to 184 persons, additionally a number of contacts were established at the various meetings which were mentioned earlier. Resultant confirmations for preregistration included 51 persons, 38 of whom attended the seminar. Represented were:

- (1) University of Kentucky
- (2) State of Ohio
- (3) Battelle Columbus Labs
- (4) University of Louisville
- (5) Columbus (Ohio) Public Schools
- (6) Ohio State University Research Foundation
- (7) Ohio State University
- (8) Case Western Reserve University
- (9) BioSpace Inc.
- (10) Research Triangle Institute
- (11) University of Cincinnati
- (12) University of Toledo
- (13) (Columbus) area physicians
- (14) Wright Patterson Air Force Base
- (15) University of Maryland
- (16) Roswell Park Memorial Institute

(see full attendance list, Appendix B).

Promotional Materials

All of the materials used - including publications, films posters, spacecraft models, seminar announcements and reply cards - proved to be invaluable aids in promoting and carrying out the two seminars.

A frequent newsletter, issued by NASA and covering current events on life sciences research could be an asset. Also, researchers expressed a desire to know more about available experimental equipment and changes in physical phenomena expected in space. NASA's recent release of "BIOSPEX Biological Space Experiments" contains excellent information on research experience to date, and should prove to be extremely useful to researchers.

Survey Response

A seminar follow-up survey was mailed to attendees of each seminar program (see Appendix C). Responses to that survey are tabulated here in summation; the following figures are based on information derived from the 38 survey forms which were returned; this represents about 50% response.

TABLE 2. SURVEY RESPONSE

Item	Response*		
	Yes	No	Maybe
● Do you now receive NASA announcements of opportunity (AO)?	14	23	
● May we refer your name to NASA for future mailings of AO's, newsletters, etc.?	35	1	
● Did the Seminar stimulate your interest in research in space?	33	2	
● Have you ever worked with NASA	15	23	
● Did you receive a copy of NASA Announcement of Opportunity No. OSS-1-78 dated Feb. 7, 1978	28	10	
● Do you intend to submit a proposal to NASA for flight experiments under this AO?	11	17	3
● Will you need assistance in understanding the AO and Proposal Requirements?	4	7	
● Would you like to develop an experiment for research in space?	26	5	2
● Do you need more information on:			
related experience	14		
experimental equipment	13		
physical phenomena	5		

* Total Survey Response 38.

In addition, the survey included 2 subjective questions; the responses are listed below at random.

What problems/limitations do you envision in carrying out life sciences research in space?

1. Interfacing with NASA centers
2. Meeting flight requirements
3. Financial
4. Time and funding for equipment development
5. Inability to make changes during course of experiment
6. Duration of experiment limited by mission time
7. Better understanding needed between NASA and other potential sponsors
8. NASA has not supported the scientific community adequately, after gaining their interest
9. Transfer of technology to earth applications
10. Disposal of organic solvents
11. Acceleration of launch and re-entry
12. Planning experimental period to coincide with actual time of weightlessness
13. wall effects of containers
14. maintenance of sample viability before and after experiment, especially pre-launch and post-recovery
15. interface with NASA concerning hardware design and fabrication
16. limited space availability
17. maintaining biological materials during pre-launch and launch
18. circulation of fluid media without nulling the benefits of weightlessness (e.g. in culture systems)
19. Long-term return on research investment
20. Experimental continuity may suffer due to limited funding and flight opportunities
21. Difficult for researchers to think in terms of \emptyset -gravity, help needed in understanding basic physical phenomena of the space environment
22. Funding: NASA should provide adequate debriefing for proposals
23. Appropriate animal housing units and facilities for sufficiently large numbers of animals
24. Time limitations (crew) in carrying out laboratory procedures in space
25. High cost of developing and producing specialized equipment

26. Experiment containment
27. Need for ground-based research prior to the design of an experiment package for space flight
28. Room to house enough animals per experiment to allow statistical analysis
29. Obtaining sponsorship
30. Administrative red tape.

It is obvious from these remarks that researchers are concerned about:

	% of responses
Technical problems	43
Experiment planning	27
Proposal acceptance	23
Technology transfer	7

What subject areas would you recommend for study in space?
(by yourself or others)

1. Crew health
2. Passenger selection criteria
3. Physiological mechanisms
4. Reproductive processes (2)
5. Deconditioning countermeasures
6. Metabolism
7. Central nervous system (behavioral)
8. Cardiovascular/renal physiology
9. Cardiovascular dynamics
10. Pharmacology
11. Arterial endothelium
12. Enzyme kinetics
13. Algal growth and life cycles
14. Biomass production
15. Maximum photosynthetic rates
16. Plant growth and form over extended periods (2)
17. Cell biology (2)
18. Tumor immunobiology
19. Fluids and electrolytes transport
20. Properties of fluids

21. Microencapsulation
22. Controlled release from microcapsules
23. Transcervical migration of microcapsules
24. Photosynthesis
25. Solar batteries based on photosynthesis
26. Basic study of transport in plants
27. Space sickness
28. Calcium metabolism
29. Developmental biology (3)
30. Biological cycles (2)
31. Development of fluid suspension processing equipment
32. Containerless processing
33. Mammalian development
34. Long-duration closed cycle systems
35. Mutagenesis
36. Cell culture
37. Embryology
38. Embryo polarity
39. Morphogenesis of plant embryos (2)
40. Plant tissue culture
41. Cellular level responses
42. Basic research on usefulness of space
43. Pulmonary physiology
44. Growth and morphogenesis of isolated plant organs
45. Hormone and drug actions in cell cultures (2)
46. Simulation verification
47. Interaction of host and endogenous/exogenous zoopathogens, as influenced by suppressed immunologic state of crew
48. Microbiology
49. Recombinant DNA
50. Artificial photosynthetic systems for life support in space
51. Bacteriorhodopsin (purple membrane) as a model for human visual membranes
52. Neuro- behavioral effects of prolonged space flight on animals born in space
53. Development neurobiology

- 54. Plant nutrition
- 55. Mycology
- 56. Vestibular/circulatory physiology
- 57. Mammalian enzymes

Proposals in Process

Among the survey forms returned were 11 which showed a positive response to the question, "Do you intend to submit a proposal --- under this A0?" (No. OSS-1-78, dated Feb. 7, 1978). The subject areas indicated and investigators are:

- (1) Cardiovascular Deconditioning
Amit Bhattacharya
Univ. of Kentucky
Lexington, Kentucky
- (2) Vestibular system
David L. Clark
Ohio State Univ.
Columbus, Ohio
- (3) Electrolytes Transport
Mumtaz A. Dinno
Univ. of Louisville
Louisville, Kentucky
- (4) Developmental Biology/Biological Cycles
Ronald B. Hoffman
General Electric Co.
Houston, Texas
- (5) Development/Embryology (2 proposals)
J. Richard Keefe
Biospace Inc.
Painesville, Ohio
- (6) Developmental Neurobiology
Alan Kolber
Research Triangle Institute
Research Triangle Park, North Carolina
- (7) Developmental Biology
Maurice Lalonde
Charles F. Kettering Research Laboratory
Yellow Springs, Ohio

- (8) **Developmental Biology**
Harold H. Lee
Univ. of Toledo
Toledo, Ohio
- (9) **Biological Rhythms, Reproduction and Developmental Biology**
Jerry R. Reel
Research Triangle Institute
Research Triangle Park, North Carolina
- (10) **Microbiology/Medical Mycology**
John A. Schmitt
Ohio State Univ.
Columbus, Ohio
- (11) **Development, Neurology**
Betty Sisken
Univ. of Kentucky
Lexington, Kentucky

Letter Responses

Several persons have expressed their interest/gratitude regarding the seminar program as developed thus far by NASA and Battelle. Some written excerpts from our return mail are included as Appendix D.

SUMMARY/CONCLUSIONS

Battelle Columbus Laboratories has participated as a regional contractor (Midwest) in a pilot program to promote the use of space for research by the life sciences community. This program has been sponsored by the Bioscience Payloads Office of the Directorate of Life Sciences, Johnson Space Center.

Following a general topic plan, two regional seminars entitled "Life Sciences Research in Space - the Shuttle Era", were held at Battelle's facilities in Columbus, Ohio to introduce area researchers to the Space Transportation System, its capabilities and potential applications. Each one-day program was centered on a group of invited speakers who discussed various aspects of NASA's space program and the opportunities for biological research in space. Contacts were established with 222 persons in various academic, industrial and government organizations generally within Ohio and the neighboring states. The particular seminar topic plan we have chosen seems to spark interest in the majority of researchers contacted,

especially when discussed in person. The two seminars, March 9 and June 15, 1978, were attended by 39 and 38 persons, respectively.

It appears that the life sciences research community is excited about the potential for space research, but generally naive regarding (1) the space shuttle vehicle, its various payloads and NASA's mission plans for them, (2) the space environment, changes in physical phenomena and their effects on man and his experimental methods, (3) NASA's key areas of interest, space research experience and potential for sponsorship of new ideas (by NASA or others), and (4) how to get involved in space life sciences research.

Persons (38) responding to a follow-up survey indicated that (1) only 1/3 regularly receive NASA Announcements of Opportunity, (2) 2/3 have never worked with NASA, (3) the seminars did stimulate interest in research in space, (4) 11 were intending to submit proposals for A.O. No. OSS-1-78, (5) 4 of these asked for assistance in understanding the AO and proposal requirements, and (6) 26 additional persons expressed an interest in developing an experiment for research in space. Many indicated a need for information on related experience and experiment equipment, while a lesser number were interested in physical phenomena.

Thirty responses were listed concerning anticipated problems/limitations. From these remarks we can conclude that researchers are concerned about obtaining funding, planning and designing experiments for space (primary), and seeing meaningful applications of their research.

Recommended for study in space were 57 subject areas covering many of the life science disciplines including physiology, biomedical/behavioral sciences, biochemistry, pharmacology, immunology, reproduction and development, cell and tissue culture, plant sciences, microbiology, mycology, toxicology, nutrition and advanced life-support systems.

The seminars described here have served to introduce many persons to life sciences research in space and to renew or reinforce the interest of others. Many verbal expressions and several written responses were received, indicating that the scientific user community is definitely interested in life sciences programs for research in space. Although difficult to quantify, it appears that in most cases researchers and corporate managers are eager to hear about the space program and what it can do for them.

The midwest regional seminar program has formed a basis for information exchange. In order to nurture ideas and ultimately enlist participation in the space program, NASA should maintain this communication. Limited assistance (courses, seminars) would be helpful to researchers in initial experiment planning; information (or sources) should be provided on related experience, experimental equipment, mission profiles, physical parameters and other background needed by the researcher in preparing proposals. When appropriate, additional follow-up meetings should be held to stimulate action on the part of the contact organization.

If presented properly, a continued user development effort would be a definite asset to NASA's life sciences program, serving in the pre-proposal stage to interest and educate researchers in the various aspects of developing experiments for space research.

APPENDIX A

SEMINAR No. 1

- 11:40 Questions and Answers - - - - - Panel Response
- 11:50 Break for Lunch
- 12:00 Buffet Luncheon - - - - - Battelle Cafeteria
- 1:00 Film "Biological Applications in Space"
- 1:20 Gerald R. Taylor - - - - - Johnson Space Center
Research topic:
"Cellular Systems in Space"
- 1:50 Robert E. Schwerzel - - - - - Battelle
Research topic: "Prospects for Photochemically-Assisted Life Support
in Space Habitats"
- 2:20 Paul D. Klimstra - - - - - G. D. Searle
Industrial Sponsorship of Research in Space
Cost vs. Benefits
Return on Investment
Proprietary Rights
- 2:50 Coffee Break
- 3:10 John A. Mason - - - - - Johnson Space Center
Using the Space Shuttle
Defining your need for space research
Interfacing with NASA and the Space Applications Community
Researching NASA's data files
Responding to Announcements of Opportunity
- 3:40 Questions and Answers - - - - - Panel response
- 4:00 Adjournment

SEMINAR NO. 1

SPEAKERS' ROSTER

- (1) William K. Douglas, M.D.
McDonnell Douglas Astronautics Co.
5301 Bolsa Avenue
Dept. 262, Mail Station 13-3
Huntington Beach, California 92647
(714) 896-3919
- (2) Kenneth E. Hughes
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- (8) Gerald R. Taylor /SD4
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LIFE SCIENCES RESEARCH IN SPACE - THE SHUTTLE ERA

Battelle-Columbus Laboratories

March 9, 1978

REGISTRATION LIST

<u>NAME</u>	<u>AFFILIATION</u>	<u>FIELD OF INTEREST</u>
Gordon Black Deputy Commissioner	Division of Mental Health State of Ohio 1382 State Office Tower 30 E Broad Street Columbus OH 43215	General
Robert S. Carbonara	Battelle-Columbus Labs 505 King Avenue Columbus OH 43201	Materials/Materials Processing
David L. Clark Associate Professor of Anatomy	414 B Hamilton Hall Ohio State University 1645 Neil Avenue Columbus OH 43210	Vestibular System of Equilibrium
J. Frederick Cornhill	Div of Thoracic Surgery Ohio State University Hospital 410 W. 10th Avenue Columbus OH 43210	Cardiovascular Physiology
James P. Crowley	Battelle-Columbus	
Melanie E. Davis	Battelle-Columbus	Plant Physiology
Anthony J. Dennis	Battelle-Columbus	Cell Biology
Dale P. DeVore	Battelle-Columbus	Protein Biochemistry/ Cell and Molecular Bio.
William K. Douglas, M.D.	McDonnell Douglas Astronautics 5301 Bolsa Avenue Dept 262, Mail Station 13-3 Huntington Beach CA 92647	Aerospace Medicine
David J. Fink	Battelle-Columbus	Biochemical Engineering, Enzymology
David L. Gardner	Battelle-Columbus	Cardiovascular and Kidney Physiology
Ed Gardner	Ohio State Univ. Research Found. 1314 Kinnear Road Columbus OH 43212	Research Administration

<u>NAME</u>	<u>AFFILIATION</u>	<u>FIELD OF INTEREST</u>
Elizabeth Gross	Dept of Biochemistry Ohio State University 484 W 12th Avenue Columbus OH 43210	Biochemistry-Photobiology
Verle Q. Hale	Battelle-Columbus	Plant Sciences/Physiology
Craig R. Hassler	Battelle-Columbus	Hard Tissue Physiology
Kenneth E. Hughes	Battelle-Columbus	Bicengineering
Danny Jackson	Battelle-Columbus	Plant/Soil Relationships
Ralph Jordan Vice President for Health	Nationwide Corporation One Nationwide Plaza Columbus OH 43215	Data Communications
Leon Kazarian	Biodynamics and Bionics Div AMRL/BB Wright Patterson AFB Ohio 45433	Biodynamics/Biomechanics
Frederick Klein Dean	Antioch International Yellow Springs OH 45387	International Implications
Paul D. Klimstra VP, Pre-Clinical Research and Development	G. D. Searle & Company Box 5110 Chicago IL 60680	Pharmaceutical Drugs
Nancy A. Klosterman	Battelle-Columbus	Photochemistry
Robert Kroll	Aerospace Engineering Dept Mail Location 70 University of Cincinnati Cincinnati OH 45221	Aerospace Engineering
Maurice LaLonde	Charles F. Kettering Research Lab 150 E South College Street Yellow Springs OH 45387	Using the space shuttle Nitrogen fixation
Robert C. Landes	Adria Labs Research Park Box 16529 Columbus OH 43216	Pharmacology (CNS)
R. Daniel Lineberger Assistant Professor	Dept of Horticulture 264 A Howlett Ohio State University 2001 Fyffe Court Columbus OH 43210	Plant Tissue Culture

NAME	AFFILIATION	FIELD OF INTEREST
John H. Litchfield	Battelle-Columbus	Microbiology/Food Science
Jack R. McDowell	Battelle-Columbus	Space Systems/Applications
John A. Mason/SD5	Biomedical Applications Branch NASA Lyndon B. Johnson Space Center Houston TX 77058	Total Program
William McComis	Battelle-Columbus	Biomedical Engineering Food Science
Roger L. Merrill	Battelle-Columbus	Defense, Transportation and Space Systems
Arnold T. Mosberg	Battelle-Columbus	Biomedical Engineering Cardiopulmonary Research
George E. Pierce	Battelle-Columbus	Microbiology
Robert M. Pfister	Department of Microbiology Ohio State University 484 W 12th Street Columbus OH 43210	Microbiology
Gerald Schopinsky	Ross Labs 625 Cleveland Avenue Columbus OH 43215	Research-Nutrition and Biochemistry
Robert E. Schwerzel	Battelle-Columbus	Research Interest: Photosynthesis and Photochemically-assisted Solar Energy Utilization
Margaret Snyder	Ohio State Univ Research Found. 1314 Kinnear Road Columbus OH 43210	Life Sciences
Gerald R. Taylor/SD-7	Biomedical Labs NASA Lyndon B. Johnson Space Center Houston TX 77058	Cell Biology
Henning E. Von Gierke	Biodynamics and Bionics Div AMRL/BB Wright Patterson AFB Ohio 45433	Biomechanics/Bioengineering Aerospace Medicine



Now's Chance To Orbit It Aboard New Space Shuttle

By James Breiner
Of The Dispatch Staff

Better book a reservation now on the Space Shuttle for your scientific experiment.

So far, 171 spaces have been reserved at \$500 each, and the National Aeronautics and Space Administration (NASA) is still taking orders, according to Jack R. McDowell, associate manager of space experiments and space systems at Battelle Columbus Laboratories.

DURING A seminar at Battelle, 505 King Ave., Thursday, McDowell told some 30 research scientists and corporate officials how they could get their experiments aboard the Shuttle.

Columbus Dispatch
Columbus, Ohio
March 9, 1973

A payload weighing 200 pounds and taking up 5 cubic feet of space would cost the experimenter about \$10,000, and his payload would have to meet strict specifications set up by NASA.

So far 99 spaces have been reserved by industrial concerns, 34% by educational institutions and 37% by private researchers, McDowell told the members of the seminar on "Life Sciences Research in Space — The Shuttle Era."

McDOWELL CALLS the program for getting small self-contained research packages aboard Shuttle flights the "getaway special."

The experiments would be put aboard the Shuttles — which are to begin about 50 orbital flights a year in 1980 — on a space available basis. McDowell calls these experiments "stocking stuffers," since they would fill up space not being used.

The "getaway special" is just one of the ways that NASA is attempting to make space research an independently funded undertaking.

HE SAID it will be possible for a large corporation like RCA or Western Union, which have paid to have communications satellites launched, to save as much as \$10 million by having its satellites put into orbit on the Shuttle flights.

The Space Shuttle is a combination aircraft and spaceship, which is launched into space by two booster

rockets and can re-enter the atmosphere and land like an airplane.

Thus it can be used again and again, unlike previous space vehicles. Even the booster rockets are recoverable and reusable for the first time.

SELF-CONTAINED experiments could test manufacturing processes, the reaction of organic material to the weightless environment of space, or, for a little extra, NASA could arrange to have the payload exposed to the solar radiation and the cold vacuum of outer space.

Cost to the experimenter will increase as special services for the experiment increase.

Among the those attending the seminar were an aerospace engineer, a mental health official, a representative of a drug manufacturer, and an expert on cardiovascular physiology, indicative of the wide variety of applications that experiments in space could have.

HOWEVER, THE back room inventor should not rush off to NASA and book a place on a Shuttle flight just yet.

NASA will select experiments on the basis of the competency of the investigator, the scientific merit of the test, the reputation of the investigator's institution and other factors.

The man who wants to test his perpetual motion machine in a weightless environment might just find the flights are all booked up.

APPENDIX B

Seminar No. 2

SEMINAR NO. 2

"LIFE SCIENCES RESEARCH IN SPACE: THE SHUTTLE ERA"

Battelle, Columbus Laboratories in conjunction with NASA, Johnson Space Center, is participating in a pilot program to promote the use of space for research by the life sciences community. This series of seminars, directed to the interests of researchers and managers from industry, universities and government agencies, is planned to:

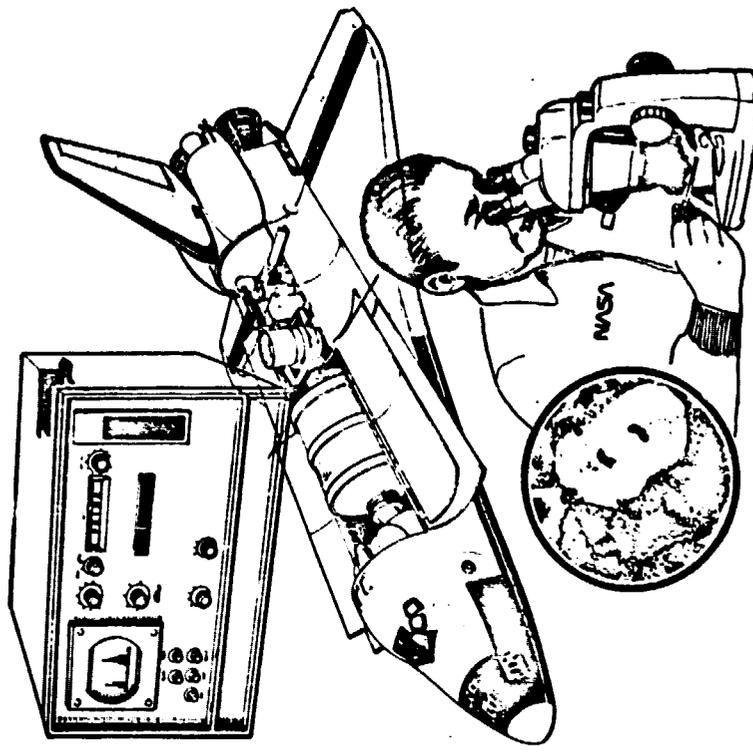
- Describe the space shuttle vehicle and some of its intended uses
- Discuss problems of manned spaceflight
- Stimulate ideas for biological research in space
- Discuss costs and potential for industrial and government sponsorship
- Show the researcher or corporate planner how to become part of the program for Life Sciences Research in Space.

Attendance at the June 15, 1978 seminar will be limited to 50 persons; please return the response form or call to confirm your reservation at the meeting. There is no registration fee.



Battelle
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

KENNETH E. HUGHES,
Research Scientist
Bioengineering/Health Sciences Section
Telephone (614) 424-7627



Battelle, Columbus Laboratories
Teleconference Facility
505 King Avenue
Columbus, Ohio 43201

June 15, 1978
9:00 a.m.-3:30 p.m.

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MORNING SESSION

9:00	Kenneth E. Hughes Battelle Greeting Introduction of Guests
9:15	William J. Clarke Battelle Battelle—An Outlook for Contract Research in Space
9:30	John A. Mason Johnson Space Center Space Shuttle/SpaceLab History Mission Profile SpaceLab and other Payloads NASA Goals
10:00	Jack R. McDowell Battelle Autonomous Payloads Small Self-Contained Research Payloads Materials Experiment Apparatus Battelle Project SARP Shuttle Payload User Charge Policy
10:30	Break
10:50	Ronald B. Hoffman General Electric Experiments in Space—The Man/Equipment Interface Principal Investigator Interactions Payload Specialists Laboratory Equipment for Use in Space
11:20	Questions and Answers Panel Response
11:30	Buffet Luncheon Battelle Cafeteria

AFTERNOON SESSION

12:40	Film "Biological Applications in Space"
1:00	Phillip C. Johnson Baylor College of Medicine Research Topic: "Biomedical Research—Man's Response to the Space Environment"
1:30	H. William Scheld University of Houston Research Topic: "Plant Physiology Experiments for SpaceLab"
2:00	George T. Brooks NIAMDD* Programs of the National Institutes of Health: Potential for Space Research NIH Program Goals Benefit to Mankind Grant Review Process
2:30	Break
2:50	John A. Mason Johnson Space Center Using the Space Shuttle Defining your need for space research Interfacing with NASA and the Space Applications Community Researching NASA's data files Responding to Announcements of Opportunity
3:20	Questions and Answers Panel Response
3:30	Adjournment

*NIAMDD—National Institute of Arthritis, Metabolism, and Digestive Diseases.

**LIFE SCIENCES RESEARCH IN SPACE:
THE SHUTTLE ERA**

Seminar No. 2

**Battelle-Columbus Laboratories
Teleconference Facility
505 King Avenue
Columbus, Ohio**

June 15, 1978

SPEAKERS

**George T. Brooks
National Institute of Arthritis,
Metabolism and Digestive Diseases
11008 Wickshire Way
Rockville MD 20852**

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and Medical Sciences Department
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**Ronald B. Hoffman
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**H. William Scheld
Department of Biology
University of Houston
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(713) 740-3135

*** * ***

LIFE SCIENCES RESEARCH IN SPACE:
THE SHUTTLE ERA

Seminar No. 2

Battelle-Columbus Laboratories
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505 King Avenue
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NO. 2 SEMINAR
LIFE SCIENCES RESEARCH IN SPACE - THE SHUTTLE ERA

Battelle-Columbus Laboratories
June 15, 1978

PRELIMINARY REGISTRATION LIST

● - Attended

NAME	AFFILIATION	FIELD OF INTEREST
● P. K. Bhagat Assistant Professor	Wenner Gren Research Lab University of Kentucky Lexington KY 40506	Biomedical Engineering
● Amit Bhattacharya	Wenner Gren Research Lab University of Kentucky Lexington KY 40506	Biomedical Engineering
Gordon C. Black Deputy Commissioner Hospital Management	Division of Mental Health 30 E Broad St Suite 1382 Columbus OH 43215	
● George T. Brooks	National Institute of Arthritis, Metabolism & Digestive Disease 11003 Wickshire Way Rockville MD 20852	Arthritis, Metabolism & Digestive Diseases
Robert S. Carbonara	Battelle-Columbus Laboratories 505 King Avenue Columbus OH 43201	
● John Charles	Wenner Gren Research Lab Dept of Physiology University of Kentucky Lexington KY 40506	Cardiovascular Physiology
● William J. Clarke	Battelle-Columbus Laboratories	
● Melanie E. Davis	Battelle-Columbus Laboratories	
● Frank Dawson Director, Corporate Technical Div	Battelle Memorial Institute 505 King Avenue Columbus OH 43201	
Anthony J. Dennis	Battelle-Columbus Laboratories	
● Dale P. DeVore	Battelle-Columbus Laboratories	
● Mumtaz A. Dinno	University of Louisville Department of Pharmacology and Toxicology Health Science Center P O Box 35260 Louisville, KY 40232	Pharmacology and Toxicology

NAME	AFFILIATION	FIELD OF INTEREST
• Kristine Eroshevich Psychiatrist	Columbus Public Schools 52 Starling St Columbus OH 43215	Psychiatry
• David J. Fink	Battelle-Columbus Laboratories	
• Peter M. Fuller	Department of Anatomy University of Louisville Health Sciences Center Louisville KY 40201	
• Anthony J. Gambone, Jr. Clinical Coordinator Respiratory Therapy	Columbus Public Schools A.E.S.S.C. Respiratory Therapy 52 Starling St Columbus OH 43215	
• David L. Gardner	Battelle-Columbus Laboratories	
• Edward J. Gardner Asst Director, Program Dev	The Ohio State University Research Foundation 1314 Kinnear Road Columbus OH 43212	
• Elizabeth Gross	Department of Biochemistry Ohio State University 484 W 12th Avenue Columbus OH 43210	Photosynthesis
• Gayle H. Gross Graduate Student	Department of Anatomy Case-Western Reserve University Cleveland OH 44106	
• Ronald B. Hoffman	General Electric Company Space Division P O Box 58408 Houston TX 77058	Neurosciences
• Peter J. Hofmann	Battelle Memorial Institute	
• Kenneth E. Hughes	Battelle-Columbus Laboratories	
• Phillip C. Johnson Chief, Nuclear Medicine Section	Baylor College of Medicine Texas Medical Center Houston TX 77030	Medicine
• J. M. Joshi	University of MD, Eastern Shore Princess Anne MD 21854	

B-6

NAME	AFFILIATION	FIELD OF INTEREST
J. Richard Keefe	BioSpace Incorporated P O Box 965 Painesville OH 44077	Developmental Biology
Alan Kolber	Research Triangle Institute P O Box 12194 Research Triangle Park NC 27709	Developmental Neurobiology
Robert Kroll	Aerospace Engineering Department Mail Location 70 University of Cincinnati Cincinnati OH 45221	Aerospace
Harold H. Lee Professor, Biology	Biology Department University of Toledo Toledo OH 43606	
N. B. Livingston Physician	3545 Olentangy River Road Suite 126 Columbus OH 43214	OB-GYN
William Cook Livingston	4444 Langfort Road Columbus OH 43220	
William Martin	Department of Anatomy Medical Center Room MN 220 University of Kentucky Lexington KY 40506	Biomedical
John A. Mason	Biomedical Applications Branch NASA Lyndon B. Johnson Space Center Houston TX 77058	
William T. McComis	Battelle-Columbus Laboratories	
Jack R. McDowell	Battelle-Columbus Laboratories	
Murry J. Mercier	Battelle Memorial Institute	
Roger L. Merrill	Battelle-Columbus Laboratories	

NAME	AFFILIATION	FIELD OF INTEREST
• H. William Scheld	Department of Biology University of Houston Houston TX 77004	Biology
• Betty F. Sisken	Wenner Gren Research Lab University of Kentucky Lexington KY 40506	Biology
Moses W. Vaughn Professor of Food Science	Division of Prof Studies Department of Agriculture University of Maryland Eastern Shore Princess Anne MD 21853	
• Sigmund F. Zakrzewski Principal Cancer Research Scientist	Department Experimental Therapeutics Roswell Park Memorial Institute 666 Elm Street Buffalo NY 14236	Cancer Research

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APPENDIX C

SEMINAR FOLLOW-UP SURVEY

SEMINAR FOLLOW-UP SURVEY

1. Please indicate any correction to your address, above
2. May we retain your name on a mailing list for further information/announcements? Yes No
3. Do you now receive NASA announcements of opportunity (AO)? Yes No
4. May we refer your name to NASA for future mailings of AO's, newsletters, etc.? Yes No
5. Are there other persons in your organization who you think would appreciate receiving information on the Space Shuttle program? (Research or Management)
- Name _____ Title _____
- _____
- _____
6. Did the Seminar stimulate your interest in research in space? Yes No
7. Have you ever worked with NASA Yes No
8. Did you receive a copy of NASA Announcement of Opportunity No. OSS-1-78 dated Feb. 7, 1978 Yes No
- If YES, please complete No. 9 & 10.

Formal proposals are due by June 30, 1978.

9. Do you intend to submit a proposal to NASA for flight experiments under this AO? Yes No

SUBJECT AREA _____

10. Will you need assistance in understanding the AO and Proposal Requirements? Yes No

11. What problems/limitations do you envision in carrying out life sciences research in space?

12. What subject areas would you recommend for study in space? (by yourself or others)

13. Would you like to develop an experiment for research in space? Yes No

SUBJECT AREA _____

14. Need more information on: related experience
experimental equipment
physical phenomena

Other _____

Please return this survey in the enclosed business reply envelope. Thank you.

KH
Kenneth E. Hughes

APPENDIX D

EXERPTS FROM RETURN MAIL

D-1

I would like to thank you for giving me the opportunity to attend the seminar regarding life science research on the space shuttle, and also I wish to thank you for your hospitality. The seminar was very useful and stimulating for me and helped clarify a number of points.

ORIGINAL PAGE IS
OF POOR QUALITY

I would like some more information concerning your program of Life Sciences Research in the Space Shuttle Era.

I learned of your seminars at the Toledo Univ. Conference

Please let me know when your upcoming seminars are, and (what) the results of your previous sessions has been.

I regret that I could not participate in the Life Sciences Research in Space - The Shuttle Era conference on June 15.

I will hope to be more responsive in the future.

I am interested in learning more about this area. However, my schedule does not allow for me to be in Columbus on April 20. Please keep me informed of the program and perhaps we can talk either in Columbus or Elkhart.

With the Air Force's renewed interest in space research we are interested in possible application of human operator technology to your field. If you feel Batelle can enlighten us on possible contributions that would fit naturally within our research mission we would be happy to schedule the meeting with you at mutual convenience.

Thank you very much for including us on the mailing list for your seminars. We hope that our schedule will allow for better participation in the future.

This is the first time I have had an opportunity to attend this type of seminar. I am extremely interested in this area and would appreciate any other info on seminars etc.

Unfortunately, neither I nor an appropriate colleague can attend your April 20th, 1978 meeting. Please keep us notified of any future seminars.

Special thanks to organizing committee for an excellent seminar series on "Life Sciences Research in Space - The Shuttle Era", held on June 15, 1978 at Battelle - Columbus Labs.