NASA's Human Research Program

For ERAU's Human Factors & Ergonomics Society

Human Research Program
Research Operations & Integration
Nichole Schwanbeck, Deputy Manager-Flight

Presenter Introduction

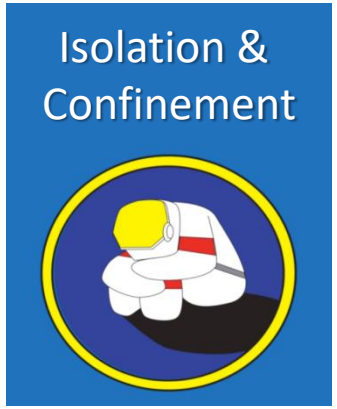
- Graduate of ERAU-Daytona Beach ‘97, BS Engineering Physics
  - ERAU Volleyball player
  - Limited internship opportunities
- Started career at NASA in the Mission Operations Directorate at JSC with United Space Alliance
  - ISS Electrical Power and Thermal Control Systems training division
  - ISS Increment Training Integrator (transitioned to Civil Servant)
  - Group Lead Management in the Training Division
  - Moved to Human Research Program’s Research Operations & Integration element
    - Increment Manager
    - Deputy Manager, Flight & CIPHER Project Manager
  - Rotational Opportunities
    - ISS Payloads Office
    - Human Health and Performance Deputy Chief Health & Performance Officer, ISS
    - Branch Chief Management - Biomedical Engineer Flight Controllers, Space Radiation Analysis, HRP’s Research Operations and Integration element, ISS and Exploration Medical Operations Integration office
- Member of ERAU’s College of Engineering Philanthropic Council and the Women’s Giving Circle

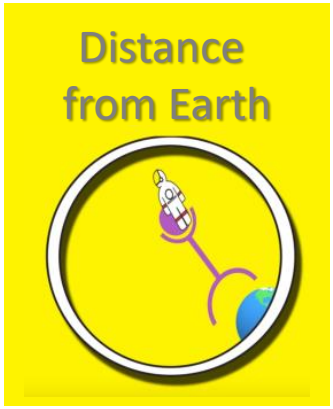
Presenter Introduction

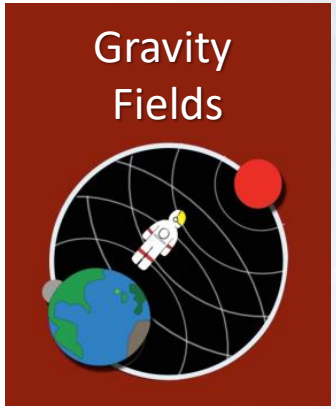
- What is a Deputy Element Manager of HRP's Research Operations & Integration do?
  - Guide our integration and operations team in implementing HRP's research portfolio.
  - Act an interface between HRP and outside programs like ISS, Artemis, Commercial Flight
  - Companies (Private Astronaut Mission, etc) for experiment execution and operations.
  - Manage operational budget
  - Strategic planning
  - Provide risk assessments
  - Have some fun with hardware testing, act as a test subject

What is HRP?

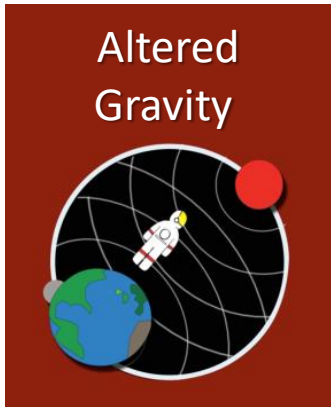
- HRP is NASA's Human Research Program, formally established in 2005.
- Investigates risks to human exploration beyond Earth's atmosphere to help inform understanding, management and mitigation of these risks to reduce threats posed to astronauts on exploration missions.
- HRP's current research portfolio is addressing 23 of the 30 NASA Human System Risks that are organized into 5 Hazard categories:



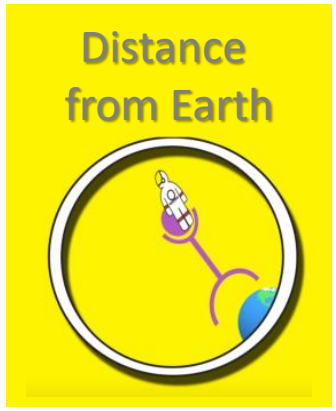




5 Hazards of Spaceflight - HRP Risk Investigation

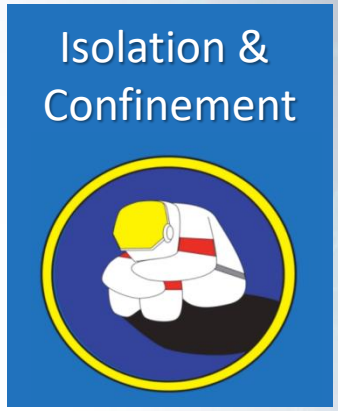


- SANS
- Sensorimotor
- Cardiac Rhythm
- Host-microorganism
- Bone Fracture
- Aerobic Capacity
- Muscle Mass/Strength
- Orthostatic Intolerance



- Medical Conditions
- HSI Architecture
- Renal Stone
- EVA Injury
- Food/Nutrition
- Ineffective/Toxic Meds

- CO2 Exposure
- Dynamic Loads
- Hypoxia
- Sleep Loss
- Immune Response
- Decompression



- Cognitive/Behavioral
- Team Adaptation

- Cancer

HRP's Research Platforms - Flight & Ground based

ARTEMIS

ORION

Soon!

GATEWAY

HUMAN LANDING SYSTEM PROGRAM

Future!

COMMERCIAL LEO DEVELOPMENT PROGRAM

HRP's Research on Human Factors

- *Portfolio related to human factors looks at the following risks/sub-risks:*
  - Risk of Adverse Outcomes due to Inadequate Human Systems Integration Architecture
    - With exploration missions, there is a need for increasing crew independence with greater operational complexity in future exploration missions.
      - There is the possibility of adverse outcomes associated with deficiencies in Human Systems Integration related to:
        - Vehicle/habitat design
        - Human and automation/robotic integration
        - Human-computer interaction
        - Mission, process, and task design
        - Performance errors due to training deficiencies
  - Risk of Injury from dynamic loads/occupant protection
    - With anticipated dynamic loads transferred to the crew via the vehicle upon launch and landing, there is a need to evaluate mitigation strategies to prevent loss of crew or crew injury during dynamic phases of flight

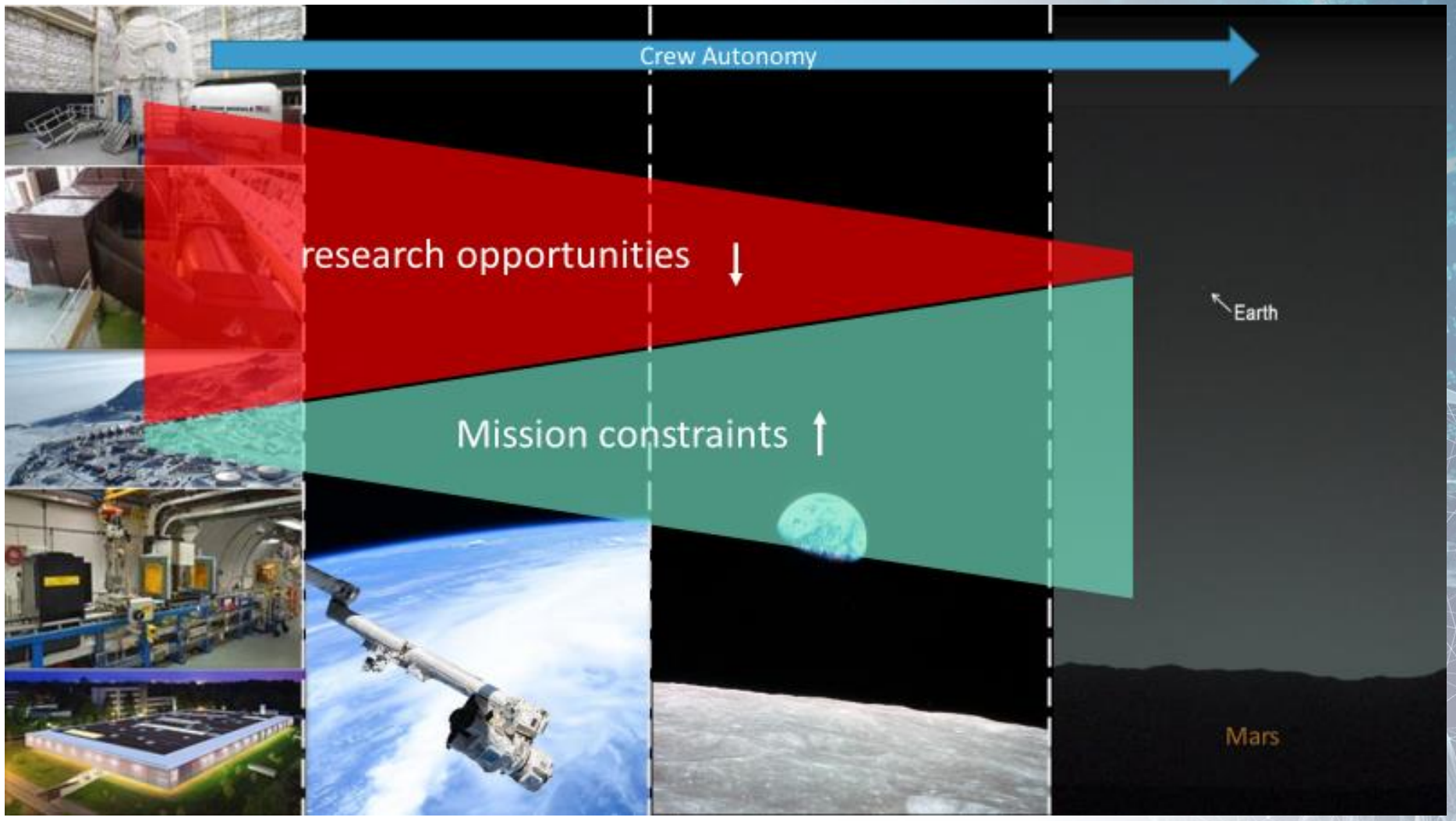
Research on ISS

- Team Task Switching
  - This study looked at understanding the risks related to switching between individual and team tasks. Astronauts are assigned to work on an “ongoing task” which captures their focus of attention. Astronauts also have a series of “alternative tasks,” which may draw their attention away from a current task. The tension between attending to the ongoing task and switching to alternative tasks can place a variety of demands on the astronauts, affecting performance and motivation. These challenges can arise in both scheduled/directed and self-directed task switching situations.
  - Data collection methods: Surveys and postflight interviews
- ISS Habitability
  - This study addressed the Risk of an Incompatible Vehicle/Habitat Design by collecting and analyzing data about human factors and habitability on board the ISS and making recommendations for future vehicle and mission designers.
  - The study utilized two custom iPad applications, Space Habitability Observation Reporting Tool (iSHORT) and iQuestion and Answer (iQ&A), which allowed participants to make open-ended observations about their living and working environment and respond to questionnaires.
  - Participants were asked to capture observations about their environment about once every two weeks; to capture a walk-through video of an area of ISS about once per month; to narrate a task about once per month; to complete a human factors and habitability questionnaire three times per mission; and to participate in a principle investigator (PI) conference with the investigator team following each questionnaire. Content analysis was used to categorize the data and draw general conclusions in order to make recommendations for future vehicle and habitat design.

Research on Artemis Missions

Constraints
- Limited Up mass
- Limited sample return
- Limited space
- Limited Crew time

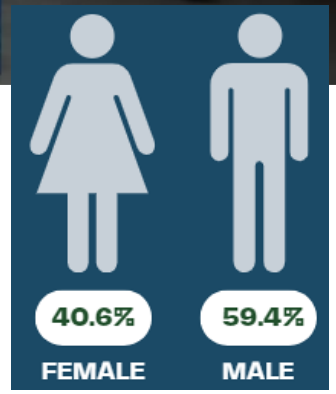
HRP Focus
- Pre/Post measures
- Minimal mass/volume sample return
- **Passive inflight measures**
  - **Video recording**
  - **Actigraphy**
- **Computer based testing**
- **Surveys**



Human Exploration Research Analog (HERA)

NUMBER OF MISSIONS

COMPLETED	24
INCOMPLETE	1



 # OF STUDIES PER CAMPAIGN

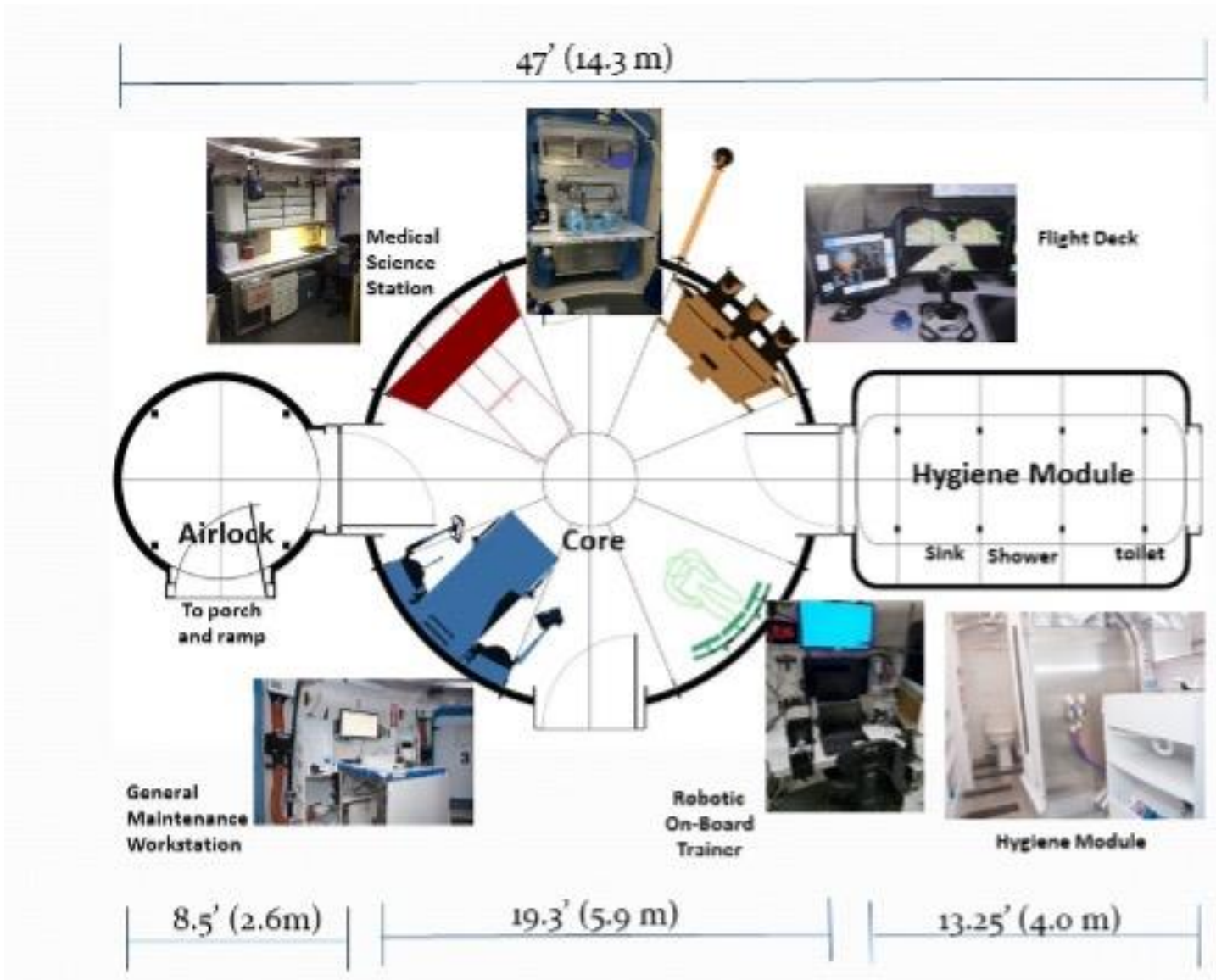
C1 = 9	7 days
C2 = 14	14 days
C3 = 18	30 days
C4 = 15	45 days
C5 = 13	
C6 = 15	
C7 = 18	

RESEARCH PARTICIPATION

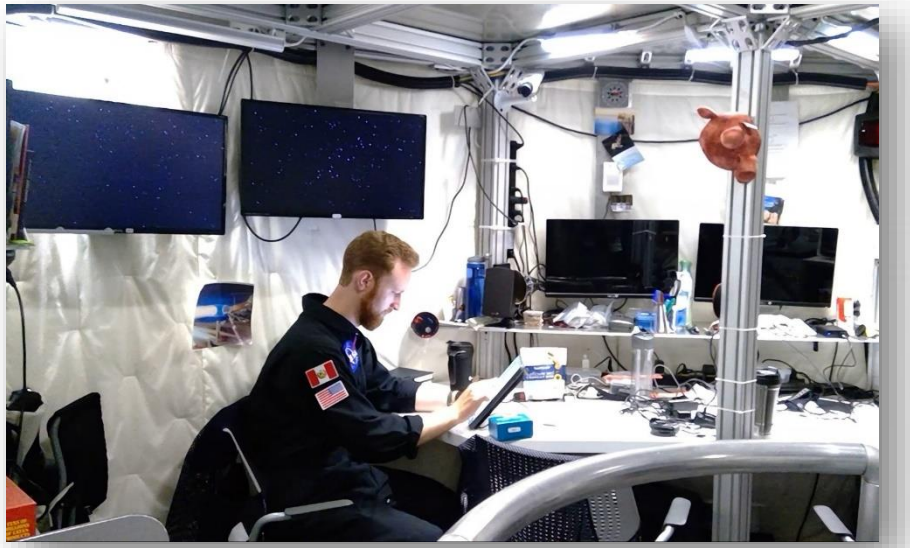
6 Campaigns * 4 missions * 4 crew members = 96

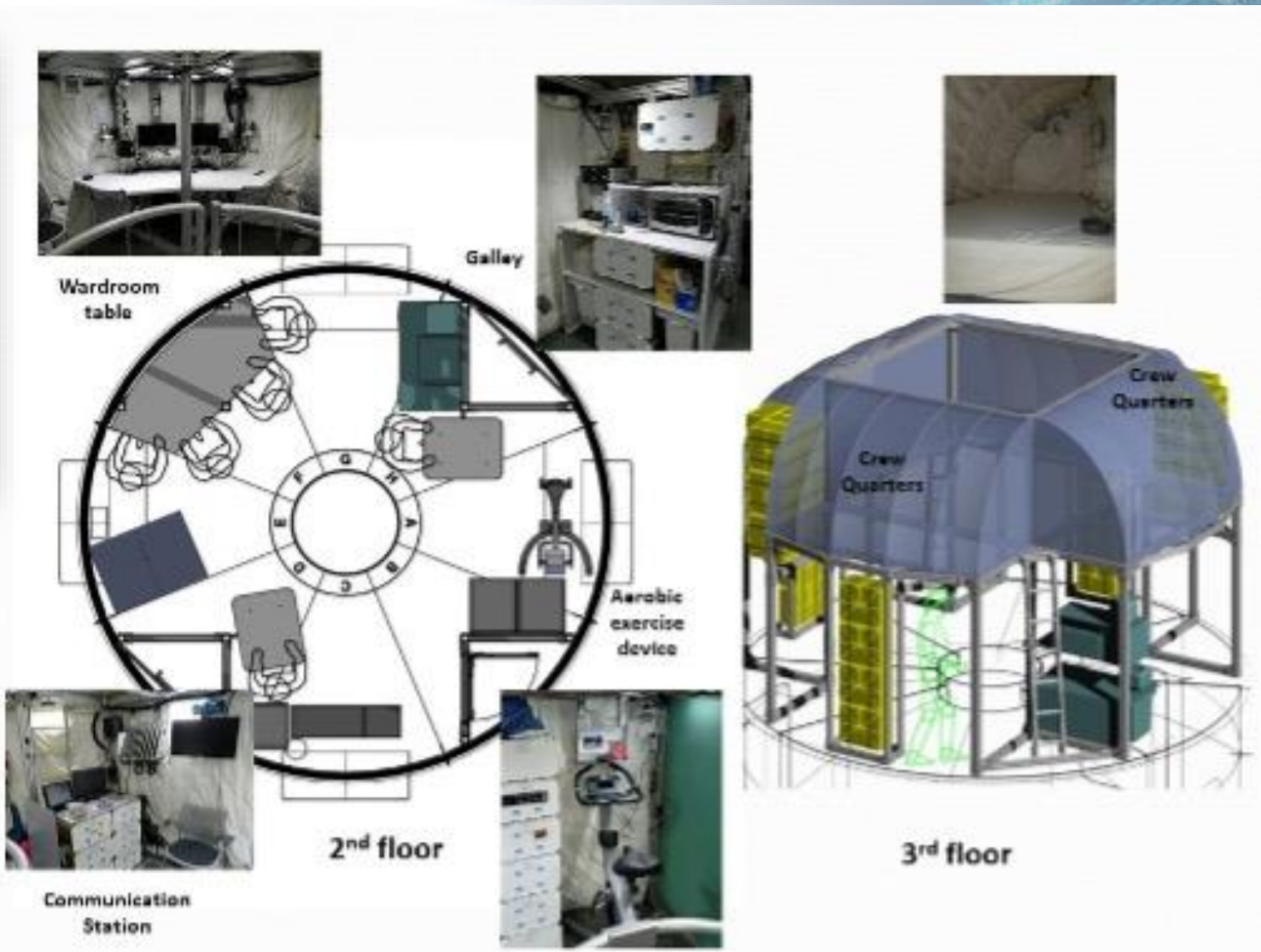
1 mission * 4 crew members = 4

Human Exploration Research Analog (HERA)



Human Exploration Research Analog (HERA)





Human Exploration Research Analog (HERA)

- "Human Capabilities Assessments for Autonomous Missions" (HCAAM) focus is on quantitative assessment of human capabilities relevant to future deep-space missions during which earth/spacecraft communication is so delayed and intermittent that the crew must be able to function autonomously.
  - crew task performance (accuracy, efficiency) (crew + automation)
  - crew Situational Awareness
  - procedure design
  - concurrent tasking (mixed manual + some level of autonomy)
  - task design and task handover
  - crew self-planning and time-lining
  - trust in automation, real-time calibration
  - human multi-sensory feedback and guidance
  - human trust in on-board software-based intelligent assistants
- Use of VR to simulate controlling lunar/mars rovers or completing tasks via robotic arm manipulation.
- Use of proximity badges to map crew activity that could be used to inform better translation paths, spatial constraints/needs, vehicle design, etc.

Informative Links

- https://www.nasa.gov/hhp/human-system-risks/
- https://humanresearchroadmap.nasa.gov/
- https://www.nasa.gov/mission/station/research-explorer/
- https://www.nasa.gov/humans-in-space/the-human-body-in-space/
- https://www.nasa.gov/hrp/
- https://www.nasa.gov/mission/hera/