

HERA Campaign 7 Patch Challenge

The Challenge

A primary goal of human exploration is the health and safety of the crew. Among the many methods NASA has developed to keep our crews safe are analog studies including HERA. Participants of this challenge will learn about these studies and develop a mission patch representing the next Human Exploration Research Analog (HERA) suite of studies, Campaign 7.

Background Information

We recently celebrated the 50th anniversary of Apollo 11, landing the first human on the surface of the moon. Following Apollo was the Space Shuttle program with the primary goal of constructing the International Space Station where crews have been working and living in space since 2000. Our new program, Artemis, is named for the goddess of the moon in Greek mythology. Artemis is also the twin sister of Apollo. With Artemis we will venture beyond Low Earth Orbit, establish a sustainable presence on the moon and prepare for a journey to Mars.

The environment of space presents numerous challenges to human travelers. Exploration class missions will expose crews to a variety of hazards which NASA has identified and grouped into five primary categories including: changes in gravity fields, radiation, hostile environments, isolation and confinement, and distance from Earth. To venture beyond Low Earth Orbit, we must understand these risks to human physiology and develop methods to protect our most precious cargo – our crew. To advance the goals of human space exploration, NASA continuously addresses the problem of keeping astronauts healthy in the closed environment of a space vehicle and surface habitats by developing innovative practices and technologies. Although we have gained an incredible amount of information from living and working on the ISS, there are still many questions to be answered. Investigating these questions in space has provided invaluable information, but has practical limitations. One consideration is cost. It is currently estimated that the cost of sending one pound of cargo to space is approximately \$10,000. Cargo for even simple experiments conducted on station must be limited in both mass and volume. Another issue is time. The ISS crew schedules are packed with both conducting experiments and maintaining the ISS. In addition, the number of crew who can be studied while in space is very low. Because of these and other challenges, NASA has developed other methods, including analog studies.

HERA

Spaceflight analogs are any environment that produces the same or similar effects on humans as is experienced in actual spaceflight. NASA uses “analogs” to represent different aspects of spaceflight here on Earth. The Human Exploration Research Analog (HERA) at the Johnson Space Center in Houston, Texas, is an analog for the isolated and confined living environment of a long-duration spaceflight mission, such as a mission to Mars. Isolation and Confinement is one of the five identified risk categories. Researchers use the HERA to study how individuals and teams perform, interact, and maintain health during extended periods of isolation in a small volume with little privacy and variable workloads, which can increase stress.

Each HERA campaign consists of 4 identical missions with 4 crewmembers per mission. Lasting 45-days, each mission simulates transit to/from Mars plus a short period of orbital operations around Mars. The HERA habitat is about the size of a 1-bedroom apartment with a small kitchen/galley, a multi-use table for dining, entertainment, and working, a bathroom, 4 sleeping bunks, exercise space, a small

airlock, and laboratory/workspace. The crews stay busy from 7am to 7pm most days as they perform science experiments, robotics and Extra Vehicular Activity (EVA) simulations, habitat systems maintenance and housekeeping, exercise, and research data and biological sample collections. The mission also includes simulating a delay in communication with the Earth-based Mission Control Center (MCC) that increases the closer they get to Mars, with a maximum of 5 minutes for radio calls to reach MCC (10 minute roundtrip). On a real Mars mission, communication delays could be up to 22 minutes one-way depending on Mars' position in orbit relative to Earth.

Each HERA campaign has a set of unique research themes that drive the mission objectives and scenarios including the types of tasks the crewmembers perform. The research themes for HERA 7, the next campaign are:

- 1) Crew autonomy with communications delay
The International Space Station has near-constant communication with mission control centers to help crews conduct science, EVAs, and repairs guided by the collective expertise of engineers and systems specialists on the ground. However, communications delays going to Mars mean crews will need to complete these tasks and problem solve unexpected issues more autonomously, without frequent input from MCC. Campaign 7 focuses on developing and testing “smart” technologies that could replace some of that lost ground expertise, such as augmented reality or artificial intelligence.
- 2) Behavioral health (e.g., mood and brain function) and physiological effects (e.g., muscular, skeletal, and cardiovascular health) of isolation and confinement for long-distance exploration
Spaceflight involves being isolated from people back on Earth as well as from the rich diversity of sensory experiences we have on Earth. Crews are unable to go outside or to a gym to exercise and they have limited space for exercise equipment onboard. Over time, doing the same type of exercise may become less motivating making the exercise less effective for both physical and mental health benefits. Isolation can also increase stress from reduced social or sensory stimulation. Stress and limited exercise together can contribute to negative health effects to muscles, bones, the gut microbiome, and the immune system. Campaign 7 science focuses on identifying these negative health effects, but also ways to prevent them through augmenting exercise with sensory stimulation or other motivators.
- 3) Teamwork and multicultural factors
NASA works collaboratively with several international space agencies and most astronaut crews include people from different countries. For the first time in HERA, Campaign 7 will partner with the United Arab Emirates to select international crews. A major theme of research and operations in these missions will be international teamwork and better understanding how different cultural and linguistic backgrounds influence team performance and cohesion.

Researchers from universities around the US will be implementing scientific studies investigating various aspects of the campaign research themes. Campaign 7 is comprised of 23 studies including studies from the United Arab Emirates and the European Space Agency.

Mission Patches

Mission patches are emblems designed and worn by astronauts and people affiliated with a mission. The patches depict an image associated with the mission and generally lists the names of the crew. Every expedition to the International Space Station (ISS) has a unique patch. Mission patches have been worn by NASA astronauts since 1965. The four HERA crews will develop a patch to represent their specific mission. NASA would like to have a student-designed patch that is representative of the HERA Campaign 7 missions and objectives. One winner will be selected by the NASA HERA team and receive a virtual tour of the HERA facility. Additionally, the winning patch will be displayed on the HERA facility during the Campaign 7 missions.

Submissions

The artwork of patch design may be submitted by individuals or a class, with one patch design per submission. Submissions are due by April 21, 2023. The format is XXXXXX and should be submitted to: innovation@spacecenter.org

Selection

The HERA team will select the winning design and notify the participant prior to the end of the 2022-23 academic year.

Prize

The winning submissions class or group will receive a tour of the HERA facility. The tour will be in person for local groups, and virtual for groups outside of the Houston area. The in-person group size is limited to XX participants. The winning patch will be displayed on the HERA facility during the Campaign 7 missions.

Resources and References

[About Analog Missions | NASA](#)

<https://www.nasa.gov/analogs/what-are-analog-missions>

[Mission Patch | NASA](#)

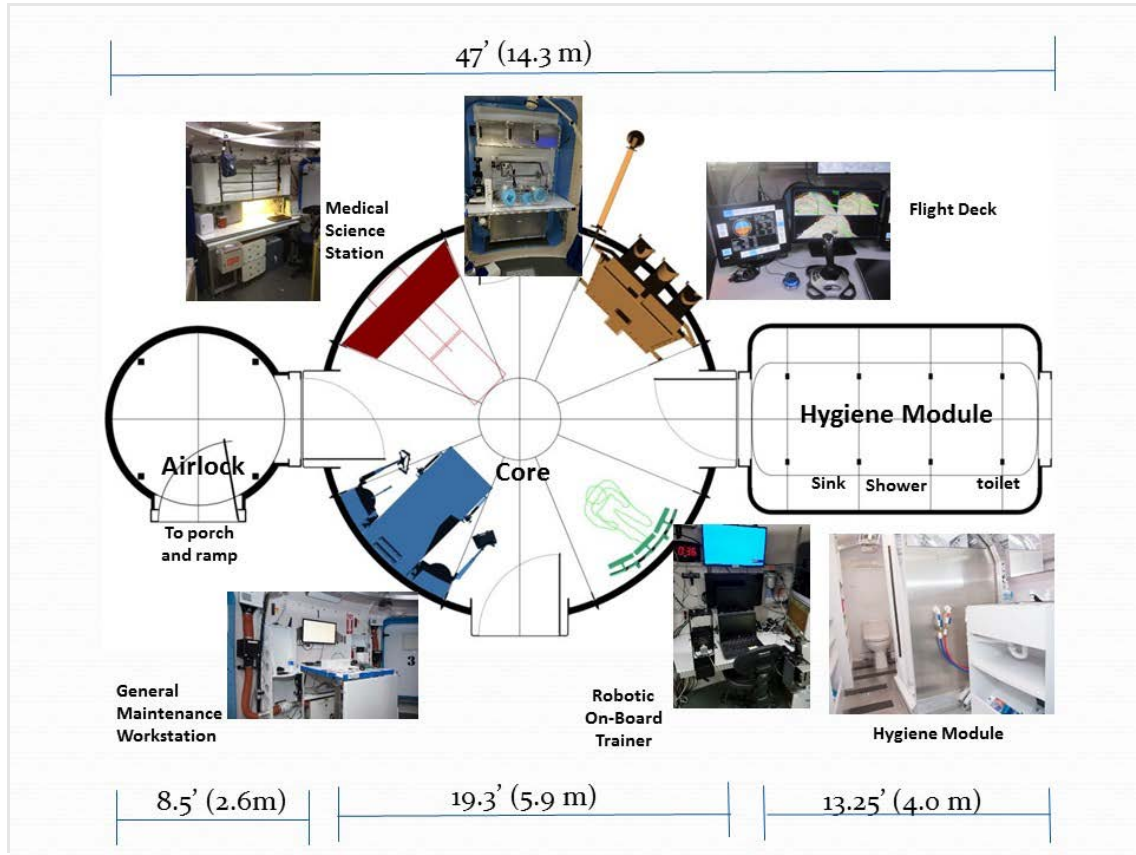
https://www.nasa.gov/audience/foreducators/stem_on_station/ncas_microalgae/patch/index.html

[Symbols of NASA | NASA](#)

<https://www.nasa.gov/audience/forstudents/5-8/features/symbols-of-nasa.html>



HERA 1st Level:



HERA 2nd & 3rd Levels:

