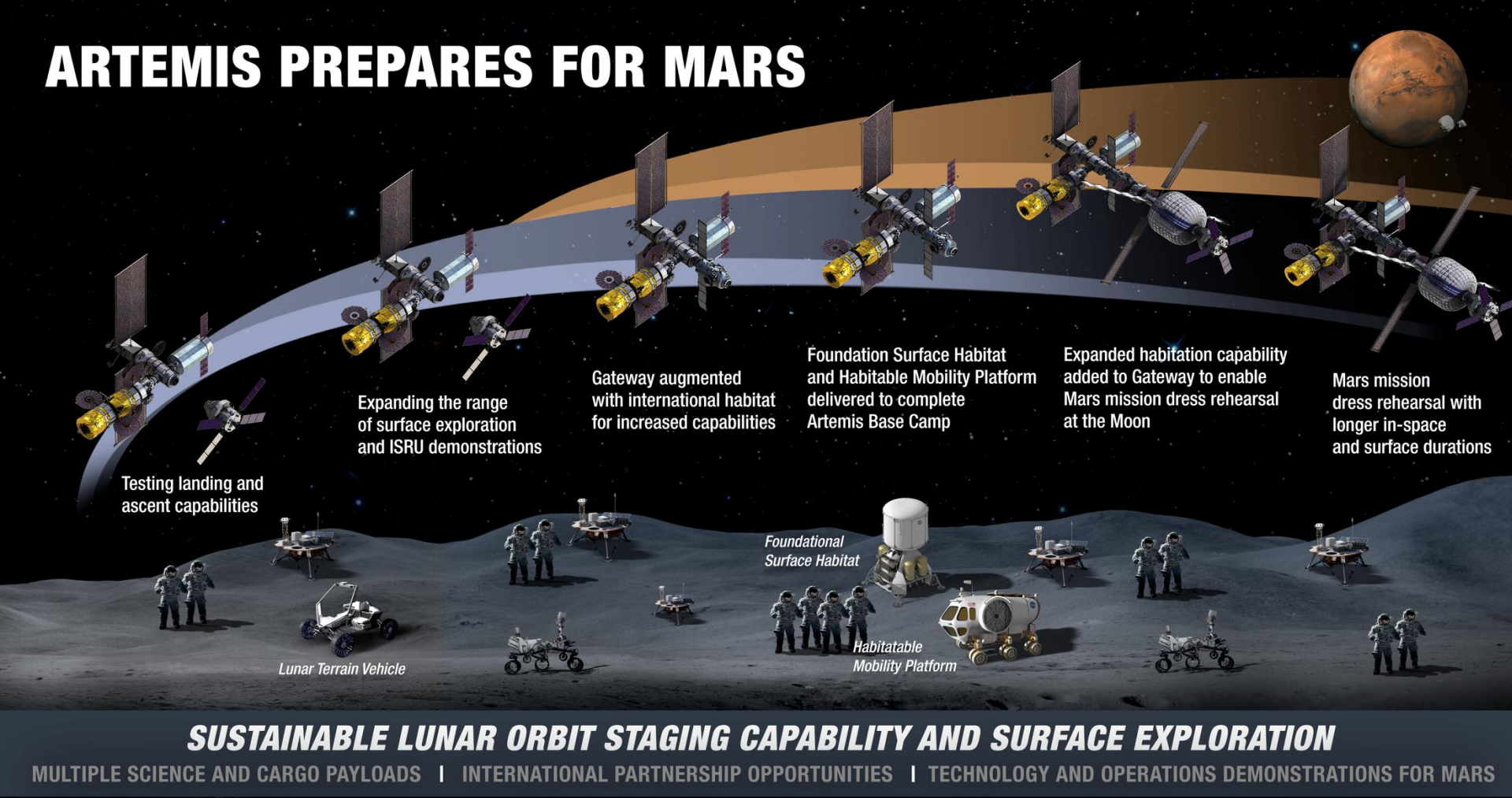
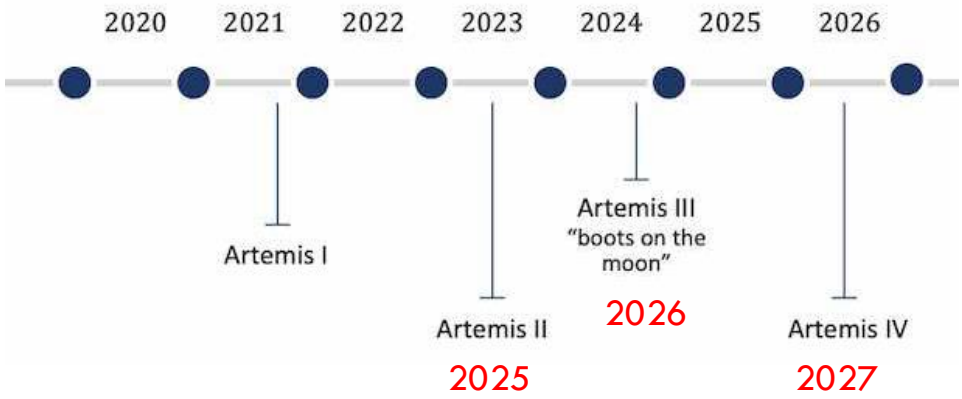
TO PHOBOS
& BACK AGAIN

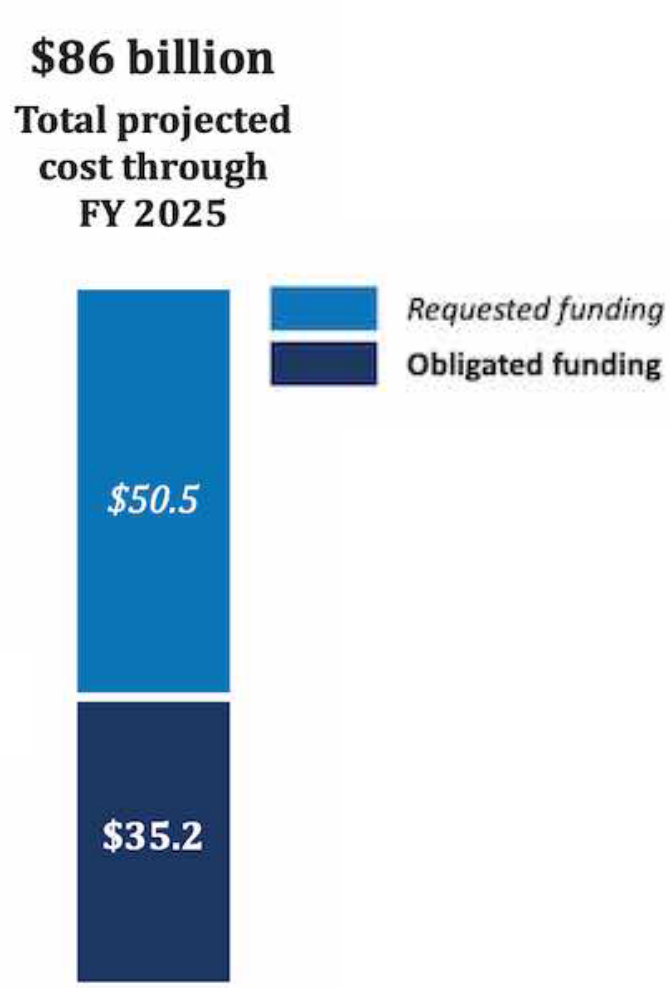
Simulating the challenges of
deep space travel
with NASA HERA

Carolynn (Carrie) Harris
Mission Specialist 1


ARTEMIS PREPARES FOR MARS
Testing landing and ascent capabilities
Expanding the range of surface exploration and ISRU demonstrations
Gateway augmented with international habitat for increased capabilities
Foundation Surface Habitat and Habitable Mobility Platform delivered to complete Artemis Base Camp
Expanded habitation capability added to Gateway to enable Mars mission dress rehearsal at the Moon
Mars mission dress rehearsal with longer in-space and surface durations
Foundational Surface Habitat
Lunar Terrain Vehicle
Habitatable Mobility Platform
SUSTAINABLE LUNAR ORBIT STAGING CAPABILITY AND SURFACE EXPLORATION
MULTIPLE SCIENCE AND CARGO PAYLOADS | INTERNATIONAL PARTNERSHIP OPPORTUNITIES | TECHNOLOGY AND OPERATIONS DEMONSTRATIONS FOR MARS

Artemis Timeline





Space is inherently dangerous

Stressors for astronauts

Distance from Earth

Radiation exposure

Changes to gravity

Body degradation

Food

Isolation & confinement

Analogs improve the astronaut experience

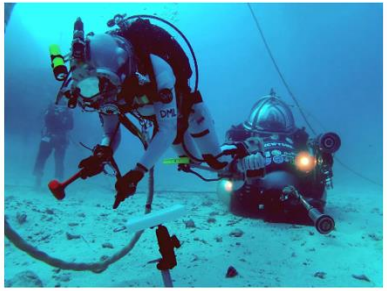
Prepare for missions to deep space destinations, like Mars or an asteroid.

Not all experiments can be done in space. Ground-based analogs save time, $$, & human-power.

Countermeasures can be validated before trying them in space. If they don't work in an analog, they won't be flown in space.

Rich history of NASA analog research

CHAPEA

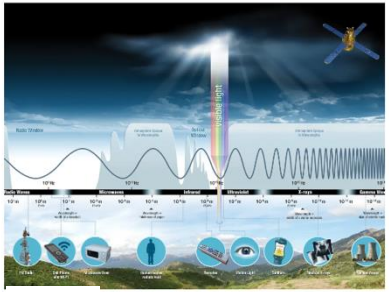


NEEMO

Human-Rated Altitude Chamber Complex

Concordia

Desert RATS



NASA Space Radiation Lab

Haughton Mars Project (HMP)

HESTIA

Human Exploration Research Analog (HERA)

Johnson Space Center | Houston

- Isolation
- Confinement
- Remote conditions

Human Exploration Research Analog (HERA)

Johnson Space Center | Houston

- Isolation
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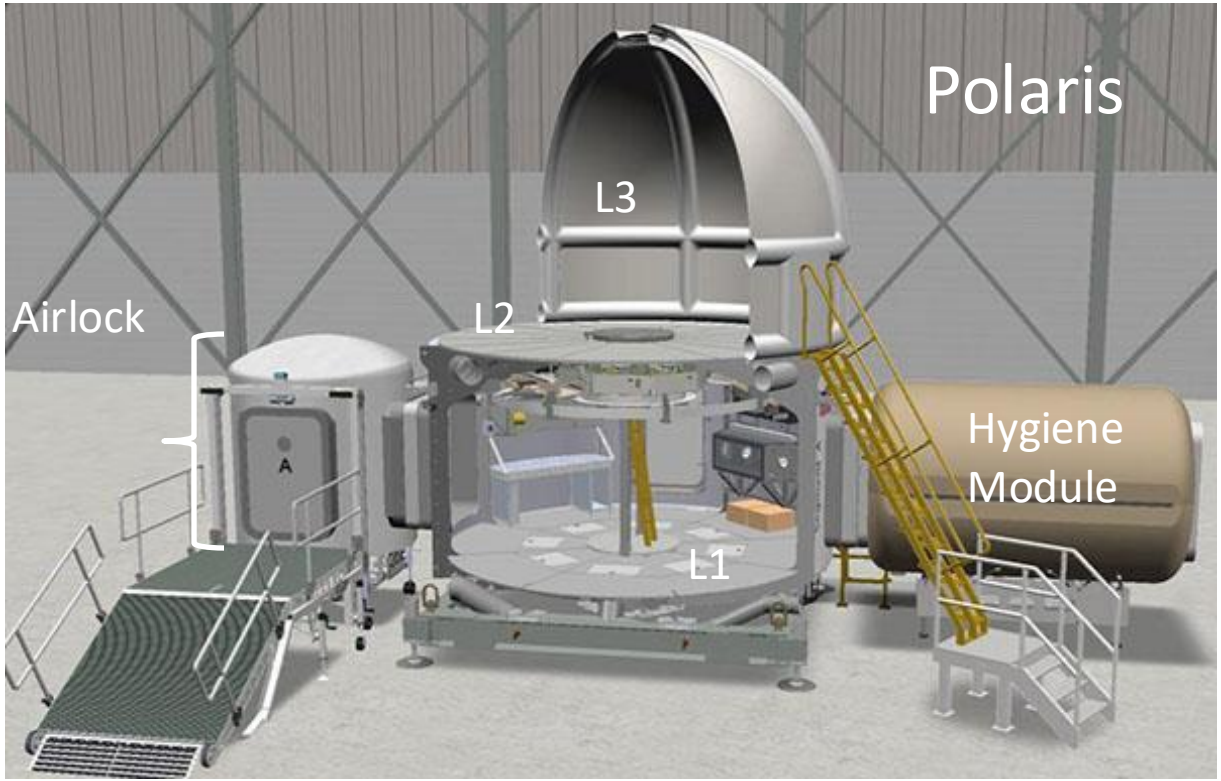
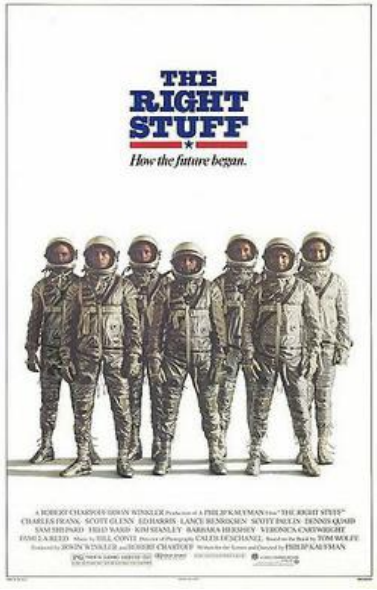


The Right(ish) Stuff

HERA analog astronaut selection criteria

- 4 analog astronauts, goal is 50/50 gender ratio
- Age 30 to 55 years
- Max height 6’2”
- Technical skills proven through professional experience
- Advanced STEM degree or military experience
- Motivation & work ethic that is “astronaut-like”



✓*Medically qualified with the NASA long-duration space flight physical*

✓*Psychological assessment for agreeableness, conscientiousness, & emotional stability*

HERA Research

High-fidelity analog

Select crews, not individuals
Flight-like timeline
Surveillance video & audio
"Astronaut-like" daily operations
No internet, TV, phone!

Missions

Single run of one HERA experiment

Campaigns

Series of 4 missions to complete a set of integrated studies

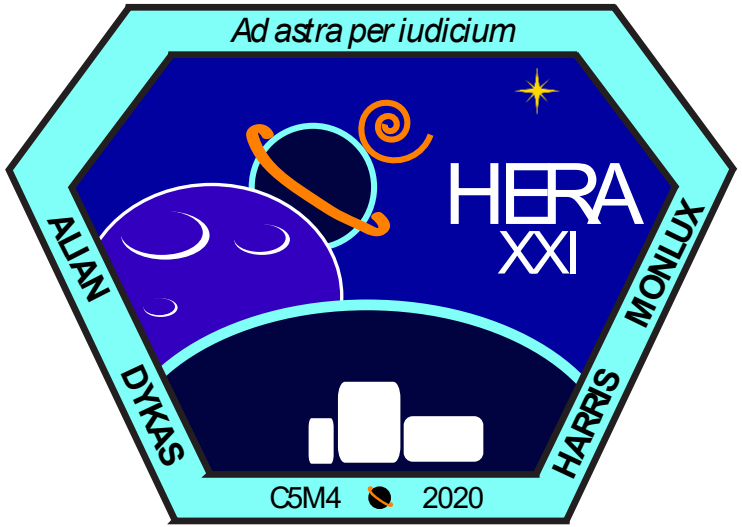
HERA Campaigns

C1: 2014 – 7 day missions
C2: 2015 – 14 days
C3: 2016 – 30 days
C4: 2017/18 – 45 days
C5: 2019/20 – 45 days
C6: 2022/23 – 45 days

HERA XX1

Campaign 5, Mission 4

January 16 – March 9, 2020



C5M4: Simulated mission to phobos

Pre – 2 weeks

Training

Baseline data collection

Mission – 6 weeks

Travel to Phobos - *20 days*

Geological survey of Phobos - *5 days*

Return safely to Earth - *20 days*

Post – 2 weeks

Debriefs

Data collection

10 research studies

Team selection

Team effectiveness

Team task switching & multitasking

Autonomy

Biomarkers for adaptations & resiliency

Flight simulation platform for predicting astronaut readiness

And more!

What was measured?

Biometric data

- Body measures
- Blood, urine & saliva
- Actiwatch
- EKGs

Cognition & mental state

- Surveys, surveys, more surveys…
- Psychomotor vigilance tests
- Cognitions tests (similar to Lumosity)

Group dynamics & cohesion

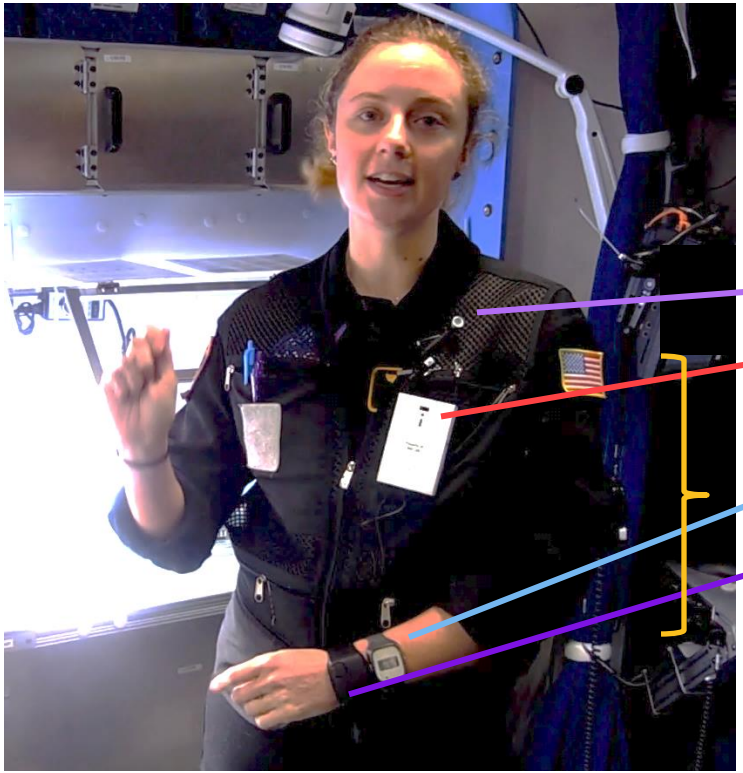
- Proximity badges
- Audio & video recording
- Surveys
- Effectiveness in team tasks

Habitat & equipment

- Surveys
- Post-mission debriefs
- Ex. satisfaction with lighting protocol, layout of science deck, etc.

Ingress & launch

“Don your wearables”



Voice recorder

Proximity badge

EKG

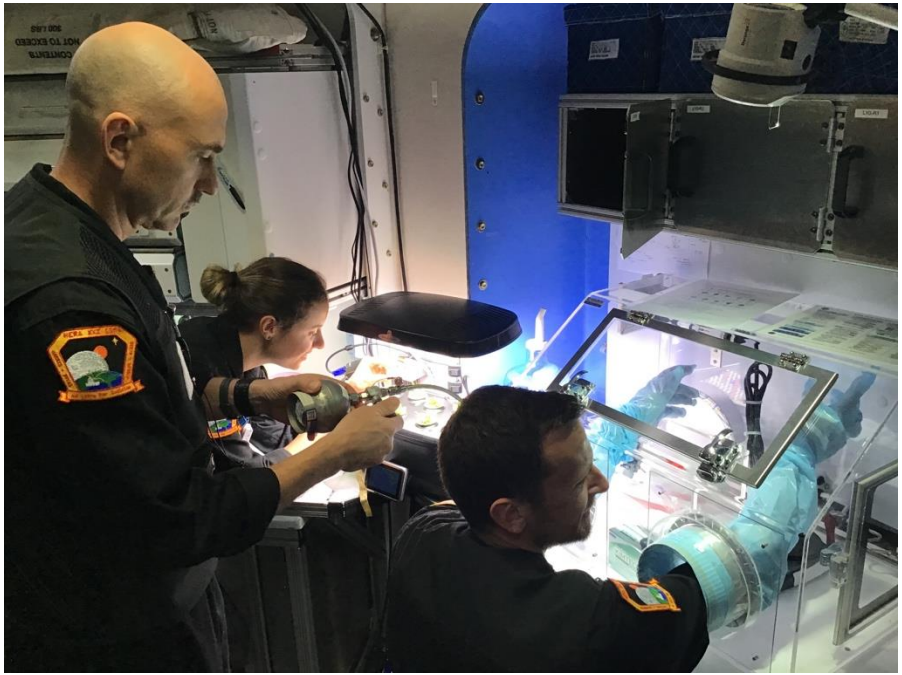
Actiwatch

Heart rate monitor

Scott Kelly

Polaris Tour

Science Deck (L1)

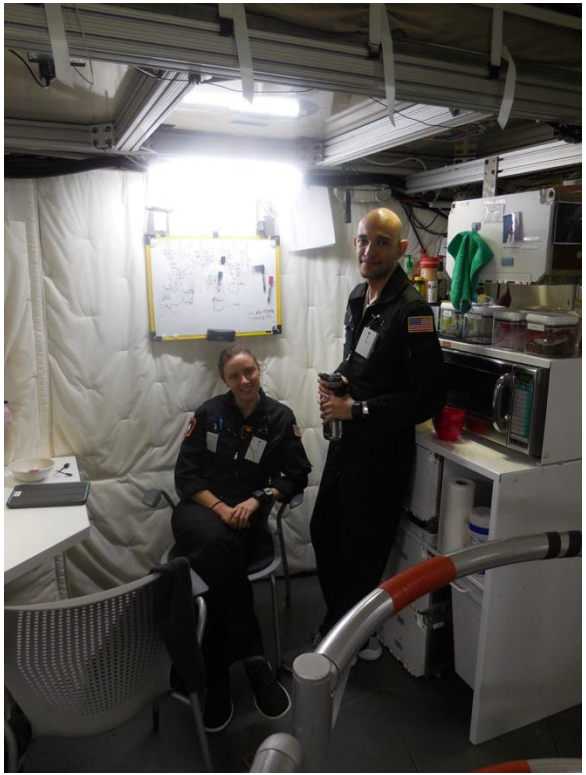


Polaris Tour

Hygiene Module

Polaris Tour

Living Deck (L2)



Polaris Tour

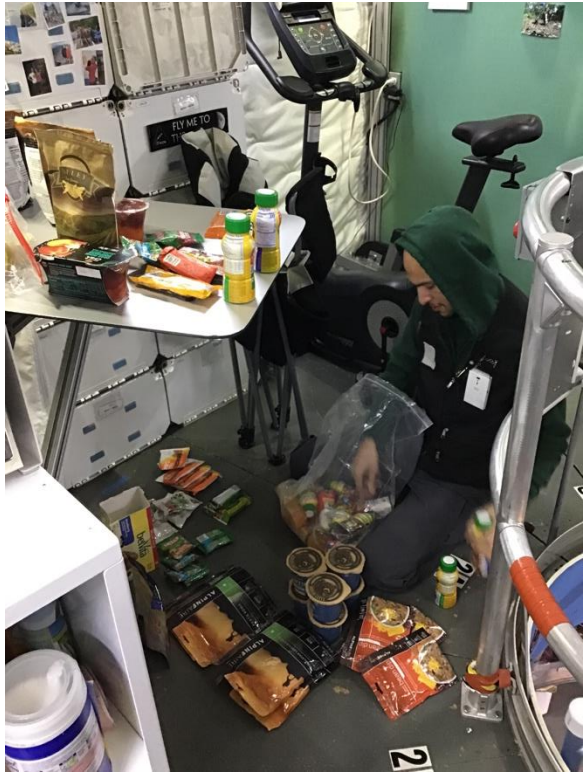
Galley

Polaris Tour

Sleeping Deck (L3)

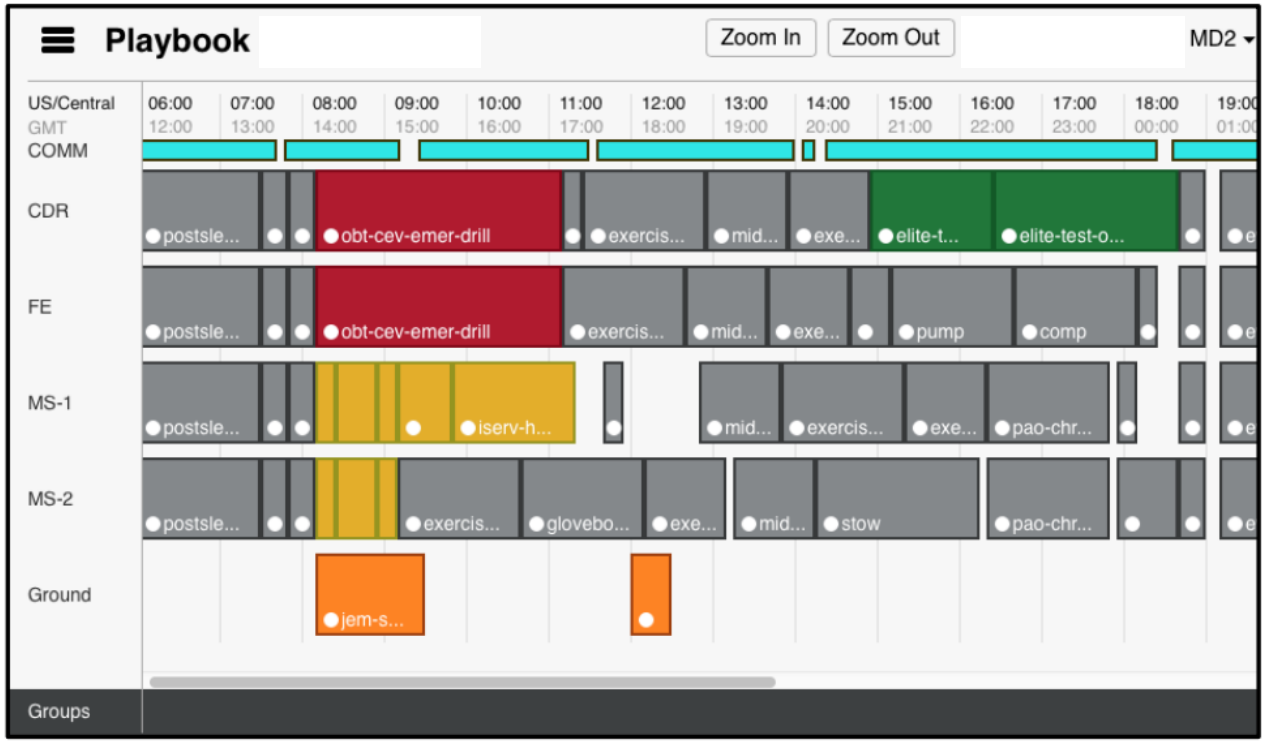
Soyuz comparison (approximate)

Diet



COFFEE RATIONING!

Daily schedules

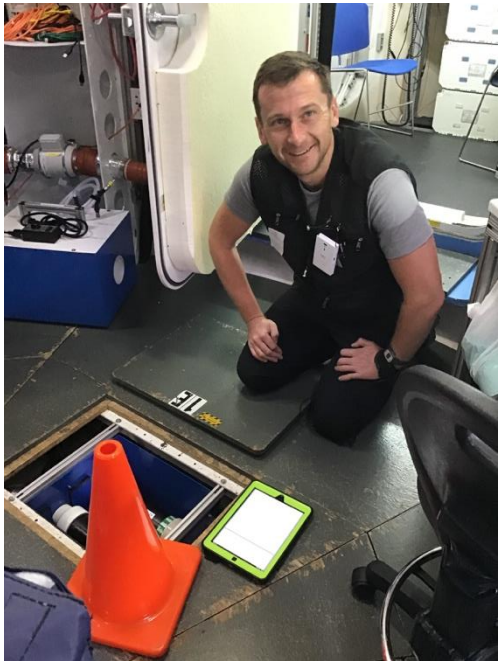


Ship maintenance & housekeeping

ECLSS

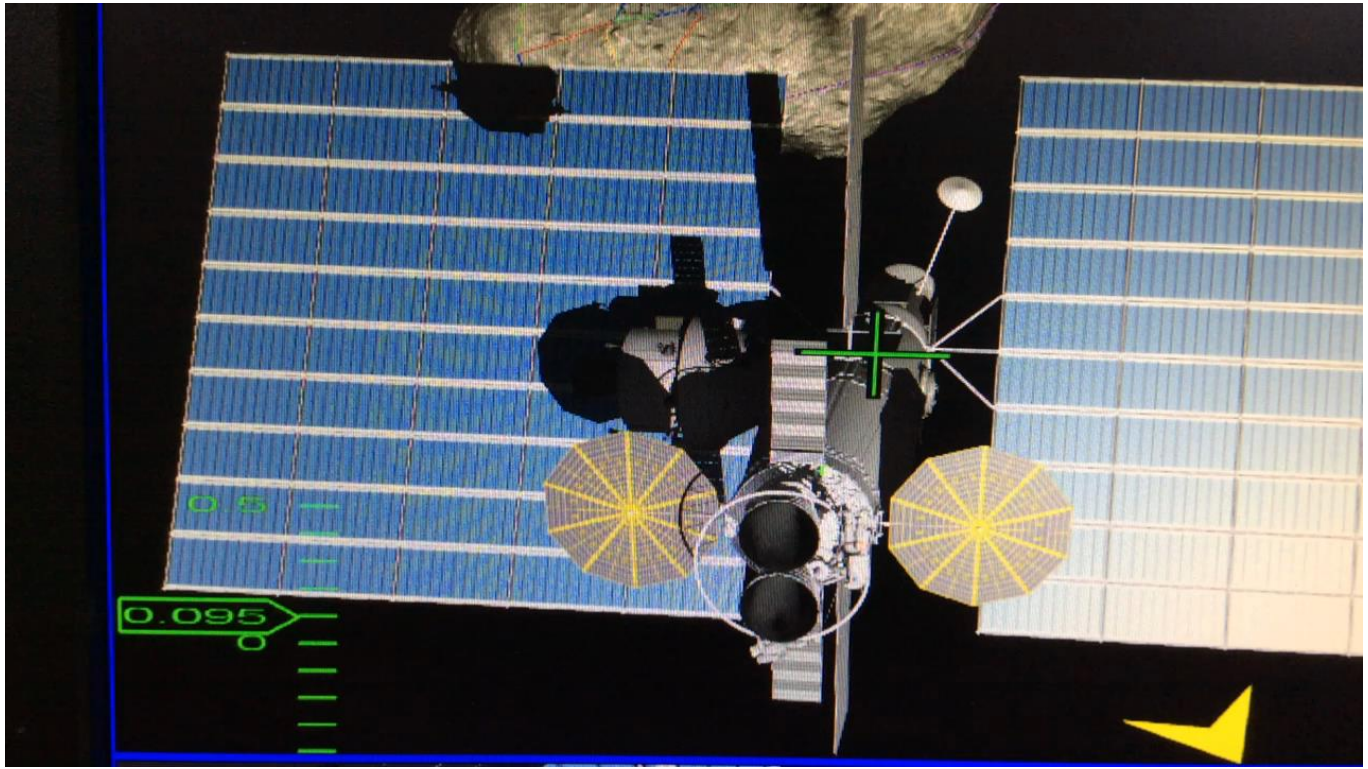
Water reclamation system

CO_2 scrubbers



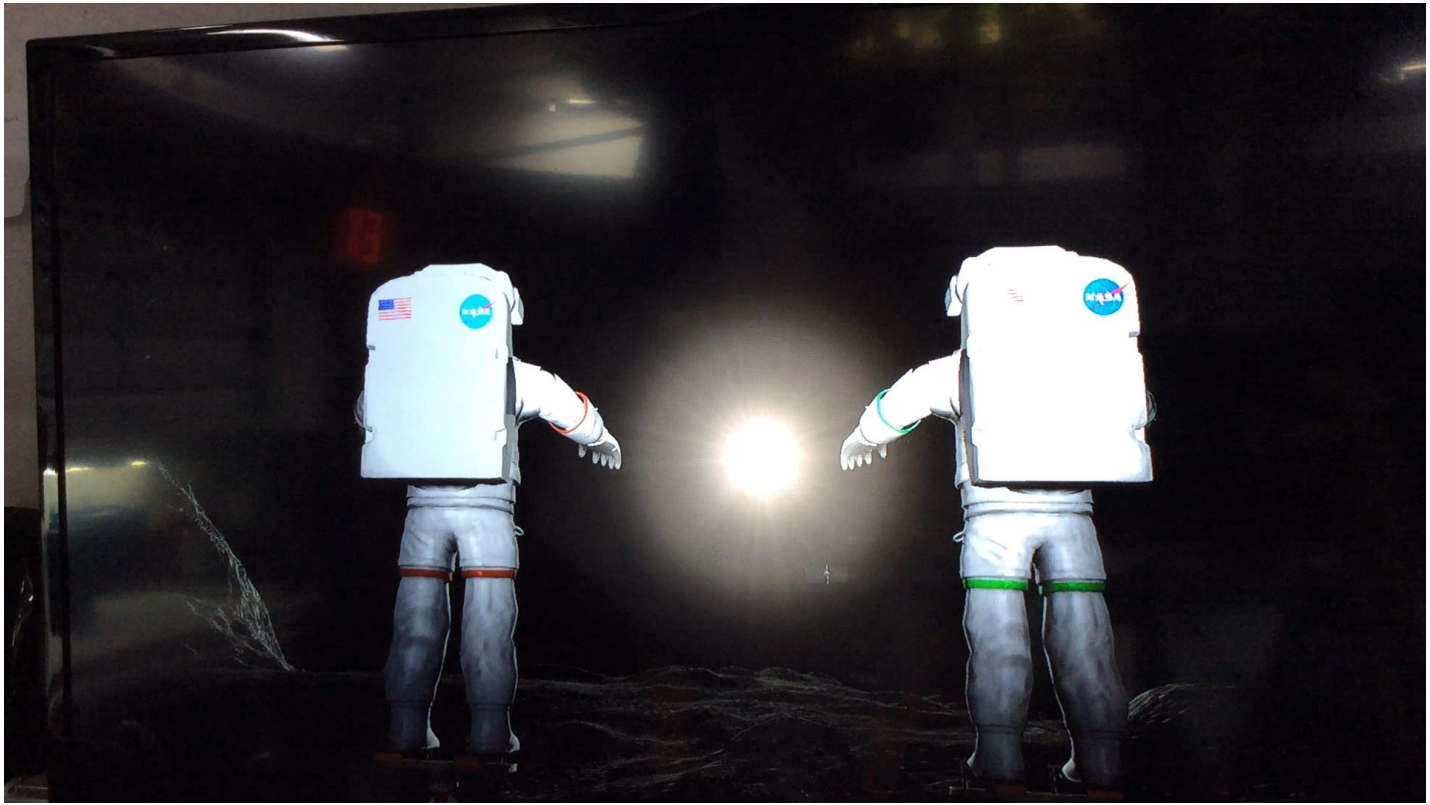
Replacing zeolite canisters

Habitat inspections



C4M5 Crew Video

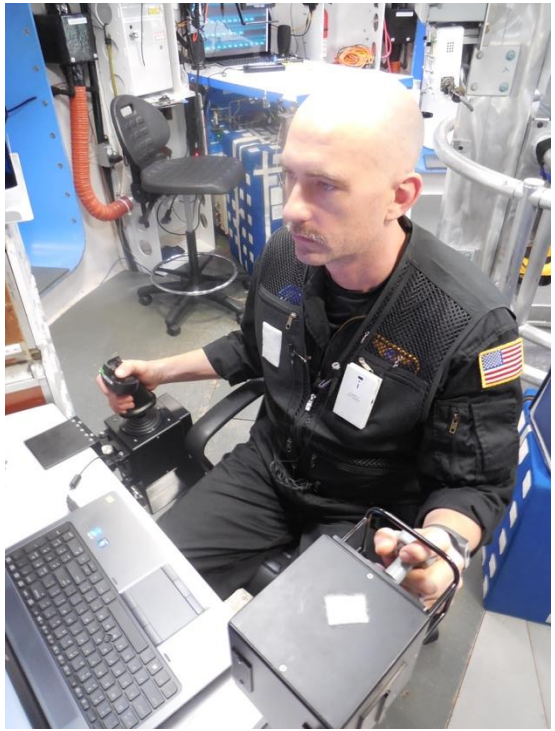
EVAs to Phobos surface



C4M5 video

EVAs to Phobos surface

Canada Arm training

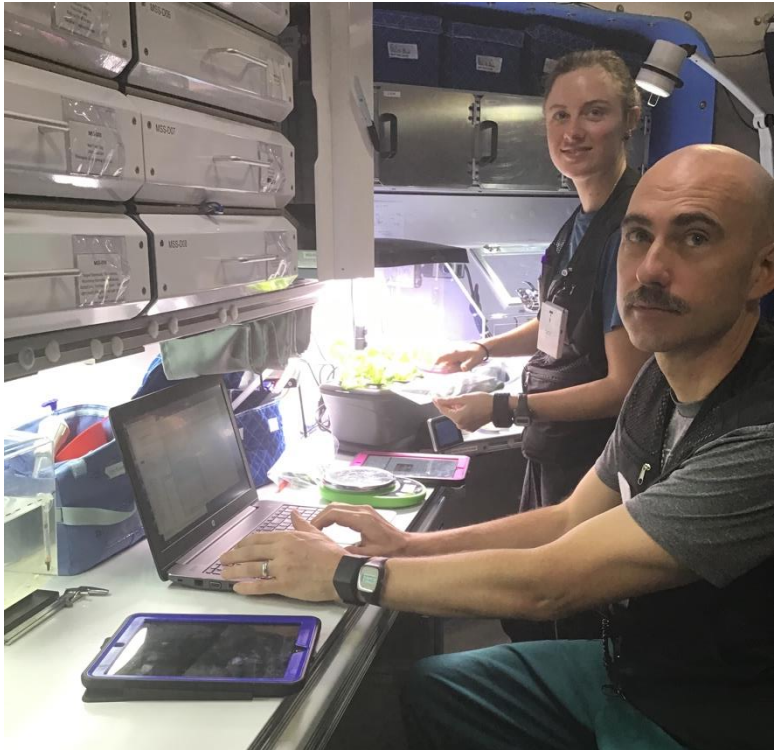


Experiments

Brine Shrimp

Experiments

Space Lettuce



“Off-nominal scenarios”

Crew bonding

So. Much. Free. Time.

Final count down

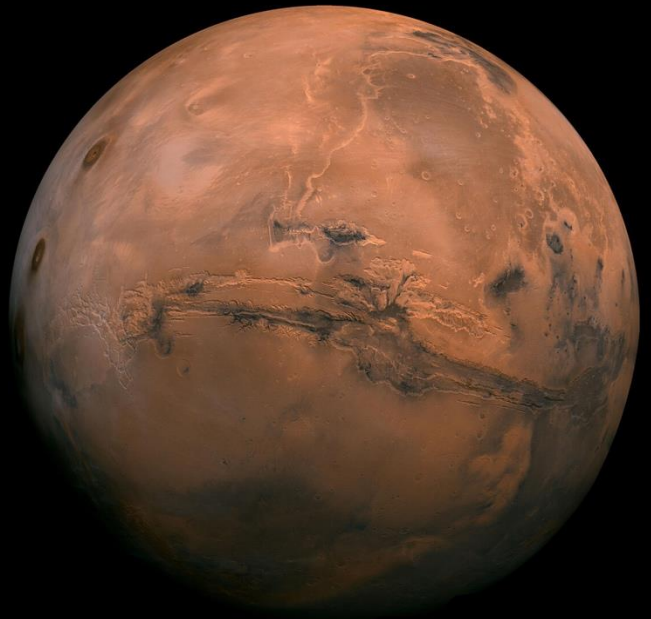
Splashdown & egress (& a pandemic?!)

Mars has been flow by, orbited, smacked into, radar examined, bounced upon, rolled over, shoveled, drilled into, baked, and even blasted…

Still to come: Mars being stepped on.

Buzz Aldrin

Apollo 11 Astronaut



Thank you for listening!

HERA is recruiting for their next campaign!

- 30-55 years old
- MS/MA in STEM field or military experience
- Pass suite of physical & psychological assessments

9 Tips from an Analog Astronaut for Surviving COVID Confinement

1. Focus on the mission goal
2. Prioritize good crew dynamics
3. Manage expectations
4. Get enough sleep
5. Create a healthy schedule
6. Distinguish weekends from weekdays
7. Limit your screen time
8. Cultivate a creative outlet
9. Connect with your community