



NASA's Human Research Program (HRP)



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Human Research Program for Civilians in
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[NASA HRP's]

Vision for Commercial Spaceflight Human Research

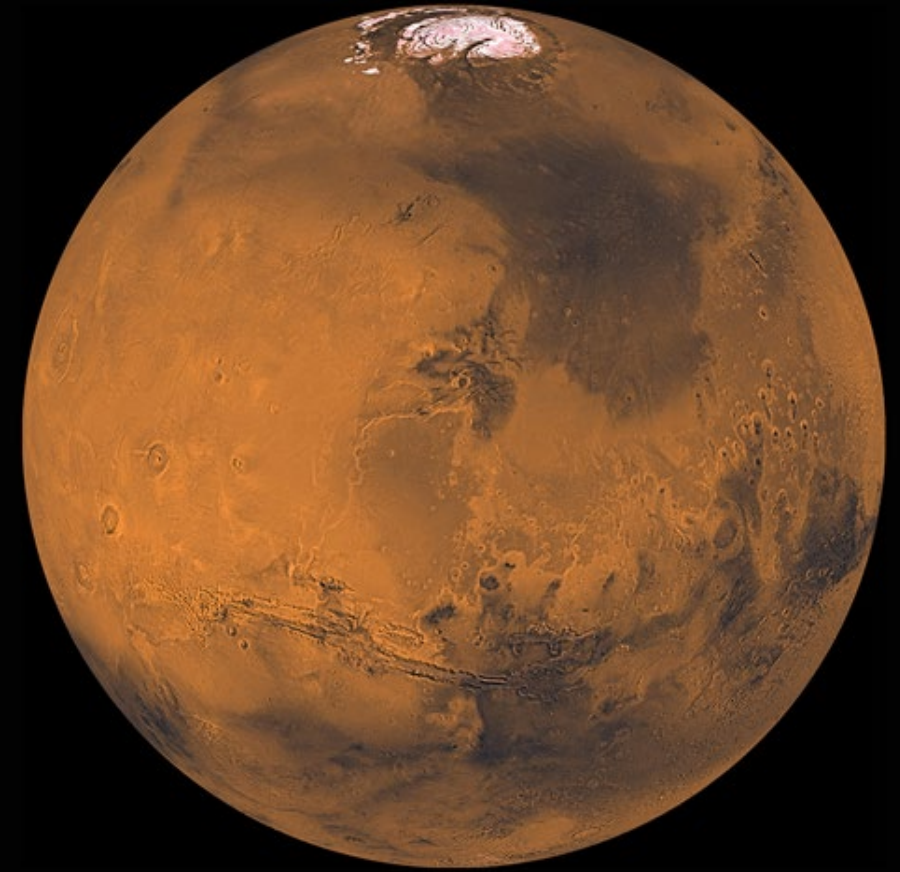
Every human that flies in space will be offered opportunities to participate in human research that reduces risks for exploration missions.





NASA's Human Research Program Mission Statement

To enable space exploration beyond
Low Earth Orbit by reducing the
risks to human health & performance





**Generic Lunar
Design Ref. Mission**

Inflight Medical Conditions

Crew Egress

Non-Ionizing Radiation

Urinary Retention

Inadequate psychosocial Adaptation within a Team

Hearing Loss

Radiation Carcinogenesis

Reduced EVA performance

Sensorimotor Alterations

Decompression Sickness

Renal Stone Formation

Cardiovascular Adaptations

Inadequate Food and Nutrition

Cardiac Rhythm Problems

Host-Microorganism Interactions

Sleep Loss

Altered Immune Response

Spaceflight-Associated Neuro-ocular Syndrome (SANS)

Ineffective or Toxic Medications

Reduced Aerobic Capacity

Electrical Shock

Adverse Cognitive or Behavioral Conditions

Orthostatic Intolerance

Bone Fracture

Inadequate Human Systems Integration Architecture

Injury from Dynamic Loads

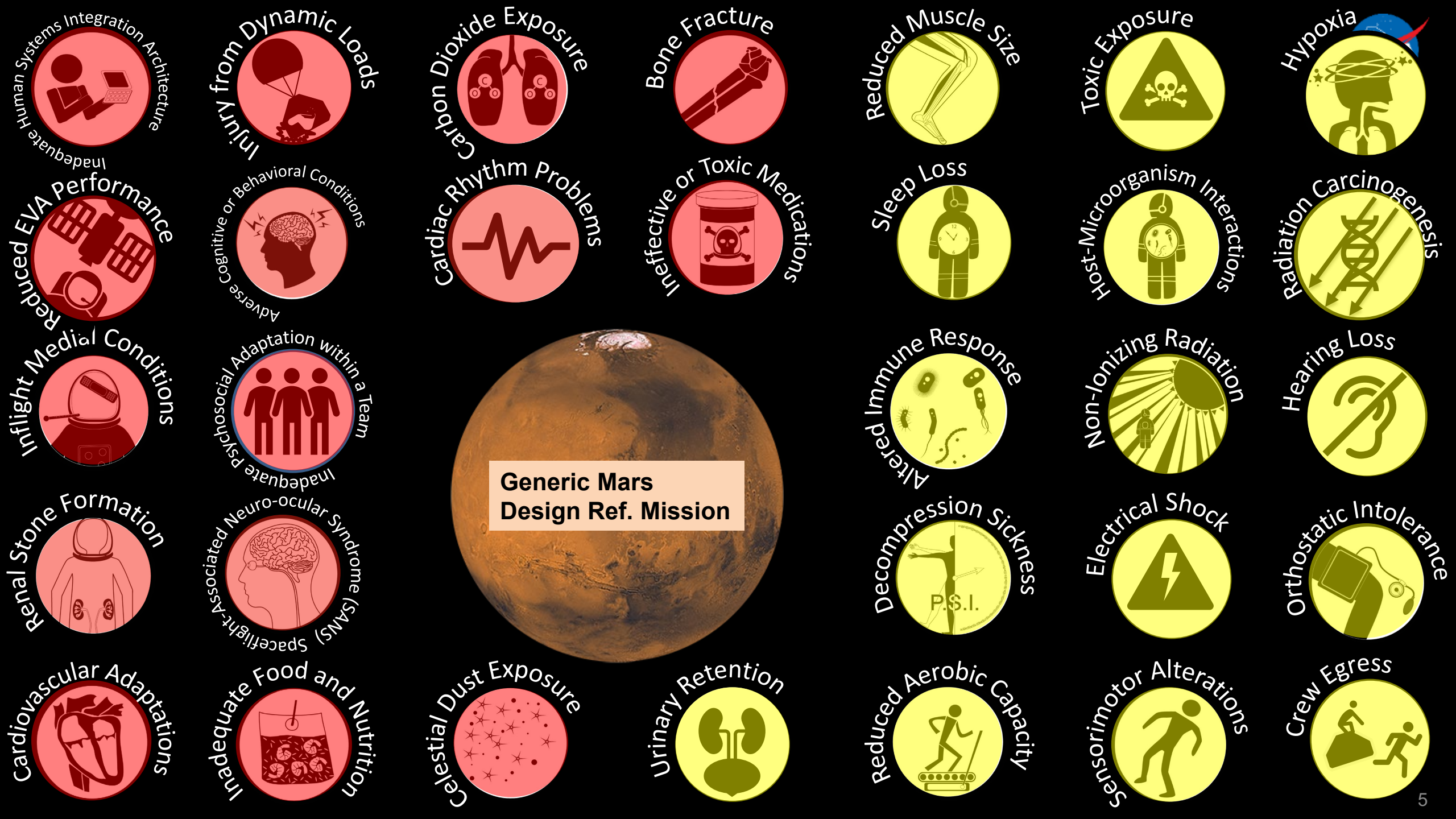
Carbon Dioxide Exposure

Reduced Muscle Size

Toxic Exposure

Celestial Dust Exposure

Hypoxia





Human Research Program

STEPS TO MARS



EARTH:

Simulated spaceflight hazards
in Ground Analogs | :envihab |
Antarctic Stations | NEK | HERA |
Space Radiation Lab

LOW EARTH ORBIT:

International Space Station –
A unique testbed to study micro-
gravity and environment hazards,
with varying mission durations

LUNAR MISSIONS:

Decreasing Earth-dependence
around and on the lunar surface.
Provides insight into deep space
radiation; behavioral health, and
gravity transitions





Examples of Artemis/Mars enabling work yet to be done on ISS



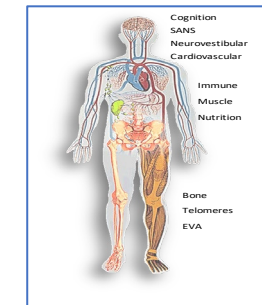
Medical autonomy and technology demonstrations

Sensorimotor/manual control countermeasures



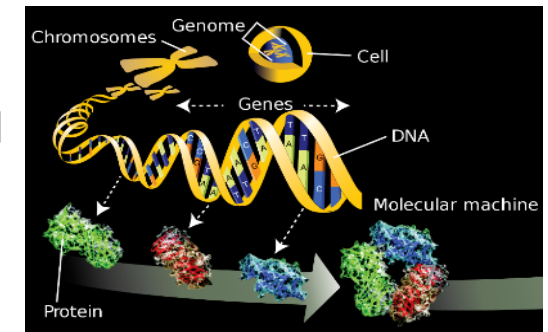
CIPHER – The most complex, integrated study ever of human physiology and psychology in space

Landing egress and EVA functional testing



SANS Countermeasure Testing

-omics Data Archive For risk assessment and personalized countermeasures development

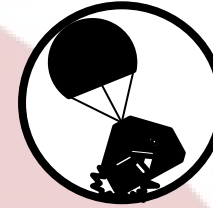




Top Crew Health and Performance System Capability Challenges for Mars



**Earth-Independent Human
Operations**



**Computational Injury &
Anthropometric Models**



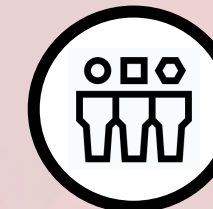
Mars Duration Food System



**Exploration Exercise
Countermeasures**



**Mars Duration Effects on
Human Physiology**



**Understanding Individual
Variability in Spaceflight**



**Risk Mitigations for Vehicle
Atmospheres**



**Sensorimotor
Countermeasures**



Commercial Space Human Research

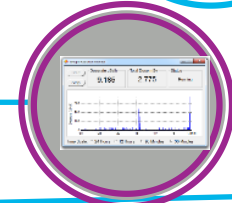
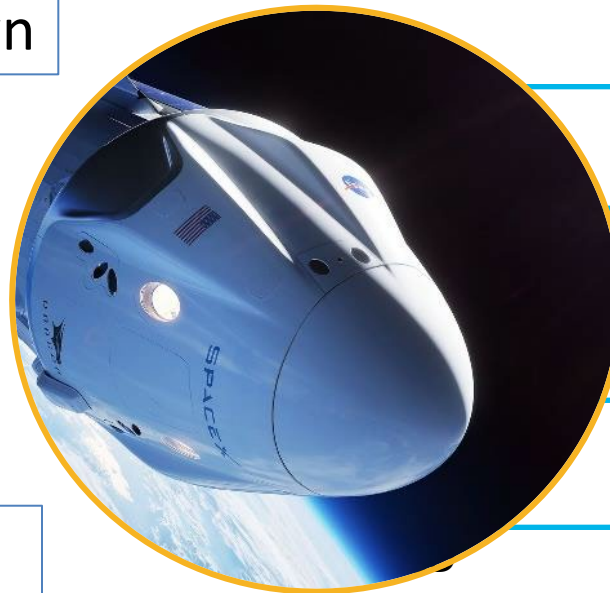
Establishing relationships to accelerate HRP's risk reduction mission.



SpaceX
Inspiration4, Polaris Dawn



Axiom
Ax-1, Ax-2, Ax-3, Ax-4



HRP and TRISH are partnering with commercial space companies to set the precedent that human research will be offered to all LEO commercial spaceflight participants



Commercial LEO Destinations (CLD)

Ensuring requirements meet future HRP and Agency needs.



Human Health Utilization | Areas of Emphasis



Researching **Countermeasures**, **Standards**, and **Technology** to inform CLD, Lunar, and Mars Missions





Summary

- NASA's Human Research Program has an important mandate to reduce human health and performance risks for Lunar and Mars missions
- We are excited about the future of commercial spaceflight human research opportunities to accelerate and augment the work of NASA HRP
- NASA HRP is actively working with commercial spaceflight companies to collaborate and enable human research opportunities



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