Introduction to the Human Research Program

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https://www.youtube.com/watch?v=tquRyE_ubQU

NASA’s Human Research Program Mission Statement

To enable space exploration beyond low-Earth orbit by reducing risks to human health & performance

Overview: Human Research Program

Established in 2005 to focus NASA's research on the highest risks to human health and performance during exploration missions

Objectives:

- Perform research on how the human body reacts to space travel
- Develop technologies to reduce medical risk
- Develop NASA spaceflight human system standards

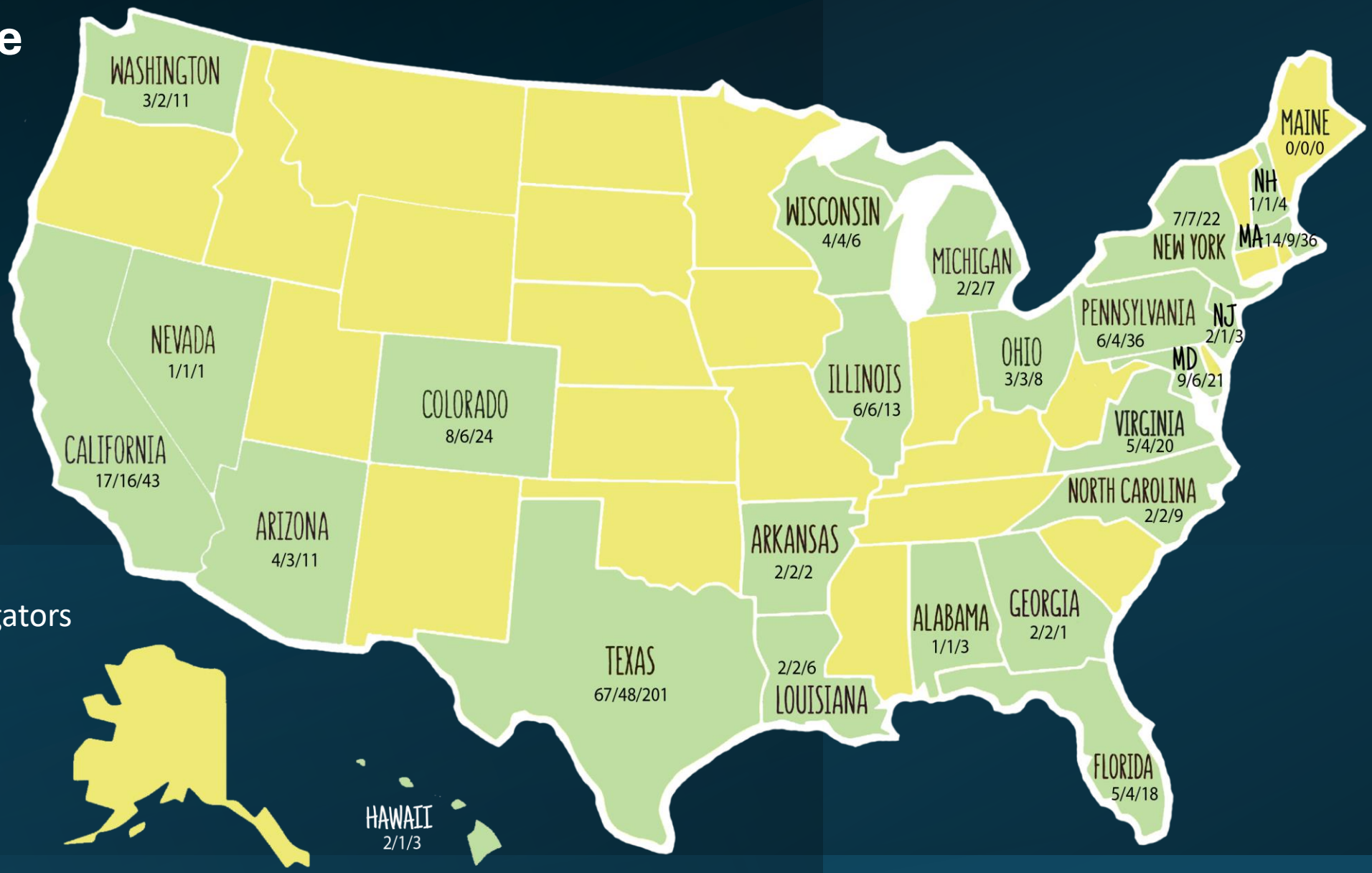
HRP: A National Research Program

Directly aligned with human exploration goals:

- NASA Mission: *"Driving advances in science, technology exploration to enhance knowledge, education, economic vitality, and stewardship of Earth in the area of Human Health and Performance."*
- Example: Strategic Goal 1: *Extending and sustaining activities across the solar system*

Research funded by HRP by state

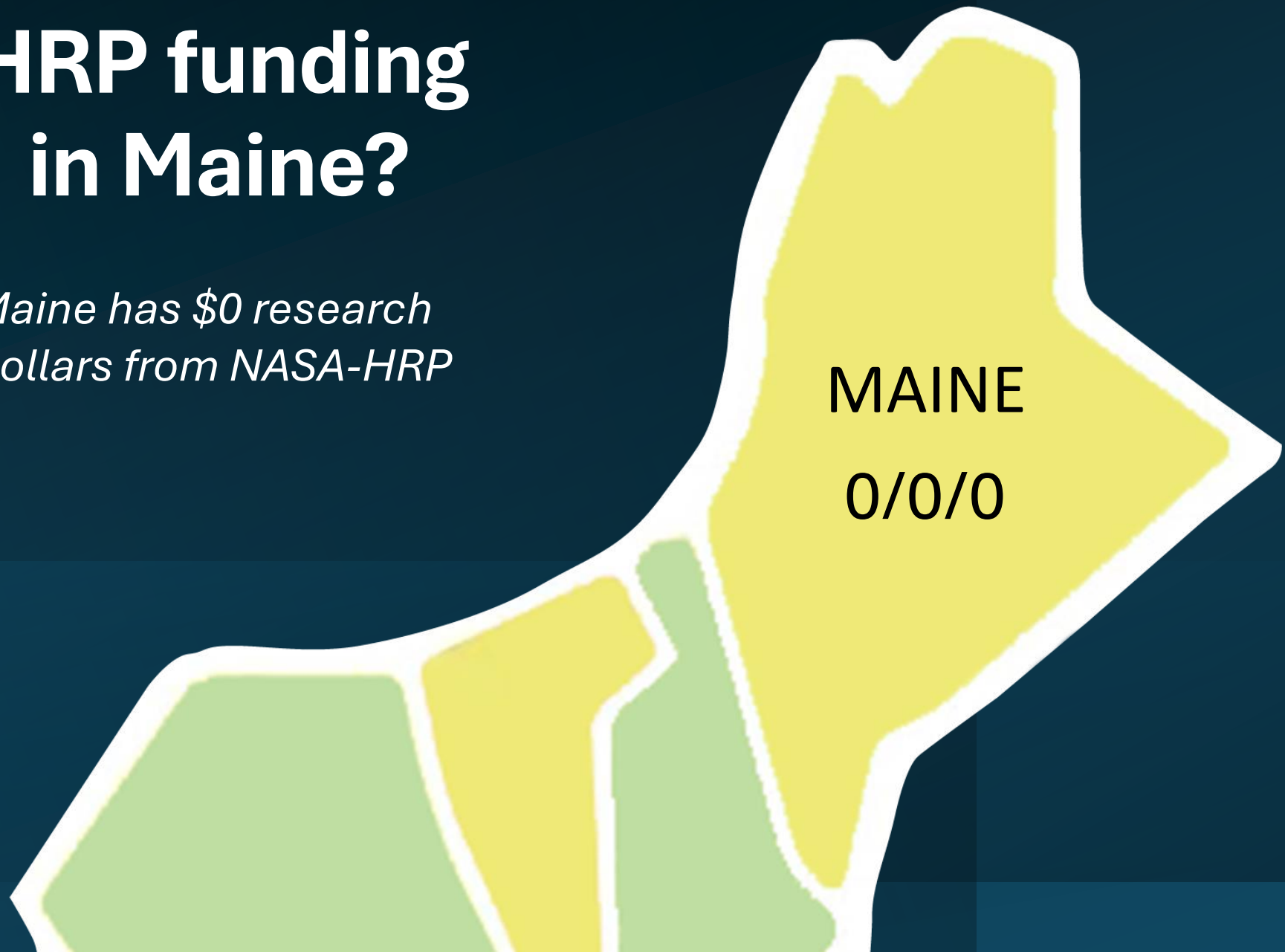
Projects / Principal Investigators / Co-Investigators



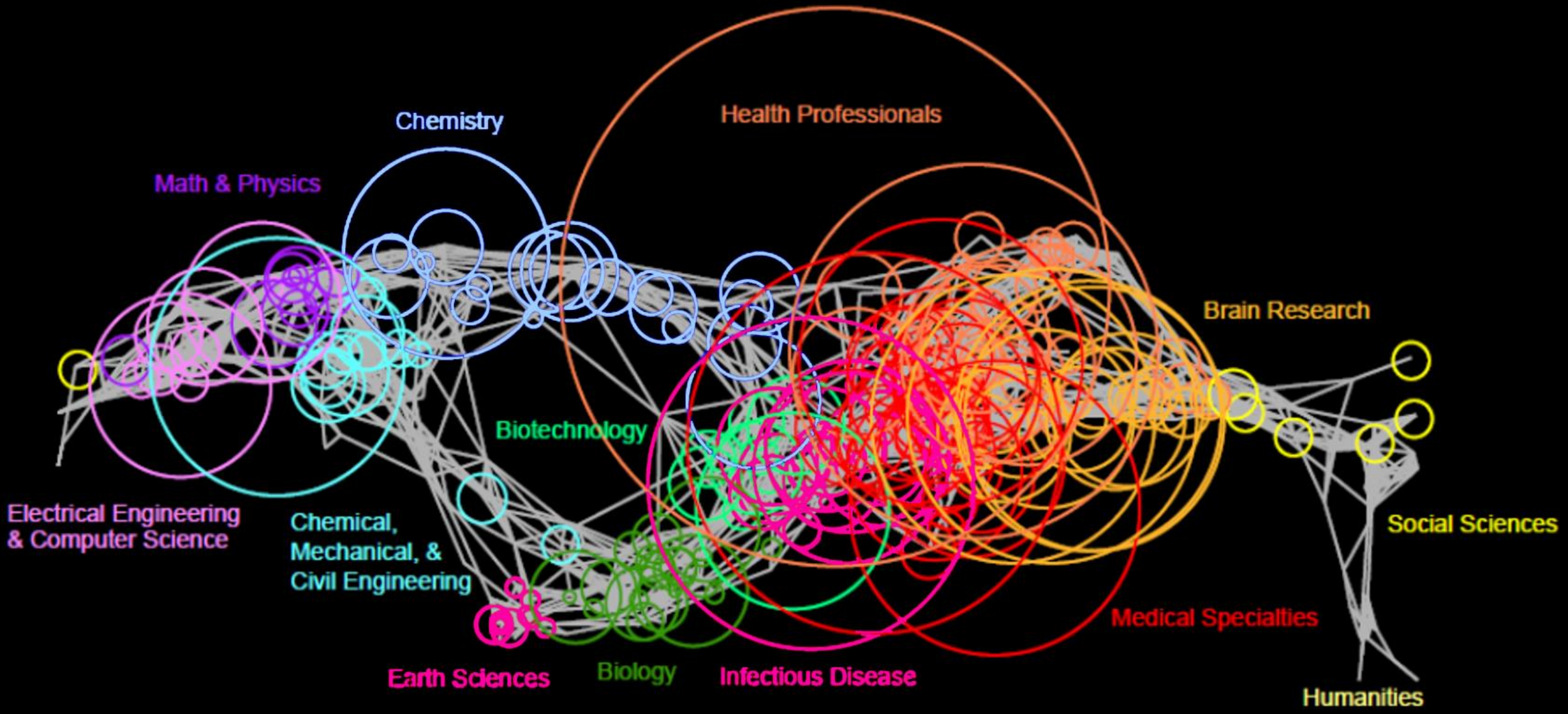
180 Projects
141 Principal Investigators
519 Co-PIs

HRP funding in Maine?

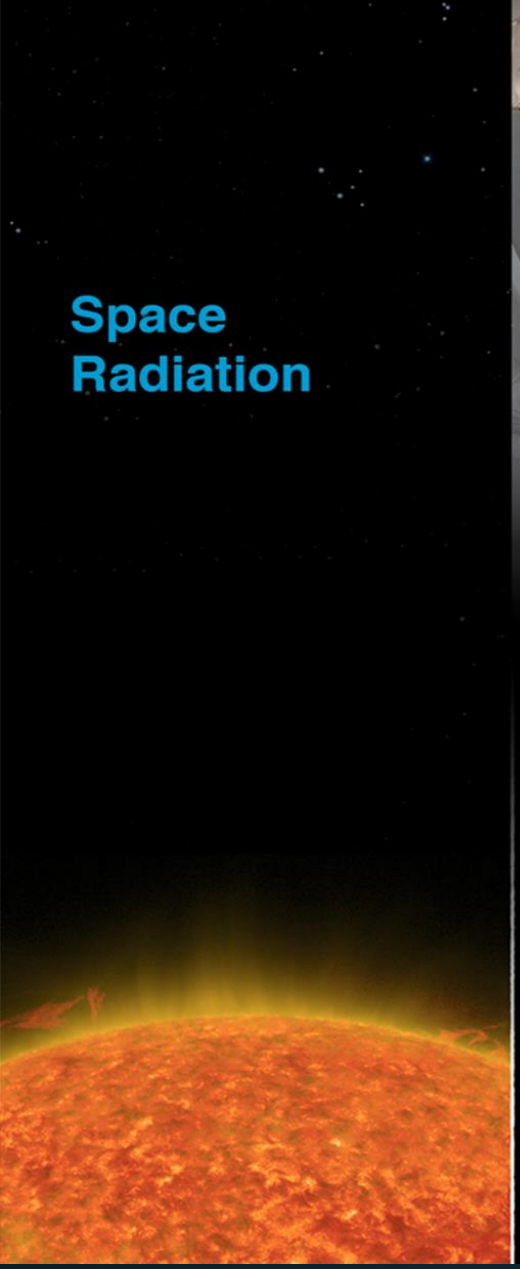
Maine has $0 research dollars from NASA-HRP



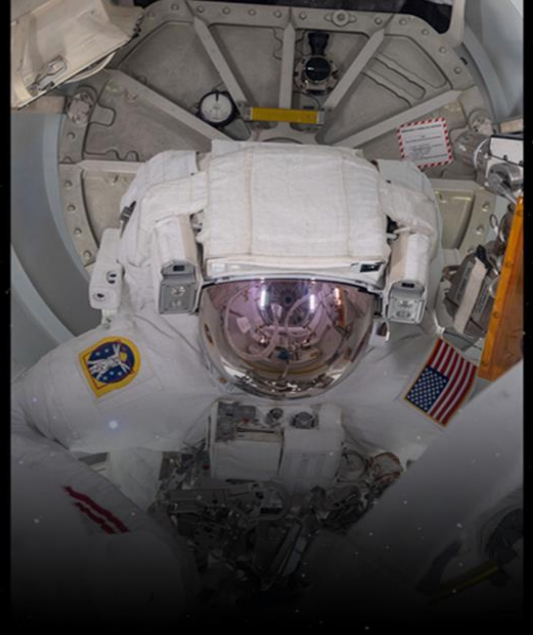
HRP Map of Science



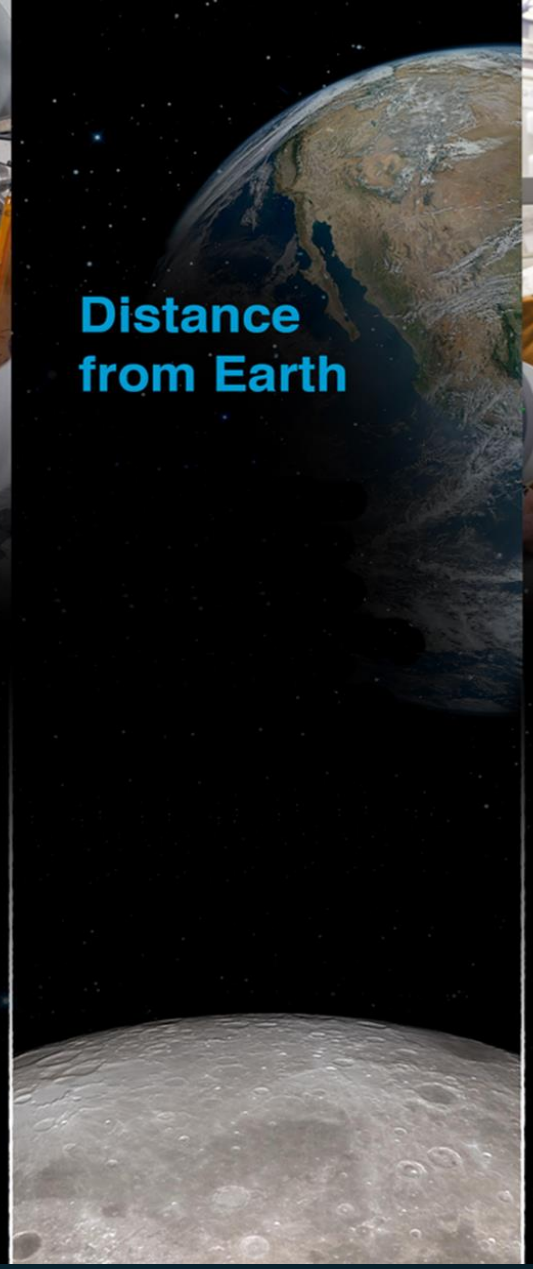
Space Radiation



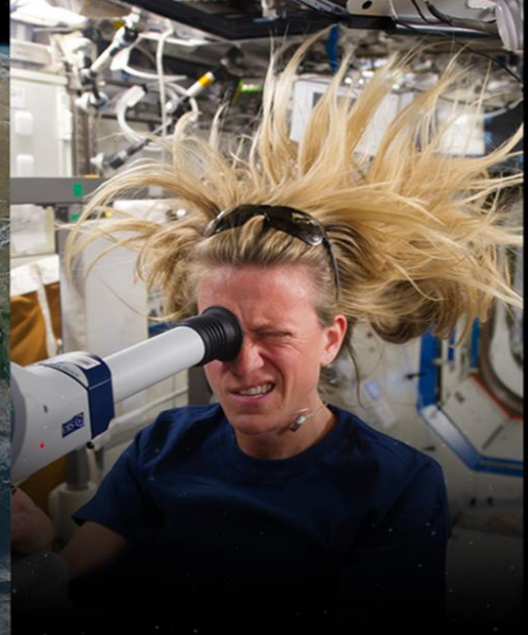
Isolation and Confinement



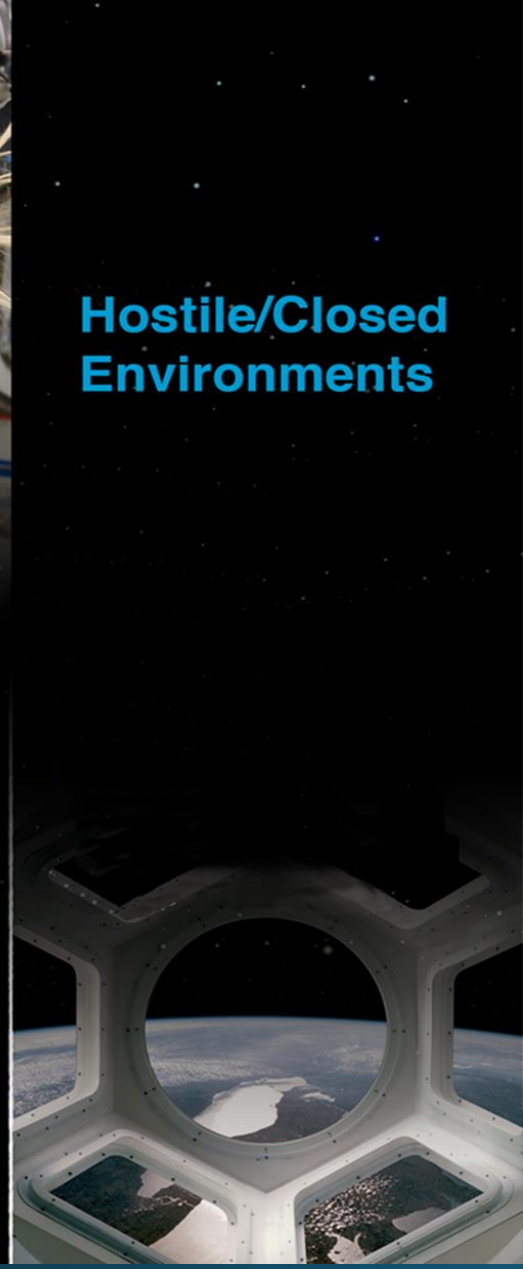
Distance from Earth



Gravity (or lack thereof)



Hostile/Closed Environments



Spaceflight Hazards

HRP Research Strategy

HRP employs a novel risk-based research strategy:

- Risks to space explorers clearly defined within NASA
- Risk mitigation status assessed for specific design reference missions using extant evidence
- Research tasks prioritized to mitigate risks most likely to present human system limitations to probable design reference missions

Human System Risk Summary – Risks by Hazard

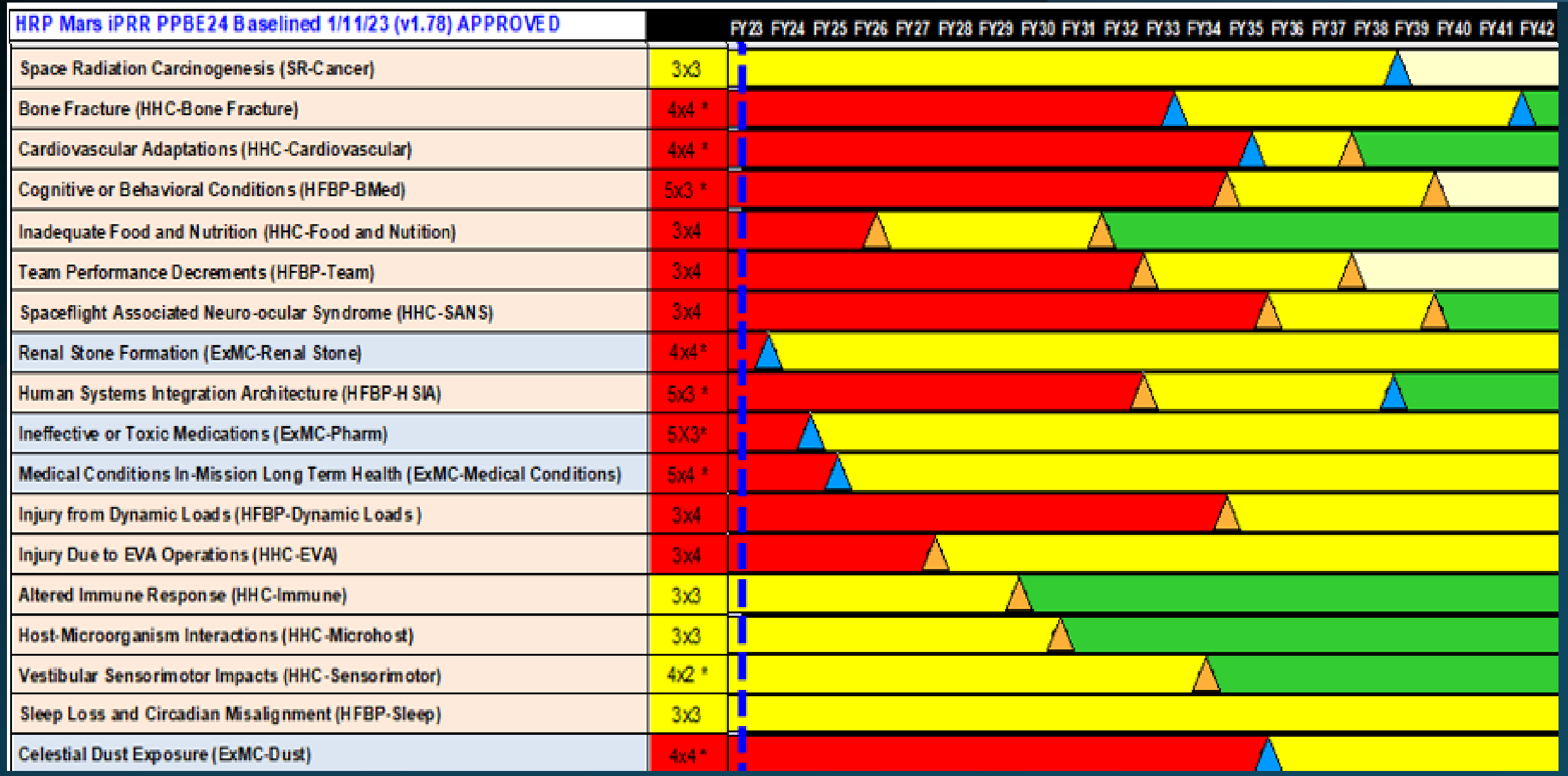
Human Spaceflight Risks	Low Earth Orbit (Long) 30 D - 1 Y	Lunar Orbital (Short) < 30 D	Lunar Orbital (Long) 30 D - 1 Y	Lunar Orbital + Surface (Short) < 30 D	Lunar Orbital + Surface (Long) 30 D - 1 Y	Mars (Preparatory) < 1 Y	Mars (Planetary) 730-1224D
Radiation							
Non-Ionizing Radiation	A	A	A	A	A	AO	AO
Radiation Carcinogenesis **(LTH)**	RC	A	RC	A	RC	RM	RM
Distance from Earth							
Inadequate Human Systems Integration Architecture	A	RM/SR	RM/SR	RM	RM	RM	RM
Inflight Medical Conditions	A	A	RM	RM	RM	RM	RM
Inadequate Food and Nutrition	A	A	RM	A	RM	RM	RM
Ineffective or Toxic Medications	A	A	A	A	A	A	RM
Isolation and Confinement							
Cognitive or Behavioral Conditions	RM	AM	RM	RC	RM	RM	RM
Psychosocial Adaptation within a Team	AM	AM	RM	AM	AM	RM	RM
Altered Gravity							
Bone Fracture	A	A	RC	A	RC	RC	RC
Cardiac Rhythm Problems	AM	AM	AM	AM	AM	RM	RM
Concern of Venous Thromboembolism (VTE)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Host-Microorganism Interactions	AM	AM	AM	AM	AM	AM	RM
Orthostatic Intolerance	A	A	A	A	A	A	A
Reduced Aerobic Capacity	AM	AO	AO	AO	AO	AO	AO
Reduced Muscle Size	AM	AO	AM	AO	AO	AO	AO
Renal Stone Formation	A	A	A	A	A	RM	RM
SANS	A	A	A	A	A	A	RM
Sensorimotor Alterations	RM/SR	AM	RM/SR	RM/SR	RM/SR	RM/SR	RM/SR
Urinary Retention	A	A	A	A	A	A	A
Crew Egress	AM	RC	RC	RC	RC	RC	RC
Cardiovascular Adaptations	AM	A	AM	AO	AO	AM	RM
Hostile Closed Environment							
Altered Immune Response	AM	AM	AM	AM	RM	RM	RM
Carbon Dioxide Exposure	A	A	A	A	A	RM	RM
Celestial Dust Exposure	N/A	A	A	A	RM	N/A	TBD
Decompression Sickness	A	RM	RM	RM	RM	RM	RM
Dynamic Loads	AM	AM	AM	RM	RM	AM	RM
Electrical Shock	A	A	A	RC	RC	RC	RC
EVA Risk	A	AO	AO	RM	RM	AO	RM
Hearing Loss **(LTH)**	AM	AM	RC	AM	AM	RC	RC
Hypoxia **(LTH)**	RM	A	RM	A	RM	RM	RM
Sleep Loss	AO	AO	AO	AO	RM	RM	RM
Toxic Exposure	AM	AM	AM	AM	AM	AM	AM

Notes:

- Risk ratings are approved at the Human System Risk Board
- Risk ratings are for In-mission operations unless otherwise noted for Long-Term Health (LTH)
- Risk text color:
  - Current risk ratings
  - Risk ratings under review
  - Proposed to be approved
  - To be transferred to another risk
- Risk colors:
  - High LxC
  - Mid LxC
  - Low LxC
- Risk Dispositions
  - **A** – Accepted
  - **AM** – Accepted with monitoring
  - **AO** – Accepted with optimization
  - **RM** – Requires Mitigation
  - **RM/SR** – Requires Mitigation/ Standard Refinement
  - **RC** – Requires Characterization

Path to Risk Reduction – Mars DRM

Human System Risks Requiring Research



Top Crew Health and Performance System Capability Gaps for Mars

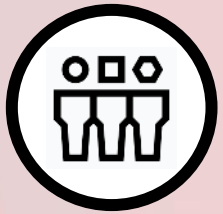
Earth-Independent Human Operations

Computational Injury & Anthropometric Models

Mars Duration Food System

Exploration Exercise Countermeasures

Mars Duration Effects on Human Physiology

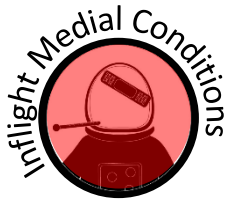
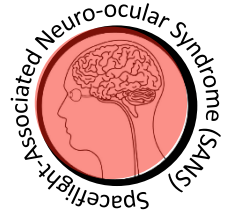
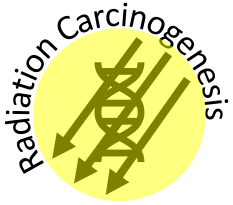
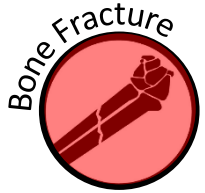


Understanding Individual Variability in Spaceflight

Risk Mitigations for Vehicle Atmospheres

Sensorimotor Countermeasures

Agency Progress on Selected Risks

	50+ years of evidence; HRP recommends moving risk to “yellow” in next 2 years		Exercise standards validated; HRP now focusing on exercise hardware
	Renal stone mitigations (hydration, exercise, etc.) in place; HRP recommends moving risk to “yellow” in next year		Antarctica validated as a spaceflight analog; ground countermeasure validation concluding soon.
	Strict head-down-tilt bedrest validated as a spaceflight analog; countermeasure concepts being tested now in analogs and in spaceflight		New dose-based standard in place; mitigations depend on advances in detection and treatment; HRP to characterize unique GCR effects and individual susceptibility
	DXA Bone Density may not be adequate to characterize fracture risk; HRP working to develop bone microarchitecture scans as more predictive tool		Compression suit and fluid loading countermeasures validated; HRP risk work completed, optimization potential

HRP's Five Elements

- Exploration Medical Capability
- Human Factors and Behavioral Performance
- Human Health Countermeasures
- Space Radiation
- Research Operations and Integration

Key Partners

- Funds Translational Research Institute for Space Health (TRISH) to pursue breakthrough approaches to reduce risks

- Collaborates with NASA Space Biology to understand spaceflight adaptation in cells, microorganisms, plants, and animals

HRP Collaborations

Efficient way to leverage assets:

- Operational medicine and technology development programs
- Other space biomedical research programs
- Other U.S. research agencies
- International partners

HRP uses competitive solicitation processes and peer review to ensure high quality research

CURRENT PARTNERSHIPS

NASA Programs and Affiliates

- Biological & Physical Sciences (BPS)
- Health & Medical Technical Authority (HMTA)
- Advanced Exploration Systems (AES)

yet2

NASA EPSCoR

SBIR-STTR

MUREP

Center of Excellence for Collaborative Innovation

TRANSLATIONAL RESEARCH INSTITUTE FOR SPACE HEALTH

International

DLR

CSA ASC

ИМБП

esa

cnes

ASI

ICRP

مركز محمد بن راشد للفضاء

MOHAMMED BIN RASHID SPACE CENTRE

AUSTRALIAN ANTARCTIC PROGRAM

इसरो ISRO

Domestic OGA

- NSRL Outside Users

NSF

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

BIOMEDICAL ADVANCED RESEARCH AND DEVELOPMENT AUTHORITY BARDA

NIH NATIONAL CANCER INSTITUTE

NIH National Institute of Allergy and Infectious Diseases

NIH National Center for Advancing Translational Sciences

Industry / External

- Commercial Space Providers
- TRISH industry partners
- Others

SCIENTIFIC AUTHORITY SINCE 1929 · NCRP · CONGRESSIONALLY CHARTERED

National Council on Radiation Protection and Measurements

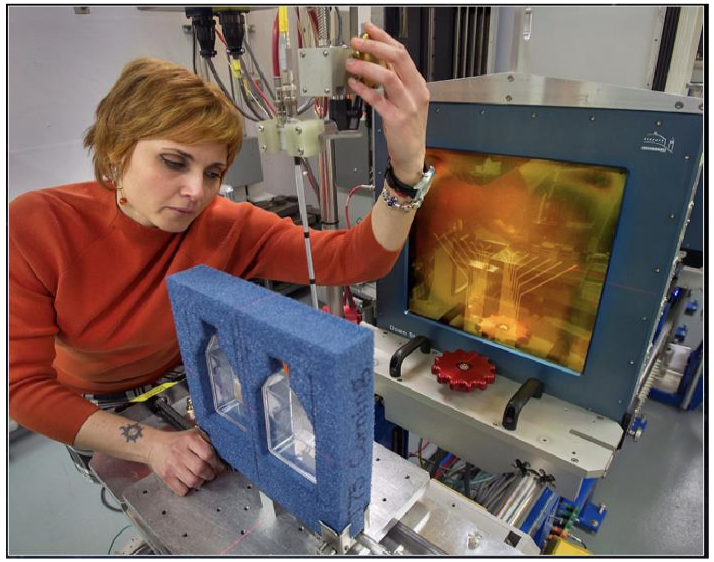

Human Research Program
STEPS TO MARS
EARTH:
Ground Analogs of Spaceflight
LOW EARTH ORBIT:
International Space Station
Commercial Spaceflight Vehicles
Commercial Space Stations
LUNAR MISSIONS:
Orion
Gateway
Human Landing Systems
Lunar Outposts and Rovers

Ground Analogs of Spaceflight

HERA

:envihab

NSRL

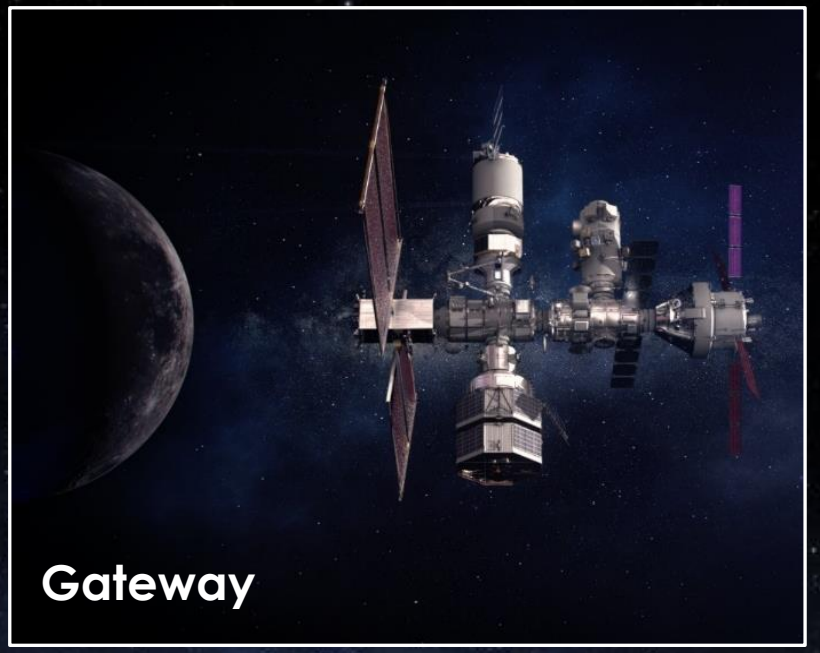


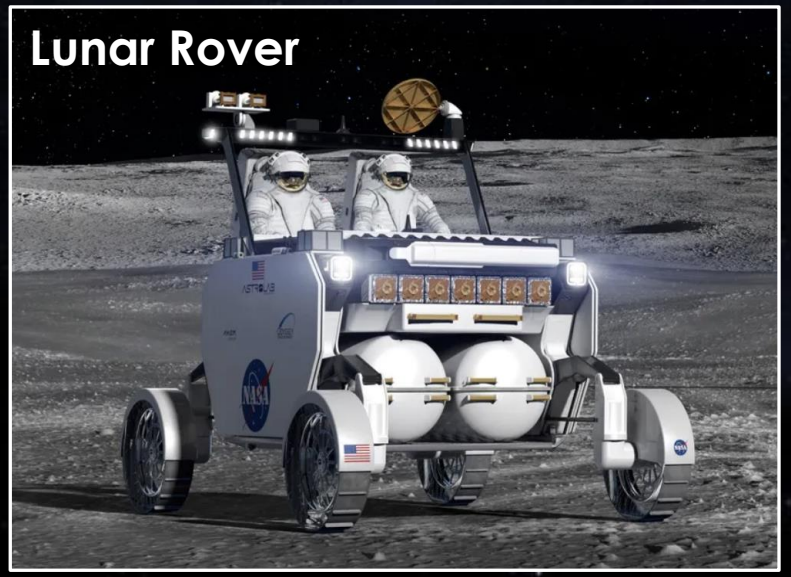
Antarctica

CHAPEA

Kraken

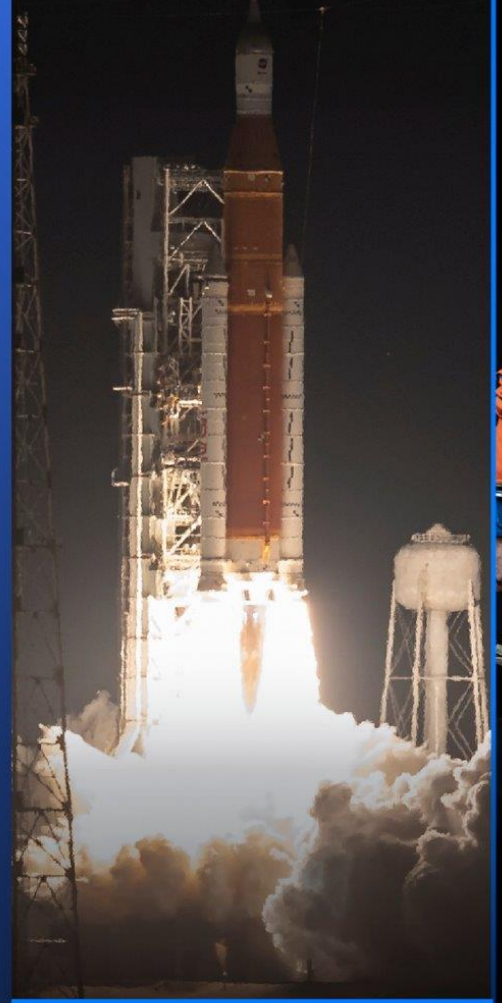
Steps to Mars: Artemis





ARTEMIS I

First Mission
(Uncrewed Flight Test)



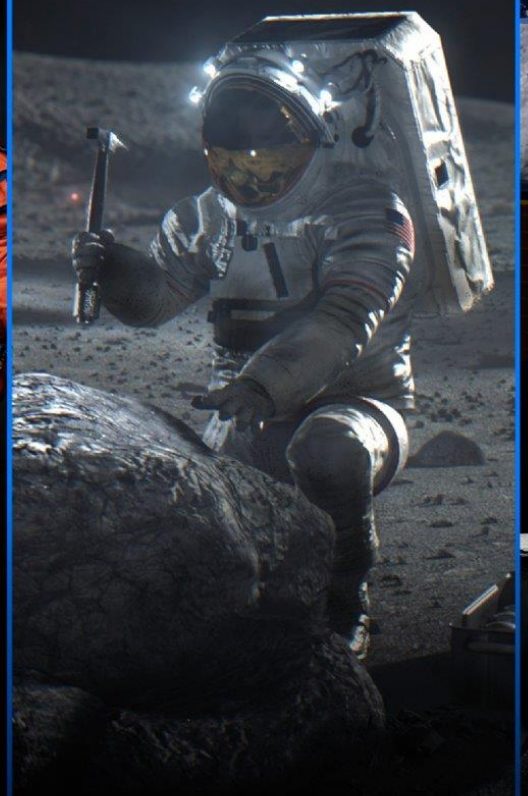
COMPLETE

ARTEMIS II

First Crew

ARTEMIS III

First Human Surface Landing

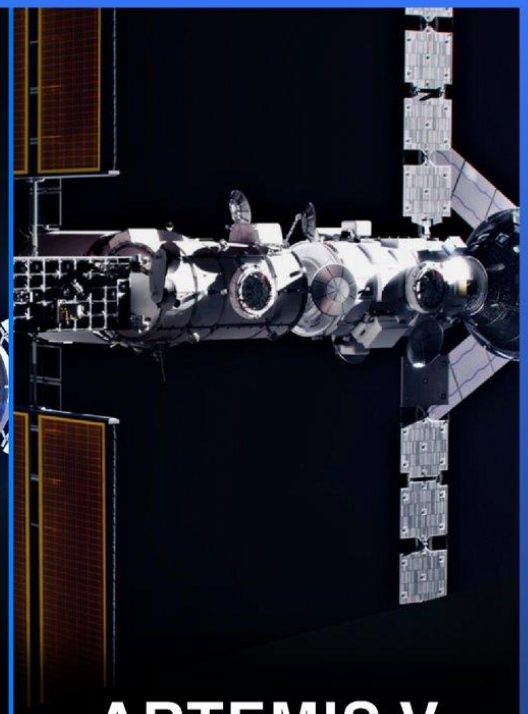


Artist's Concept

ARTEMIS IV

First Lunar Space Station
Assembly Mission

Artist's Concept



ARTEMIS V

Crewed Mobile Surface Exploration,
Gateway Expansion

Artist's Concept

Artemis II HRP Payloads

Artemis Research for Crew Health & Readiness (ARCHeR):

- Wearable device for crewmembers.
- Study sleep-wake patterns & activity levels in Orion.
- Collect performance data on crew and team operational tasks
- Audio/video from Orion to be scrutinized after the mission.

Artemis II
HRP Payloads

Immune Biomarkers:

- Dry samples of crew saliva taken during the mission.
- Scientists to examine samples for stress hormones, protective proteins, and latent viruses that could be reactivated.

HRP Lunar Surface Study Candidates

Sensorimotor Assessment Pre-EVA:

Cardiovascular monitoring, ultrasound, balance testing, videos of crew, surveys

Manual Control In-Flight Training

Hand controller, sim software, data collection

Artemis Standard Measures (ASSM):

Sleep, movement (actigraphy), individual/team performance, cognitive assessment, surveys

Lunar Descent/Ascent Injury Assessment:

Dynamic loads/accelerometer, videos, survey

Immune Biomarkers:

Dry saliva booklets, dried blood spot cards

Alterations of Multi-Sensory Integration:

Dosimetry, videos

Mars Landing

HRP Publications Annual Report

- 233 research papers published during FY 2023
- Encompasses research of more than 400 scientists from 18 countries.

To guide you:

- Word clouds identify themes on research topics, publication journals.
- “Map of Science” shows the integrated nature of HRP work
- Eigenfactor now used to document impact

~4,700 HRP research publications from 2006-2023

- January 28-31, 2025
- Galveston, Texas
- Hybrid Meeting
- Registration Required, no fee

Link: https://www.nasa.gov/hrp-iws-2025/

Conclusions

- NASA’s Human Research Program is dedicated to discovering the methods and technologies to support safe, productive human spaceflight.

- By conducting human research on the early lunar surface crews, results will help inform the missions of tomorrow.

Recommended reading and additional resources

- **Moon2Mars Human Health white paper**
  - https://www.nasa.gov/wp-content/uploads/2024/01/human-health-and-performance.pdf
- **NASA Office of the Chief Health and Medical Officer (OCHMO) Technical Briefs**
  - https://www.nasa.gov/ochmo/health-operations-and-oversight/hsa-standards/ochmo-technical-briefs/
- **Human research roadmap websites (evidence, risks, gaps, risk approach plans)**
  - https://humanresearchroadmap.nasa.gov/
- **HRP Evidence reports**
  - https://humanresearchroadmap.nasa.gov/Evidence/
- **My email**
  - steven.platts-1@nasa.gov

QUESTIONS?

www.nasa.gov/hrp


ARTEMIS I
ARTEMIS

ARTEMIS II

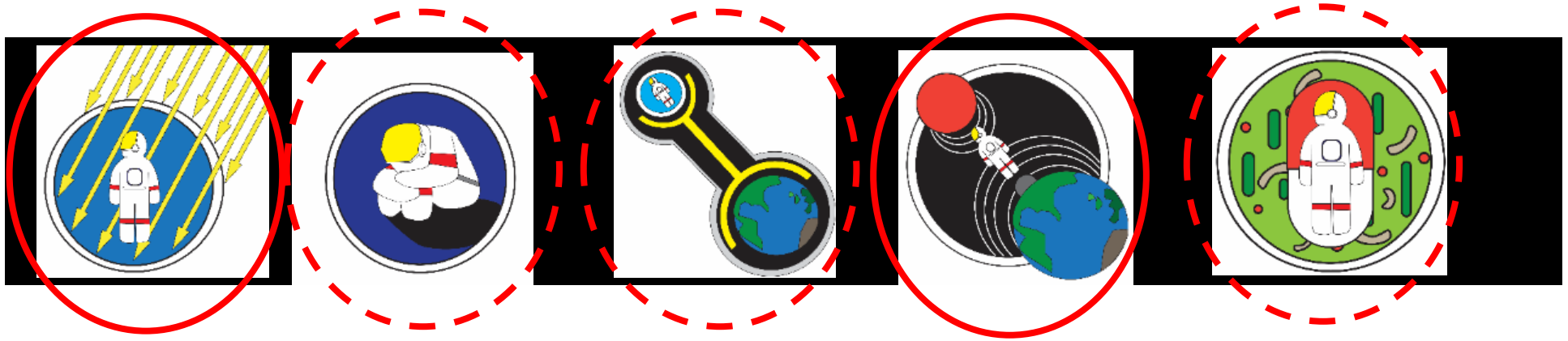

ARTEMIS III
ARTEMIS

FIRST VERSION OF ALL SLIDES

HRP HERO Solicitations

- Flagship
- Omnibus
  - New Investigator
  - Early career
- TRISH
- EPSCoR
- MUREP
- SBIR
- Joint activities with BPS

Why Artemis?



HRP enabling Artemis missions

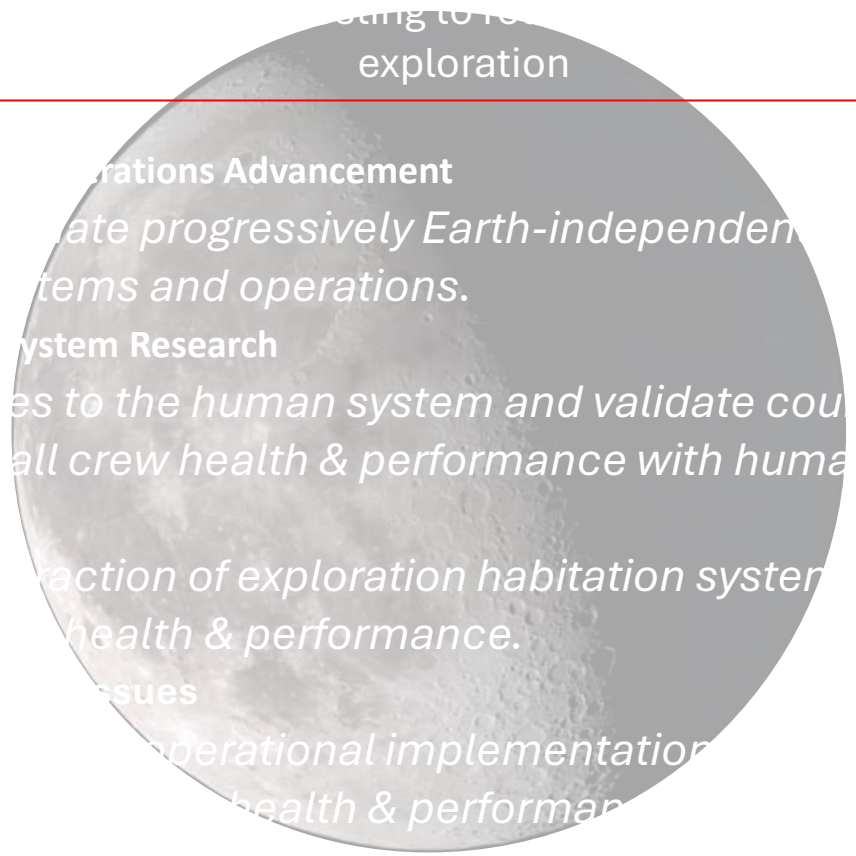
HRP solving problems for today's vehicle Programs.

HRP enabling Artemis missions

HRP solving problems for today's vehicle Programs.

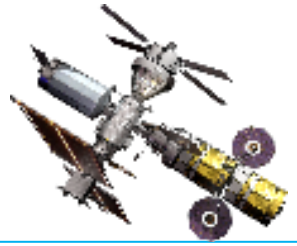
HRP Goal & Objectives for Artemis

exploration



Artemis Utilization Planning

HRP Leading International complement planning for Human Life Sciences



HRP Goals & Objectives

Advance knowledge to support safe, productive human space travel, and perform systems testing to reduce risks for future human exploration

ation Medical Operations Advancement

te and validate progressively Earth-independent crew health & performance s and operations.

ated Human System Research

te changes to the human system and validate countermeasures to mitigate ts to overall crew health & performance with human subject research.

Environment

te the interaction of exploration habitation systems and spaceflight hazards lidate crew health & performance.

l Task-Related Issues

te and validate operational implementation of critical tasks and human for adequate crew health & performance.

ded Mission Durations

ew health & performance with the hazard environments, mission durations, stems representative of Mars-class missions.