

AM IX - WORKING AGENDA June 14-16, 2022 at GWU

1. Day 1: June 14

Morning: 9:00 am – 1:00 pm EDT

- Introduction to the Workshop Goals and Topics, and Keynote Presentations on Human Health (**Lindner Common Rm 602**)
- **Session 1** – Human health and performance – Part 1 (**Lindner Common Rm 602**)

<https://us02web.zoom.us/j/83349044659?pwd=Q1hqWFY3ZTdsc0l1eUpvOCtZN2pXQT09>

- **Session 2** – Priority Science Objectives for Human Missions Part 1 (**Rm 505**)

<https://us02web.zoom.us/j/87303448601?pwd=UEU5RGtsbW9ORnJ1NUluemUvSkpLUT09>

Afternoon: 2:00 pm – 5:00 pm

- **Session 3** – Human health and performance – Part 2 (**Lindner Common Rm 602**)

<https://us02web.zoom.us/j/83349044659?pwd=Q1hqWFY3ZTdsc0l1eUpvOCtZN2pXQT09>

- **Session 4** – Mars Surface Operations and Mobility (**Rm 505**)

<https://us02web.zoom.us/j/87303448601?pwd=UEU5RGtsbW9ORnJ1NUluemUvSkpLUT09>

- EOD – Report out in Plenary (**Lindner Common Rm 602**)

<https://us02web.zoom.us/j/83349044659?pwd=Q1hqWFY3ZTdsc0l1eUpvOCtZN2pXQT09>

2. Day 2: June 15

Morning: 9:00 am – 12:30 pm EDT

- **Session 5** – Priority Science Objectives for Human Missions – Part 2 (**Lindner Common Rm 602**)

<https://us02web.zoom.us/j/89253708086?pwd=WUthdDRDQzRnNjgrSms3S09kQ2dOdz09>

- **Session 6** – Operations and Technologies for Transit to and From Mars (**Rm 505**)

<https://us02web.zoom.us/j/87194853270?pwd=RGxyT1pMWHNJZVRlSEpoOFJaZ29yZz09>

Afternoon: 1:30 pm – 5:00 pm

- **Session 7** – Landing site issues; results of Humans on Mars workshop; synopsis of session discussions ([Lindner Common Rm 602](#))

<https://us02web.zoom.us/j/89253708086?pwd=WUthdDRDQzRnNjgrSms3S09kQ2dOdz09>

- EOD – Report out in Plenary ([Lindner Common Rm 602](#))

<https://us02web.zoom.us/j/89253708086?pwd=WUthdDRDQzRnNjgrSms3S09kQ2dOdz09>

3. Day 3: June 16

Morning: 9:00 am – 12:30 pm EDT

- **Session 8** – Mars Architecture Planning ([Lindner Common Rm 602](#))

<https://us02web.zoom.us/j/81302147410?pwd=QkcyY0xOTUsyNzJCOVd6dldWd093UT09>

Afternoon: 1:30 pm – 3:00 pm

- Group wrap up ([Lindner Common Rm 602](#))

<https://us02web.zoom.us/j/81302147410?pwd=QkcyY0xOTUsyNzJCOVd6dldWd093UT09>

DAY 1: JUNE 14: MORNING ([Lindner Common Rm 602](#))

Time	Topic	Duration	Speaker	Details
8:30 AM	Coffee and catchup	30 mins.	All	So that we can start on time and people still have time to socialize/network a bit.

PLENARY SESSION – INTRODUCTION TO WORKSHOP GOALS AND TOPICS, AND KEYNOTE HUMAN HEALTH PRESENTATIONS

Lisa May, Steve Mackwell, Rick Zucker (co-Chairs) (*Lindner Common Rm 602*)

Time	Topic	Duration	Speaker	Details
9:00 AM	Welcome	5 min.	Chris Carberry	Welcome and Logistics
9:05 AM	Overview	20 mins.	Lisa or Steve	Introduction to Workshop Goals, Topics and Deliverables
9:25 AM	Human Health: Physical Overview	15 min	Torin McCoy Jancy McPhee	<p>What are the medical challenges posed across the missions such as the different gravity and radiation environments as well as length of mission?</p> <p>What are we doing to mitigate them?</p> <p>What are the priority human physiology science questions that we might address on human Mars missions?</p>
9:40 AM	Human Health: Psychology Overview	15 min	Sandra Whitmire (Virtual)	<p>What are the challenges for human psychological wellbeing on Missions to Mars?</p> <p>What are we doing to mitigate them?</p> <p>What are the priority human psychology science questions that we might address on human Mars missions?</p>
9:55 AM	Q&A / Discussion	15 min	All	

Session 1: Human Health and Performance – Part 1 (*Lindner Common Rm 602*)

Belinda Lopez and Lashawn Boulware (co-Chairs)

Time	Topic	Duration	Speaker	Details
10:15 AM	<p>Goals & Deliverables; Framework for discussion:</p> <p>Risk Reduction</p> <ul style="list-style-type: none"> · Timeline · What we need to start now · Crew Selection/ Requirements – including commercial crews · Crew Roles & Assignments – now through Crew 1 <p>How it affects mission design & hardware architecture</p>	15 min	Belinda Lopez	<p>The framework will set the stage for all other sessions. We can develop a scoring/rating criteria to use to help guide this. Overall goal is risk reduction/safety for a human crew.</p>
10:30 AM	Brain/Bio Break	20 min	All	
10:50 AM	<ul style="list-style-type: none"> · Cadre & Crew Selection/Requirements/ Quantity · Epigenomics · Psychological <p>OIG says not enough astronauts!</p>	20 min	<p>Lauren Landon (virtual)</p>	<ul style="list-style-type: none"> ● What is the minimum acceptable Crew compliment? (Too few and mission could be compromised by health/other issues. Too many and logistics get larger.) ● What size Cadre will be needed to fully support each mission? ● What requirements/ pre-requisites will be different for Mars Crews than Artemis & ISS? ● Skillsets

11:10 AM	Q&A and Discussion	30 min	All	
11:40 AM	Isolation & Confinement, Closed Environments & Distance from Earth	20 min	Bailey Burns (virtual)	<ul style="list-style-type: none"> Habitat design considerations for health and mental wellness Nutrition – food growing
12:00 PM	Q&A and Discussion	30 min	All	
12:30 PM	Lunch	60 min		

Session 2: Science Priorities at Mars – Part 1 (Rm 505)

Bob Collom, Clive Neal, and Rick Davis (co-Chairs)

Time	Topic	Duration	Speaker	Details
10:15 AM	Goals & Deliverables	10 min	Rick Davis	<p>Identification of the goals and deliverables for Science Priorities</p> <ol style="list-style-type: none"> What do human explorers with robots bring in terms of enabling science (e.g., real-time decision making, more power, heavier equipment etc.)? What are the preliminary, priority science objectives enabled by humans on the surface of Mars, in transit, and in orbit? What precursor information do you need from the Martian system prior to humans going to Mars? Does your priority science require equipment on the Mars Transfer Vehicle?

				5. What are the synergies with Lunar exploration?
10:25 AM	HSO-SAG Summary	10 min	Dave Beaty (virtual)	Inputs into the science questions introduced above
10:35 AM	AM 8 Input	10 min	Rick Davis	
10:45 AM	Science Objectives for Human Exploration of Mars Workshop	10 min	Paul Niles (virtual)	
10:55 AM	Planetary Science and Astrobiology Decadal Survey 2023-2032	10 min	Jen Heldman (virtual)	
11:05 AM	MEPAG: Science Priorities for Humans	10 min	Tbd	
11:15 AM	Synthesis	20 min	All	Discussion / Q&A
11:35 AM	Break	10 min	All	
11:45 AM	Climatology Overview	10 min	Tbd	Main Questions above, plus How can we best research the contents of subsurface ice and its ephemeral properties?
11:55 AM	Q&A / Discussion	15 min	All	

12:10 PM	Astrobiology Overview	10 min	Chris McKay (virtual)	How can we apply lessons learned from analog Earth Surface and in-Space environments to Martian exploration? <ul style="list-style-type: none"> • Antarctic • ISS • Gateway • Lunar Surface
12:20 PM	Q&A / Discussion	15 min	All	
12:35 PM	Geology Overview	10 min	Dave Beaty (virtual)	Main Questions above, plus How can we best research the contents of subsurface ice and its ephemeral properties?
12:45 PM	Q&A / Discussion	15 min	All	
1:00 PM	Lunch	60 min	All	

DAY 1: JUNE 14: AFTERNOON

Session 3: Human Health and Performance - Part 2 (*Lindner Common Rm 602*)

Belinda Lopez and Lashawn Boulware (co-Chairs)

Time	Topic	Duration	Speaker	Details
2:00 PM	Space Radiation	20 min	Lisa Simonsen	<ul style="list-style-type: none"> • Current radiation protection requirements and the various options for mitigation • Mitigation strategies: habitat/cabin design, suits, medical/pharmaceutical

2:20 PM	Q&A and Discussion	30 min	All	
2:50 PM	Hostile Environment and Gravity Effects	20 min	Marissa Rosenberg	<ul style="list-style-type: none"> Assessing ISS astronauts immediately after they land back on Earth as an analog for how crews on Mars will perform just after landing.
3:10 PM	Q&A and Discussion	30 min	All	
3:40 PM	Analogues for Mars mission – ISS-Earth surface and Gateway-Lunar surface	30 min	Erin Bonilla	<ul style="list-style-type: none"> Earth – ISS – Earth Gateway – Lunar Surface – Gateway Issues of cost / time / expected returns on investment- what is needed
4:10 PM	Panel and discussion	20 min	Panel of the speakers	<ul style="list-style-type: none"> What is needed now to prepare for humans to Mars? Can the Moon provide suitable analog activities to reduce risk for humans to Mars?
4:30 PM	Report Out to Plenary	30 min	All	Report out to Plenary

Session 4: Mars Surface Operations and Mobility *(Rm 505)*

Tim Cichan, Clive Neal and Christy Edwards (co-Chairs)

Time	Topic	Duration	Speaker	Details
2:00 PM	Goals & Deliverables	15 min	Tim Cichan Christy Edwards	Identification of the goals and deliverables for Mars Surface Ops and Mobility

2:15 PM	Mobility Technology Q&A	30 min	Sarah Shull Robert Howard (virtual)	Q&A on recorded briefing on Lunar Terrain Vehicle (LTV), pressurized rover, and the Exploration Extravehicular Mobility Unit (xEMU) EVA suit.
2:45 PM	Science Enabled by Mobility	30 min	Tim Cichan	Out-brief of key findings from the Lunar Surface Science Workshop on Mobility and Science Objectives for Human Exploration of Mars Workshop
3:15 PM	How does mobility enable surface operations?	45 min	All	<ul style="list-style-type: none"> ● Given orbital robotic reconnaissance, is surface robotic reconnaissance required before humans? ● Should only robotic assets be used to explore sensitive/extreme environments (teleoperations; ice sampling)? ● What capabilities do crewed rovers require? ● How can unpressurized and pressurized operations work together? ● Can certain rover capabilities replace some of the need for EVA operations? ● How can robotic rovers enhance crewed operations?
4:00 PM	How do the plans for Artemis surface operations feed forward to Mars?	20 min	All	<ul style="list-style-type: none"> ● Can systems be identical for the Moon and Mars, and if not, why? ● What science objectives for Mars that drive mobility requirements are unique? ● What key operations should be practiced on the Moon?

4:20 PM	Discussion - Summary and Report-Out Prep.	10 min	All	<ul style="list-style-type: none"> Key findings for the two main questions from the group discussions
4:30 PM	Report Out to Plenary	30 min	All	Report out to Plenary

DAY 2: JUNE 15: MORNING

Time	Topic	Duration	Speaker	Details
8:30 AM	Coffee and catchup	30 min	All	

Session 5: Science Priorities at Mars – Part 2 *(Lindner Common Rm 602)*

Clive Neal, Bob Collom and Rick Davis (co-Chairs)

Time	Topic	Duration	Speaker	Details
9:00 AM	Science of Humans during Missions	15 min	Torin McCoy Jancy McPhee	<p>Identification of the goals and deliverables for Science Priorities (continued)</p> <ol style="list-style-type: none"> 1. What do human explorers with robots bring in terms of enabling science (e.g., real-time decision making, more power, heavier equipment etc.)? 2. What are the preliminary, priority science objectives enabled by humans on the surface of Mars, in transit, and in orbit? 3. What precursor information do you need from the Martian system prior to humans going to Mars?

9:00 AM (cont.)				<ul style="list-style-type: none"> 4. Does your priority science require equipment on the Mars Transfer Vehicle? 5. What are the synergies with Lunar exploration?
9:15 AM	Q&A / Discussion	20 min	All	
9:35 AM	Biological & Physical Science Overview	15 min	Kevin Sato (virtual)	<p>Main Questions above, plus</p> <ul style="list-style-type: none"> • How do different space/Mars environments affect: <ul style="list-style-type: none"> ○ plant biology, ○ microbial organisms/research?
9:50 AM	Q&A / Discussion	20 min	All	
10:10 AM	Break	10 min	All	
10:20 AM	Synthesis: By Discipline	40 min	All	<ul style="list-style-type: none"> • What are the prioritized objectives within each discipline?
11:00 AM	Synthesis: Across Disciplines	40 min	All	<ul style="list-style-type: none"> • What are the prioritized objectives within each discipline?
11:40 AM	Break	10 min	All	
11:50 AM	Surface Science Objectives and Priorities	45 min	All	<ul style="list-style-type: none"> • How do the above prioritized objectives inform the architecture of the first missions? • What other conclusions can be drawn?
12:30 PM	Lunch	60 min	All	

Session 6: Operations and Technologies for Transit to and From Mars (pm) (Rm 505)

Mike Fuller and Joe Cassady (co-chairs)

Time	Topic	Duration	Speaker	Details
9:00 AM	Tech/Ops In transit	15 min	Joe Cassady Mike Fuller	<ul style="list-style-type: none"> • Introduction • Identification of goals and deliverables for session
9:15 AM	“Green Wall” discussion	30 min	Bill O’Hara	<ul style="list-style-type: none"> • Plant growth for food and oxygen
9:45 AM	Training environment/ Entertainment	30 min	Erin Bonilla	<ul style="list-style-type: none"> • Drills, practicing for emergencies, etc. • Crew morale
10:15 AM	Open discussion	20 min	All	
10:35 AM	Ops In transit outbound	30 min		<ul style="list-style-type: none"> • Remote Earth-Moon system Ops • “Long baseline” observations (solar/stellar/etc) • Science goals • Phobos/Deimos observations • MOI Prep (Orbital/Landing)
11:05 AM	Discussion	30 min	All	
11:35 AM	Ops In transit Inbound	30 min		<ul style="list-style-type: none"> • Transit vehicle checkout/TEI prep • Preliminary Sample evaluation • Science goals • “Long baseline” observations (solar/stellar/etc.) • EOI Prep
12:05 PM	Discussion	25 min	All	
12:30 PM	Lunch	60 min	All	

DAY 2: JUNE 15: AFTERNOON

Session 7: – Landing site issues; results of Humans on Mars workshop; synopsis of session discussions (*Lindner Common Rm 602*)

Lisa May, Steve Mackwell and Rick Zucker (Workshop Co-chairs)

Time	Topic	Duration	Speaker	Details
1:30 PM	Water Mapping	15 min	Sydney Do	Overview of Ongoing Water Mapping Efforts at Mars
1:45 PM	Planetary Protection Considerations	15 min	Andy Spry	Overview of planetary protection considerations for human missions
2:00 PM	I-MIM Measurements Definition Team Report	15 min	tbd	Key measurements needed to inform landing site selection
2:15 PM	Discussion	15 min	All	On Landing Site Selection Considerations
2:30 PM	Synopsis	15 min	Belinda Lopez	Human Health and Performance synopsis – challenges and opportunities
2:45 PM	Synopsis	15 min	Bob Collom Rick Davis	Science Priorities at Mars synopsis – challenges and opportunities
3:00 PM	Discussion	30 min	All	
3:30 PM	Break	15 min		
3:45 PM	Synopsis	15 min	Tim Cichan Christy Edwards	Mars Surface Operations and Mobility synopsis – challenges and opportunities

4:00 PM	Synopsis	15 min	Mike Fuller Joe Cassady	Operations and Technologies for Transit to and from Mars synopsis – challenges and opportunities
4:15 PM	Discussion	45 min	All	

DAY 3: JUNE 16: MORNING *(Lindner Common Rm 602)*

Time	Topic	Duration	Speaker	Details
8:00 AM	Coffee & Catchup	30 min	All	

Session 8: Mars Architectures (am – also into early pm)

Scott Hubbard and Hoppy Price (co-Chairs)

Time	Topic	Duration	Speaker	Details
8:30 AM	Session Overview	15 min	Hubbard	Identification of the goals and objectives of the Architecture Session.
8:45 AM	<i>Near-Term Minimal Architecture with 2033 Orbital Mission</i>	20 min	Hoppy Price	A concept has been studied to perform a crewed Mars orbit-only mission with a 570-day total trip time taking advantage of the unique opportunity in 2033. The architecture avoids the risks cited by the 2019 STPI assessment by utilizing conventional space-storable chemical propulsion in addition to Orion and a Mars Transit Habitat (MTH). Follow-on missions are described for a short-stay landing and subsequent long-stay landing missions. New capabilities such as nuclear propulsion, reusable systems, and ISRU would be on-ramped when available.
9:05 AM	Q&A of clarification	5 min	All	

9:10 AM	<i>New Nuclear Thermal Propulsion Configuration for Mars Base Camp</i>	20 min	Tim Cichan	<p>In 2016, Lockheed Martin presented a vision for achieving crewed exploration of Martian space. Known as Mars Base Camp, this design reference mission envisioned a crewed vehicle in Martian orbit from which astronauts could perform excursions to Phobos and Deimos and could also perform telerobotic exploration of the Martian surface, including sample return. This presentation presents an update to the Mars Base Camp concept that builds on the capabilities that will be developed and demonstrated through Artemis missions. It presents the trades that led to this update in Mars Base Camp design, including the benefits and limitations of conjunction versus opposition class missions. Additionally, the presentation discusses the trade of implementing chemical, nuclear thermal, or nuclear electric propulsion.</p>
9:30 AM	Q&A of clarification	5 min	All	

9:35 AM	<i>Start-up to Steady State: Aerojet Rocketdyne Architecture Thoughts on Early Human Mars Missions</i>	20 min	Joe Cassady	Aerojet Rocketdyne (AR) has been examining various options for missions in the late 2020s and 2030s that would culminate in a campaign of missions to establish a sustainable human presence on Mars. This is based on NASA plans for Artemis and tries to reflect how the technology development activities related to Artemis and NASA's plans for lunar exploration can be used to best prepare for Mars. As a result of this internal architecture work, together with some sponsored technology programs in Space Nuclear propulsion, AR has synthesized a plan we call "Start-up to Steady State" which uses a variety of mission classes and opportunities starting in the late 2020s to buy down risk and advance understanding of the propulsion and transit related aspects of human Mars missions. Our approach is a "walk-before-you-run" path, not content to wait until all new developments are completed before even attempting a human mission to Mars. The following chart package summarizes the Start-up to Steady State approach.
9:55 AM	Q&A of clarification	5 min	All	
10:00 AM	<i>Starship Crewed Mars Mission Architecture</i>	20 min	Nick Cummings (virtual) Caitlin Smith	SpaceX is developing the fully reusable Starship launch and planetary landing system to enable a large and sustained human presence on Mars. [TBD] will provide a brief overview of the architecture.
10:20 AM	Q&A of clarification	5 min	All	

10:25 AM	Break	15 min	All	
10:40 AM	Questions and comments for each Theme lead	40 min		Assume 10 mins from each
11:10 AM	Open discussion / synthesis	60 min	All	Commonalities / key questions / smart investments?
12:00 PM	Summary Findings	15 mins	Scott Hubbard	
12:15 PM	Lunch	45 min	All	

DAY 3: JUNE 16: AFTERNOON *(Lindner Common Rm 602)*

Summary of key themes, take-aways, and next steps (afternoon)

Lisa May, Steve Mackwell, Rick Zucker (co-Chairs)

Time	Topic	Duration	Speaker	Details
1:00 PM	Summary of meeting; collection of key issues	40 min	Co-chairs	Pulling the key issues from the sessions
1:40 PM	Science wrap-up – tied to deliverables	30 min	All interested	Flesh out the science for the report
2:10 PM	Planning for report and other products; assignment of roles	50 min	All interested	