

**INTEGRATING SCIENCE, TECHNOLOGY AND OTHER CONSIDERATIONS INTO PLANETARY PROTECTION REQUIREMENTS FOR HUMAN MISSIONS.** M. S. Race<sup>1</sup>, J.A. Spry<sup>1</sup>, C.A. Conley<sup>2</sup> and B. Siegel<sup>3</sup>. <sup>1</sup>SETI Institute, 189 Bernardo Ave, Mountain View CA 94043, ([mrace@seti.org](mailto:mrace@seti.org); [aspry@seti.org](mailto:aspry@seti.org)), <sup>2</sup>NASA Planetary Protection Office, Washington D.C. ([Cassie.Conley@nasa.gov](mailto:Cassie.Conley@nasa.gov)) and <sup>3</sup>NASA HEOMD, Washington D.C. ([bette.siegel@nasa.gov](mailto:bette.siegel@nasa.gov))

While planetary protection requirements are in place for robotic missions to the Moon, Mars and other celestial bodies, the international policy for human missions to Mars includes only qualitative principles and guidelines set by the Committee on Space Research (COSPAR) almost a decade ago. After considerable deliberation, NASA outlined a Policy Instruction on Planetary Protection Requirements for Human Extraterrestrial Missions (NPI 8020.7) that outlined a path forward for translating COSPAR's Principles and Guidelines into detailed requirements drawn from built input from assorted scientific and technical communities. This NPI process has already begun to make incremental progress by identifying important astrobiological research and technology development areas that will be needed to address cross-contamination concerns; ensure effective sample handling, testing and containment procedures; and consider other critical round-trip human mission concerns in the coming decades.

Over the past two years, both NASA and COSPAR have convened separate workshops to identify the specific knowledge gaps that must be addressed in order to make progress in formulating more detailed Planetary Protection policy and requirements for human missions. Both workshops included a diverse mix of participants from science, engineering, technology, and policy areas who discussed issues in a combination of plenary sessions and subgroup deliberations. This presentation will summarize the findings of the two planetary protection workshops as well as briefly reviews other potential societal questions that have been raised about round trip human missions

*NASA Workshop on Planetary Protection Knowledge Gaps for Human Extraterrestrial Missions [1].* This 2015 workshop began with examination of the COSPAR principles and guidelines and aimed to identify the current state of knowledge in planetary protection and human mission systems; develop a prioritized list of studies needed to inform requirements; and identify future Research and Technology Development (R&TD) studies that will iteratively lead to development of draft requirements. Deliberations centered on three key study areas of importance for integrating planetary protection concerns into mission plans: 1) Microbial and Human Health Monitoring, 2) Technology and Operations for Contamination Con-

trol, and 3) Natural Transport of Contamination on Mars

The NASA Workshop identified 25 key R&TD gaps in the three areas, highlighting research needed to appropriately inform planetary protection requirements development for the future human exploration of Mars. Additionally, each sub-group indicated how their knowledge gaps related to current COSPAR Implementation Guidelines.

*COSPAR Workshop on Refining Planetary Protection Requirements for Human Missions [2].* The subsequent COSPAR international workshop, which built upon the NASA workshop findings, began by asking whether other R&TD gaps should be added to the list. Participants were then asked to rank the identified gaps in priority order, assess where and how the research and technology work might be done, and consider research sequencing and test-bed opportunities, including Earth analogue or simulation research, and experiments or data collection on ISS, the moon, asteroids, or future Mars robotic missions.

The information from these workshops is relevant to diverse science disciplines, particularly those whose research input is needed for future success of human missions, regardless whether the mission aim is to search for evidence of life on other celestial bodies or establish space-based infrastructure that will support astrobiology sciences. As astrobiologists engage in their respective research areas, they should be mindful of ways that their research may contribute towards addressing planetary protection R&TD gaps identified by these recent workshops.

#### References:

- [1] Race, M.S. et al. 2016. NASA Workshop on Planetary Protection Knowledge Gaps for Human Extraterrestrial Missions. <http://hdl.handle.net/2060/20160012793>
- [2] Kminek, G., C.A. Conley et al. 2017. COSPAR Workshop on Refining Planetary Protection Requirements for Human Missions. *In preparation.*