MARS SAMPLE RETURN FEEDFORWARD OF POTENTIAL PLANETARY PROTECTION TECHNOLOGY/KNOWLEDGE TO HUMAN EXPLORATION. L. E. Hays[1], D. W. Beaty[1], and M. A. Jones[2]. [1]Mars Program Office, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109 (lindsay.e.hays@jpl.nasa.gov), [2]Biotechnology and Planetary Protection Group, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109.

Introduction: At our current vantage point, two major potential enterprises lie in the future: Mars sample return (MSR), and human exploration of Mars. Although many significant planetary protection-related knowledge gaps are associated with the latter, there is significant overlap in the type of research that would help address current planetary protection knowledge gaps for both lines of discovery. It is therefore important that these overlaps are identified early, so that information that addresses these knowledge gaps is shared in order to minimize duplicating effort and maximize achievement of common goals. In these areas, the expected accomplishments of potential sample return would not need to be separately planned and budgeted for in association with a human mission. In this paper, we plan to introduce for discussion two topics where information from MSR could clearly feed forward into human extraterrestrial missions, and one topic where the path to sharing information is less clear (and perhaps not possible).

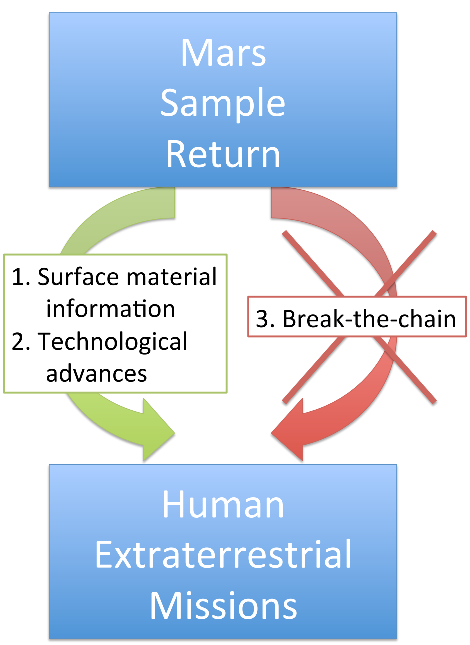

Figure 1. General overview of the feed forward of knowledge from Mars sample return to human extraterrestrial missions.

Areas of Overlap: There are at least two general aspects of planetary protection planning and implementation strategy related to the multiple possible missions of the MSR campaign that would benefit human exploration:

1. Detailed analysis of martian surface materials.
2. Technological advances in cleaning and contamination control.

Martian surface material analysis: The primary planetary protection question that could be addressed by potential MSR analyses would be results of investigation into the potential for past or present life on Mars. In addition, returned samples could also provide detailed information about the physical, chemical, and electrical properties of the martian regolith – strategic knowledge gaps which were acknowledged in the 2012 P-SAG final report [1]. In that report, knowledge gaps were considered with respect to the direct effects on astronauts for a human mission. However, they are also relevant specifically to planetary protection in that they provide the detailed information needed to make specifications for meeting requirements pertaining to cleaning, sterilizing and preventing re-contamination in surface habitat environments.

Questions addressed: If no martian life is detected in returned samples, but human extraterrestrial missions explore a different location on Mars, what environmental information from returned samples could be useful to minimizing human impacts in the explored location? How can information about returned martian regolith be used to study the effect of dust on seals designed to minimize contamination?

Technological advances: The second area of overlap between MSR and human extraterrestrial missions would be in the technological advances developed for controlled recovery and analysis of the returned martian samples. These technical advances could then be used for developing in-situ cleaning and sterilization protocols for nominal surface operations of a human mission, or for back up clean-up protocols in the event of an inadvertent release of terrestrial material, among other applications. If considerations for the type of developments needed for human exploration were outlined within the MSR timeline, these technological developments could be broadened to meet both needs.

Questions addressed: How can methods designed for and tested on returned samples be used to design effective cleaning methods for nominal operations during human exploration? How can studies into clean-up of the location where the potential returned sample container would impact Earth's surface, combined with information about physical properties of returned martian regolith, be used to design environmental clean-up protocols for Mars surface operations?

In addition to feeding into general operations of any future human extraterrestrial missions, information from Mars sample return could also inform decisions that were made as to the type of science investigations that future astronauts could perform without risk of contamination of the martian surface or risk to themselves.

Break-the-chain: Although breaking the chain of contact with Mars for sample return is a familiar, though complicated, problem, for human exploration of Mars there may conceivably be no way to break the chain of contact if an astronaut becomes part of the "chain." Although Mars sample return technologies can help minimize the chances that this scenario would occur, if it did, the type of break-the-chain architecture developed for MSR may not be applicable to human missions.

Questions addressed: Is perfect separation between the martian surface environment and human surface habitats possible? Are there break-the-chain options that exist or could be explored for human exploration?

Conclusions: Although there are certainly areas of overlap between Mars sample return and human extraterrestrial missions where data addressing knowledge gaps from the former could be fed forward into similar knowledge gaps in the later, many of these focus on human health factors and questions of design of surface habitats and mobility systems. When considering the overlaps that are of concern to planetary protection, although there are fewer, some of the remaining questions can only be answered by sample return. Although feed-forward of information from Mars sample return could be of significant value to human exploration, in order to most efficiently use the very valuable resource of returned samples, the planetary protection investigations undertaken must be carefully planned well in advance.

References: [1] Beaty D. W. and Carr M. H. (2012)*, posted at http://mepag.jpl.nasa.gov/reports/*.