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Executive Summary

Date Prepared:	10-19-2009
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Presentation Title

Lunar sample requirements for biology; plant responses to lunar regolith in support of human missions and as a measure of lunar biological responses.

Key Ideas

Science on the moon - extraterrestrial biology
In situ resource utilization – lunar regolith as a plant growth substrate
What do we need to know before we go?

Supporting Information

Recent plans for human return to the Moon have significantly elevated scientific interest in the lunar environment with emphases on the science to be done in preparation for the return and the science to be done while on the lunar surface. Since the return to the Moon is envisioned as a dedicated and potentially longer term commitment to lunar exploration, questions of the lunar environment and particularly its impact on biology and biological systems have become a significant part of the lunar science discussion.

Plants are integral to the discussion of biology on the Moon. Plants are envisioned as important components of advanced habitats and fundamental components of advanced life support systems. Moreover, plants are sophisticated multicellular eukaryotic life forms with highly orchestrated developmental processes, well characterized signal transduction pathways and exceedingly fine tuned responses to their environments. Therefore plants represent key test organisms for understanding the biological impact of the lunar environment on terrestrial life forms. Indeed, plants were among the initial and primary organisms that were exposed to returned lunar regolith from the Apollo lunar missions, as represented by a large body of literature by Charles Walkinshaw and colleagues in the early 1970's. In these studies plants were *exposed* to a variety of lunar materials while growing in terrestrial substrates, a setup designed to maximize information on biotoxicity but a setup that does not address biological reactions to lunar regolith. Contemporary tools can significantly expand on the amount of information that can be collected on the biological impact of lunar materials on terrestrial biology. The sophisticated genomics, proteomics and metabolomics tools of the modern molecular era that were not available during the initial biological experiments of the Apollo era can now be applied to a robust characterization of plant responses to lunar regolith, which would inform the approaches we take for in situ resource utilization for lunar sortie and outpost missions. Further, the development of small model systems, such as the plant *Arabidopsis thaliana*, enables the use of undiluted materials that would better mimic true in situ utilization parameters.