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Life and Microgravity Sciences on board ISS and beyond (Part II) (7)

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EVALUATING THE MICROBIAL ENVIRONMENT ABOARD ISS TO ENABLE AN OPTIMIZED MICROBIOME FOR DEEP SPACE HUMAN EXPLORATION

Abstract

The recent advent of high-throughput DNA sequencing technologies has allowed for unprecedented insight into various "microbiomes," including those on occupied spacecraft. However, no standards currently exist to characterize a "healthy" or "unhealthy" microbial community in this environment. This paper presents the results of ongoing efforts to characterize and identify microbial communities and functions in dust found aboard the International Space Station. We utilize chamber studies to consider the impact of moisture on population dynamics that could occur in long-duration spaceflight. We utilize -omics-enable approaches to measure microbial communities and plan to characterize these communities under different environmental conditions. In addition to the biological information derived, we also elucidate valuable engineering-design information which can lead to the future development of microbial standards for spacecraft, to avoid microbial-induced hardware corrosion such as was seen on the space station MIR. In addition to mitigating exposure to unhealthy organisms, this knowledge will lead to the determination of criteria for curating a healthy spacecraft microbiome in future long-duration human spaceflight, which may be more sustainable than relying on sterilization to avoid pathogens or other unwanted microbes. In this regard it is planned to develop an automated system to vary different environmental parameters

without human access, in order to observe the organisms' reactions in these studies. Eventually, operating as a long-term, completely automated *"Microbial Observatory"*, these results will provide a long-baseline approach to learning how these microbial communities in low-gravity, higher radiation, and closed-loop environments may influence crew health, with applicability to terrestrial environments such as submarines, aircraft, and ships. Finally, we assess how to develop improved microbial clearance protocols that are more relevant to astronaut health, planetary protection, and spacecraft integrity.