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MICROBIOME CHAMBER DEVELOPMENT FOR GROUND-BASED MARTIAN EVOLUTIONARY STUDIES

Abstract

When Charles Darwin stated "It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptive to change", it was probably without the insight about spacefaring humanity in the upcoming millennia. As the slow but sure process evolution is, understanding its due course on humanity is vital to call the highly anticipated Martian colonization of this Millenium a success. Yet, with the accelerated developments, time is of the essence and a method to anticipate and navigate through beneficial and maleficent evolutionary trends judiciously is a paramount need. Unlike humans, microbes have rapid life cycles and due to their primitive features, are easier to study in terms of genome sequence and variations in the ATGC/AUGC base-pair changes due to evolution driven by environmental conditions. A digital study in combination with a controlled experimental setup is needed to validate the discoveries acquired. This student-authored work proposes a miniaturized control environment to simulate Martian conditions for bacteria samples to study their genome sequences and hence evolutionary trends. The work encompasses studies and design of the environment and life control system, electromechanical structures, radiation and thermoregulation features, atmospheric, water, and soil composition control mechanisms, to enlist a few. The system-level design and analysis were performed iteratively to obtain a configuration feasible to manufacture and validate on software such as COMSOL Multiphysics, LAMMPS, and SIMULOME. This will be a precursor to a variety of experimentation and an entire field in itself for advancing pursuits in Martian Astrobiology and Astronaut Support Technologies, especially in low cost and across the world.