The Importance of Conducting Life Sciences Experiments on the Deep Space Gateway Platform. S. Bhattacharya. NASA Ames Research Center, Moffett Field, CA (sharmila.bhattacharya@nasa.gov).

Introduction: Over the last several decades important information has been gathered by conducting life science experiments on the Space Shuttle and on the International Space Station. It is now time to leverage that scientific knowledge, as well as aspects of the hardware that have been developed to support the biological model systems, to NASA's next frontier – the Deep Space Gateway.

In order to facilitate long duration deep space exploration for humans, it is critical for NASA to understand the effects of long duration, low dose, deep space radiation on biological systems. While carefully controlled ground experiments on Earth-based radiation facilities have provided valuable preliminary information, we still have a significant knowledge gap on the biological responses of organisms to chronic low doses of the highly ionizing particles encountered beyond low Earth orbit. Furthermore, the combined effects of altered gravity and radiation have the potential to cause greater biological changes than either of these parameters alone. Therefore a thorough investigation of the biological effects of a cis-lunar environment will facilitate long term human exploration of deep space.

Approach: Several pieces of hardware that have been validated in low Earth orbit can be utilized for Deep Space Gateway experiments using relevant genetic model organisms. Some of the critical needs for life sciences experiments include an internal centrifuge in order to differentiate the effects of radiation and other spaceflight factors from that of microgravity. Similarly the availability of life support systems within the Deep Space Gateway will allow environmental conditions to be maintained in habitats for supporting life sciences samples. In some cases, unpowered/ambient habitats could be utilized to maintain multigenerational populations of small model organisms, with sample return or sample fixation to facilitate post-flight analyses. In the case of powered habitats, automated features such as videography/imaging, food-changeout etc. will allow for more complex experiments to be handled with little or no crew intervention. Currently available hardware options can be utilized to further science goals and enable the efficient ulilization of the Deep Space Gateway platform. Such hardware options and potential scientific benefits will be discussed.

Resource needs: The resource requirements will depend on the hardware used. For example with some of the powered and automated hardware options that have an internal centrifuge, the specifications could include a volume of approximately $0.04m^3$, power requirement of ~0.37kw, temperature range accommodation of 14^0 – 40^0C. On the other hand, unpowered ambient payloads could occupy a volume of $0.02m^3$ and require no power and return biological samples for processing on the ground post-flight.

Relevance to NASA: Both the National Academy of Science's Decadal Survey as well as the Space Biology Science plan describe the need for biological studies at the molecular, genomic, genetic, physiological and behavioral levels. The areas of study that are of importance to NASA include immunology, neurobiology, oxidative stress, cardiovascular, radiation biology, microbiology, plant biology, structural biology etc. All of these focus areas can be studied on the Deep Space Gateway using well characterized genetic model organisms and leveraging many of the tools that have been developed previously.