

IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Biology in Space (8)

Author: Dr. Rihana Bokhari
Center for Space Medicine, Baylor College of Medicine, United States

Mr. Jimmy Wu
Baylor College of Medicine, United States
Dr. Dorit Donoviel
Baylor College of Medicine, United States

SCIENCE ENTERPRISE TO INFORM EXPLORATION LIMITS (SENTINEL): THE VALUE OF
TISSUE CHIPS IN SPACEFLIGHT**Abstract**

NASA's Artemis missions will place astronauts in the lunar vicinity where they will experience deep space exposure on par with the Apollo missions, eventually far exceeding the prior experience. The Science ENTERprise to INform Exploration Limits (SENTINEL) initiative is the TRISH effort to build automated microphysiological systems (MPS; also known as 3D tissues, tissue-on-a-chip or organ-on-a chip) that also have in-line sensing capabilities to self-regulate and provide data to the astronaut crew and scientists on the ground thus overcoming the need to return samples to Earth for analysis. These MPS constructs have the potential to address several knowledge gaps in the impacts of the deep space environment. This will greatly improve upon the current primary methods of characterizing space exploration risks that use ground analogs and the International Space Station (ISS) providing limited or incomplete translatability and requiring sample return to Earth.

By using automated and self-reporting MPS, the lunar surface and vicinity can enable critical health and performance studies. These systems can also be built as single organs or as systems of organs allowing for interactions to simulate responses that might occur within the human body in space. Successful research and technology development in this area will improve the capability to test the effects of the realistic, deep space radiation environment on a tissue as well as the impacts of medications or other interventions.

This approach during the Artemis missions and emerging commercial spaceflight opportunities will allow the MPS payloads to experience deep space exposures similar to those anticipated for exploration class missions and return data throughout the deep space exposure. Thus, these MPS would enable researchers to conduct time-course, mechanistic and countermeasure development studies while the MPS remain in space.

TRISH is working to advance these state-of-the-art platform capabilities and move towards autonomous systems. In the future, these tissue chips could be utilized for personalized medicine: with a customized tissue chip of an individual astronaut, sent into deep space before or with an astronaut, thus assisting in the overall assessment of the risks of the space environment on that individual's physiology. The end goal of the SENTINEL initiative is to provide the space life science research community with effective and reliable tools to preserve astronauts' health span and ensure a performance-ready state during and after the mission.

This research is supported by the Translational Research Institute for Space Health (TRISH), funded under NASA Cooperative Agreement NNX16AO69A.