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CASIS and NCATS Announce Five Projects Selected from International Space Station Funding Opportunity Focused on Human Physiology Research

These initial grants are part of a four-year partnership to fund research onboard the International Space Station U.S. National Laboratory

Kennedy Space Center, FL (June 20, 2017) — The Center for the Advancement of Science in Space (CASIS) and the National Center for Advancing Translational Sciences (NCATS), part of the National Institutes of Health (NIH), today announced five grants have been awarded in response to a funding opportunity focused on human physiology and disease onboard the International Space Station (ISS) U.S. National Laboratory. Data from this research — which will feature "tissue chips" (or "organs-on-chips") — will help scientists develop and advance novel technologies to improve human health here on Earth. These initial five projects are part of a four-year collaboration through which NCATS will provide two-years of initial funding of approximately $6 million, to use tissue chip technology for translational research onboard the ISS National Laboratory. Awardees will be eligible for a subsequent two years of funding, pending availability of funds, based upon performance and achieving milestones for each project.

"The opportunity to partner with CASIS to perform tissue chip science on the International Space Station is a remarkable opportunity to understand disease and improve human health," said NCATS Director Christopher P. Austin, M.D. "Physiological functions in the microgravity of the International Space Station will provide insights that will increase translational effectiveness on earth, including identifying novel targets for drug discovery and development."

The NCATS grants will support the following research projects:

Lung Host Defense in Microgravity
George Worthen, M.D. and Dan Huh, M.D, Children's Hospital of Philadelphia *(PA)*
Implementation Partners: Space Technology and Advanced Research Systems *(STaARS) and* SpacePharma Inc

There is a link between infections and the health of our immune system. Infections are commonly reported onboard spacecraft where exposure to microgravity negatively affects immune system function, but the mechanisms responsible are not well understood. The goals of this project are to test engineered microphysiological systems that model the airway and bone marrow; and to combine the models to emulate and understand the integrated immune responses of the human respiratory system in microgravity.

Organs-on-Chips as a Platform for Studying Effects of Microgravity on Human Physiology: Blood-Brain Barrier-Chip in Health and Disease
Christopher Hinojosa, M.S. and Katia Karalis, D.S., M.D, Emulate*, Boston (MA)*
Implementation Partner: SpaceTango

The objective of this project is to validate, optimize and further develop Emulate's proprietary Organs-On-Chips technology platform for experimentation with human cells in space. The intent is to develop an automated platform and software to accelerate experimentation in space that will become available to the broader scientific community for studies in human physiology and disease in space. The scientific findings will provide new advancements for Earth studies in human disease and drug discovery. The Brain-Chip to be studied in microgravity is a prototype for an organ system centrally positioned in homeostasis and thus, involved in the pathogenesis of multiple types of disease including neurodegeneration, traumatic injury, and cancer.

Cartilage-Bone-Synovium Microphysiological System: Musculoskeletal Disease Biology in Space
Alan Grodzinsky, Sc.D., M.S and Murat Cirit, Ph.D., Massachusetts Institute of Technology*, Cambridge (MA)*
Implementation Partner: Techshot

This research focuses on a cartilage-bone-synovium joint tissue chip model to study the effects of space flight on musculoskeletal disease biology, motivated by post-traumatic osteoarthritis and bone loss. The effects of pharmacological agents to ameliorate bone and cartilage degeneration will be tested on earth and in the International Space Station, using a quantitative and high-content experimental and computational approach.

Microgravity as Model for Immunological Senescence and its Impact on Tissue Stem Cells and Regeneration
Sonja Schrepfer, M.D., Ph.D., Tobias Deuse, M.D., and Heath J. Mills, Ph.D., University of California, San Francisco *(CA)*
Implementation Partner: Space Technology Advanced Research Systems (STaARS)

Many space-related physiological changes resemble those observed during cellular aging, including defects in bone healing, loss of cardiovascular and neurological capacity, and altered immune function. This project aims to investigate the relationship between an individual's immune aging and healing outcomes, and to investigate the biology of aging from two directions—not only during its development in microgravity conditions but also during recovery after return to earth's environment**.**

Effects of Microgravity on the Structure and Function of Proximal and Distal Tubule Microphysiological System
Jonathan Himmelfarb, M.D., and Ed Kelly, M.S, Ph.D., University of Washington*, Seattle (WA)*
Implementation Partner: BioServe Space Technologies

When healthy, your two kidneys work together filter about 110 to 140 liters of blood to produce about 1 to 2 liters of urine every day. Dehydration or diseases like diabetes and high blood pressure impair kidney function and result in serious medical conditions including protein in the urine and kidney stones. Like osteoporosis, these conditions are even more common and follow an accelerated time-course in people living in microgravity. This project will send a kidney model to the International Space Station in order to understand how microgravity and other factors affect kidney function, and to use these discoveries to design better treatments for proteinuria, osteoporosis, and kidney stones on earth.

“Our partnership with NCATS builds upon dramatic results fostered by public and private investment in organ-on-chip research and enables these pioneering researchers the opportunity to leverage the ISS National Laboratory to further advance an integral and burgeoning area of medical discovery to improve human health on Earth,” said CASIS Deputy Chief Scientist Dr. Michael Roberts. “Additionally, through these creative and collaborative partnerships with established granting agencies like the NCATS, the ISS National Lab demonstrates that research in microgravity is a viable setting to push beyond the terrestrial limits of scientific discovery and opportunity.”

All grants and subsequent flight opportunities are contingent on final contract agreements between the award recipients, NCATS and CASIS.

For more information on the NCATS Tissue Chip for Drug Screening Program, including Tissue Chips in Space, please visit https://ncats.nih.gov/tissuechip.

To learn more about the on-orbit capabilities of the ISS National Lab, including past research initiatives and available facilities, visit www.spacestationresearch.com.

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About CASIS: The Center for Advancement of Science in Space (CASIS) is the non-profit organization selected to manage the ISS National Laboratory with a focus on enabling a new era of space research to improve life on Earth. In this innovative role, CASIS promotes and brokers a diverse range of research in life sciences, physical sciences, remote sensing, technology development, and education.

Since 2011, the ISS National Lab portfolio has included hundreds of novel research projects spanning multiple scientific disciplines, all with the intention of benefitting life on Earth. Working together with NASA, CASIS aims to advance the nation’s leadership in commercial space, pursue groundbreaking science not possible on Earth, and leverage the space station to inspire the next generation.

About the ISS National Laboratory: In 2005, Congress designated the U.S. portion of the International Space Station as the nation's newest national laboratory to maximize its use for improving life on Earth, promoting collaboration among diverse users, and advancing STEM education. This unique laboratory environment is available for use by other U.S. government agencies and by academic and private institutions, providing access to the permanent microgravity setting, vantage point in low Earth orbit, and varied environments of space.

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