American Society for Gravitational and Space Research



Biological and Physical Sciences Bridging Earth and Space

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## U.S. Leadership in Microgravity and Gravitational Research within Reach

Contrary to popular beliefs, the purpose of space-based research is not only to advance our exploration of space, in fact, space-based research vastly increases our understanding of our environment off-*and*-on planet, the natural processes that occur on Earth, our biology, and more. Using microgravity platforms from suborbital flights to space stations in low Earth orbit, and beyond, we can leverage our national ability to surmount a wide range of complex and difficult biomedical, physical science, and engineering-related challenges. **Strategic, productive, and uninterrupted commitment to research by the U.S. government is critical to exploiting the space environment for advancing U.S. science and innovation agendas.** 

### Importance of Microgravity Research in Biology and Physical Sciences

This basic microgravity research in biology and physical sciences is the pipeline into innovative biology and technology breakthroughs. For example, normally plant roots grow downward, where it's easy for them to soak up water and nutrients that make their way into the soil. In space, roots grow in every direction, and water and other essential plant foods float. Research with plants in space is dedicated to systematic studies that explore the role gravity plays at all stages in the life of higher plants. Research focuses on the interaction of gravity and other environmental factors with plant systems, and uses hypergravity, simulated hypogravity, and microgravity as tools to advance fundamental knowledge of plant biology. **Results of the research contribute efforts to further human exploration of space and to improve the quality of life on Earth through applications in medicine, agriculture, biotechnology and environmental management.** 

## Align and Bolster Strategy for Critical Biology and Physical Sciences Research

Funding for these strategic areas in science and technology have decreased over the years with NASA receiving \$512M alone in 2004 (\$678M in 2020 dollars) to an average of about \$81M/year in the last 8 years. Funding in these areas can be bolstered by strategic partnerships and interagency coordination by NASA, NIH, NSF, USDA, and other interested agencies. However, there is no integrated national strategy for microgravity research in these areas to coordinate and guide such tactical partnerships. **We recommend:** 

- An integrated national strategy on space life and physical sciences microgravity research
  - Work on a decadal survey on Biological and Physical Sciences Research in Space has begun which aims to help NASA define and align biological and physical sciences research. The work done for the decadal should align with other agencies and industry to feed a "whole of government" approach to microgravity research in life and physical sciences.
- A study on NASA's BPS and other directorate plans for microgravity research spending, and outcomes
  - Leveraging BPS strengths with other NASA missions and programs will strengthen research and science portfolios across the agency
- Increase funding for these strategic areas at NASA and other federal agencies in this research.
  - Research being performed in these fields contribute to learning more about our planet, changes its going through, and creating potentially new and sustainable solutions. Potentially with authorization incentivizing inter-agency partnership and collaboration.

#### About ASGSR

The American Society for Gravitational and Space Research (ASGSR), founded in 1984, provides a forum to foster research, education, and professional development in the multidisciplinary fields of gravitational research. ASGSR brings together a diverse group of scientists, engineers and students from academia, government, and industry to promote research, education, training and development in the areas of Space Life and Physical Sciences research. The knowledge gained leads to a better understanding of the effects of gravity on living and physical systems on Earth and enables human space exploration. The society's mission is "to inspire, educate, and advocate" for this research. <u>www.asgsr.org</u>

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# MICROGRAVITY RESEARCH - PAVING THE WAY FOR EXPLORATION

### GARDENING IN THE GALAXY

In FY 2021, NASA researchers will conduct a series of plant biology experiments on the International Space Station (ISS) to investigate how plants respond and adapt to the space environment to enable the growth of plants in space for food and other purposes in future exploration missions.

These experiments will also collaborate with the Human Research Program to study both the psychological benefits to humans of having plants in space, as well ways to improve the taste of space-grown food on the International Space Station.



Image credit: NASA

In addition, this experiment will study the effects of various environmental conditions on plant growth to identify novel genetic engineering strategies for improving the ability to grow plants in space and on Earth.

### DECIPHERING THE IMMUNE SYSTEM

Spaceflight is known to have a dramatic influence on immune response, but there is little research on its effect following an actual challenge to the body's immune system. A recent experiment on ISS using rodents investigated an immune system that closely parallels that of humans, to understand how the immune system functioned in space after it was challenged by tetanus toxin. This study will provide a basis for developing measures designed to prevent compromised immune systems in space and help to enable crew health during long-duration exploration missions.

Future analysis of the study results may also help to improve response to vaccines and antibody production, increasing the effectiveness of vaccines and other therapies for treating diseases on Earth.

#### STUDYING COMBUSTION IN SPACE



A secondary objective is to improve fire prevention, particularly on spacecraft by studying the combustion of solid materials in space, thus leading to critical insights into how fire spreads in a microgravity environment.



Image credit: NASA



Image credit: NASA