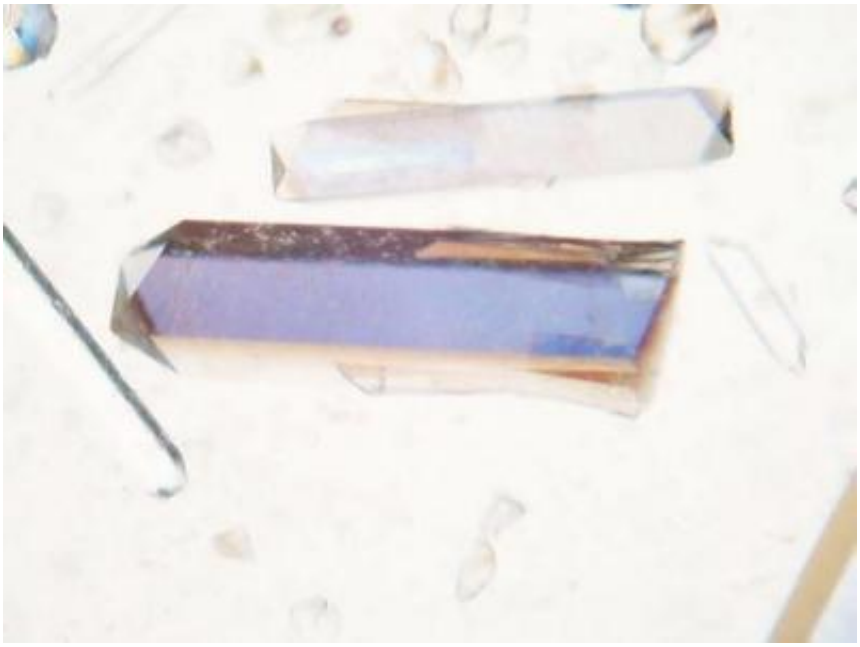
Forum highlights future of research aboard the International Space Station

May 22 2014, by Laura Niles



This is an image of Crystal of Trypsin grown in microgravity during Expedition 4 on the International Space Station. Credit: NASA

To highlight the direction for life and physical sciences aboard the International Space Station, a panel of experts gathered May 21 for the Destination Station: International Space Station Science Forum. This forum, the first in a new series of public discussions dedicated to research aboard the station, emphasized current and future microgravity research that will prepare astronauts for long-duration missions farther into the solar system than ever before and provide lasting benefits to life

on Earth.

Not only does the space station provide a one-of-a-kind orbiting laboratory for researching many science disciplines in microgravity, but it also serves as a technology development testbed for deep space exploration and is a destination to grow a robust commercial market in low-Earth orbit. While the use of the space station continues to grow, science studied aboard is underway at an unprecedented pace. In addition to continued scientific opportunity, there also are key areas in which to focus on the most crucial research needs in space.

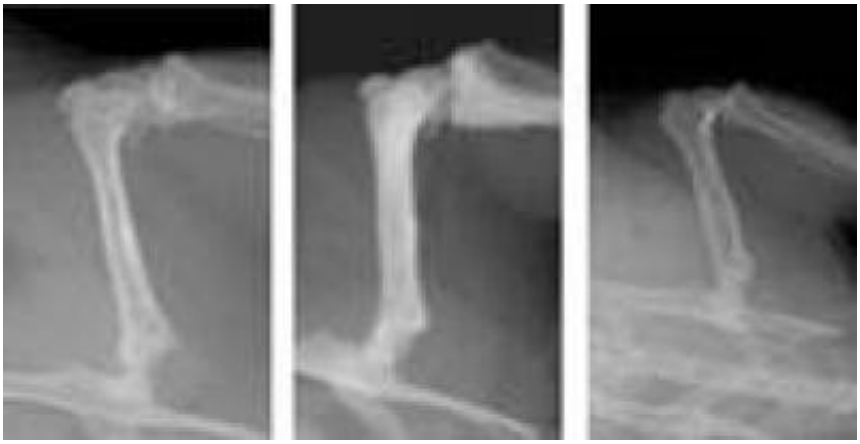
In 2011, the National Research Council published a report on how best to use the space station. This report, entitled "Recapturing a Future for Space Exploration: Life and Physical Sciences Research for a New Era," established priorities and provided recommendations for life and physical sciences research in microgravity for the 2010-2020 decade.

"We took a broad look at what research needed to be done in the physical sciences and the life sciences to underpin the future of space exploration," said Elizabeth Cantwell, director for mission development in the engineering directorate at Lawrence Livermore National Laboratory in Livermore, California, and co-chair of the National Research Council's decadal study. "We recommended that because animal studies underpin so much of our knowledge and understanding of human health terrestrially, that animal studies be supported more strongly in the space station science program and that microbial studies be beefed up in the form of long-term ability to study microbes in space on the space station."

Among other recommendations for the space station, the report endorsed a clearly defined and prioritized integrated life and physical sciences research portfolio and associated objectives. This report detailed seven major disciplines for focus by station research, including plant and

microbial biology and animal and human biology.

Life science research already conducted aboard the space station includes studies of protein crystals, pharmaceutical treatments and model organisms like plants and fish. Model organisms have characteristics that allow them to easily be maintained, reproduced and studied in a laboratory and have a genetic makeup that is relatively well-documented and well-understood by scientists. Upcoming research in the area of -omics, the study of the entire complement of biomolecules like proteins or genes, and in rodent research will further enable humans to carry out long-term space exploration and support a greater understanding of how gravity shapes fundamental biological processes.



This shows X-rays of mouse bones from the Commercial Biomedical Testing Module study showing a ground control (left), as treated with Osteoprotegerin in microgravity (middle), and with no drug treatment during spaceflight (right). Credit: L. Stodieck, Bioserve; T. Bateman, Univ. of North California

In response to the report, "we identified new facilities that we needed, like new rodent and plant habitats, and starting this year, those facilities are going to keep coming online one-by-one, and each will be used on

every flight over and over on the space station for the next 10 years," said Julie Robinson, Ph.D., chief program scientist for the International Space Station.

Protein crystals have been studied in microgravity throughout the space station's assembly, and investigations using protein crystals continue today. High quality crystals grown on the space station are used to determine protein structure. This helps researchers understand better protein the three-dimensional structure of proteins and may lead to designing new therapeutics for diseases. In fact, a previous study of protein crystals on the space station led to the discovery of a water molecule in a protein-inhibitor complex that now is being used to develop a treatment for Duchenne muscular dystrophy.

The Center for the Advancement of Science in Space (CASIS), the non-profit organization that manages the U.S. portion of the space station designated as a national laboratory, currently is coordinating other protein crystal growth investigations with potentially significant results. The Crystallization of Huntingtin Exon 1 Using Microgravity (CASIS PCG HDPCG-1) seeks to crystallize huntingtin, a protein associated with Huntington's disease. Meanwhile, the Advancing Membrane Protein Crystallization By Using Microgravity (CASIS PCG HDPCG-2) investigation seeks to crystallize the cystic fibrosis protein and closely related proteins to contribute to research for improved treatments for cystic fibrosis.

Past and future research using model organisms, such as plants, microbes like yeast or animals, advances knowledge about the influence of microgravity on cells. Taking these organisms to space allows for examination of growth and development and physiological, psychological and aging processes without the impact of gravity.

One such investigation, the Commercial Biomedical Testing Module

(CBTM): Effects of Osteoprotegerin on Bone Maintenance in Microgravity studied mice on the space station to understand better a drug therapy for bone health and how it functions. The research showed that mice treated with osteoprotegerin exhibited decreased bone substance loss compared to untreated mice. The findings in orbit were combined with ground study data and included in a drug application to the Food and Drug Administration, resulting in the pharmaceutical Prolia, which is used to treat osteoporosis. Upcoming CASIS rodent research will provide pharmaceutical evaluation of muscle atrophy.

The recently developed geneLAB research platform greatly expands life science investigation in microgravity. Through the geneLAB platform, scientists will have access to tools aboard the space station that enable drug development and biomedical research, expanding investigation into many more types of disease systems. The geneLAB model allows researchers to study several types of model organisms routinely used in genetics research on Earth, including bacteria and fungi, plants, fruit flies, worms, fish and mice.

"Instead of representing a particular piece of space hardware or equipment, or a single mission or study, geneLAB is a new research model that enables a wide range of science experiments that will seek to understand how exposure to spaceflight affects living issues at the biomolecular and genetic level," said Marshall Porterfield, Ph.D., director of Space Life and Physical Sciences in the Human Exploration and Operations Mission Directorate at NASA Headquarters in Washington.

While this expansion of research is happening 250 miles above Earth in the orbiting lab, astronaut and Expedition 40 commander Steve Swanson, Ph.D., provided details about conducting that research during the science forum via live downlink from the space station.

"When we're up here, we try to get as much science as we can done each and every day," said Swanson. "One of the advantages of being a national lab is that we get to help other government agencies and other companies do research and that, in turn, helps our economy."

With the Obama Administration's commitment to extend the space station to at least 2024, scientists have an additional 10 years of research opportunity for new discoveries, medical breakthroughs and advancements in technology development. Many dedicated researchers have already discovered the invaluable opportunity for their investigations aboard the space station and are producing benefits to people on Earth. The findings also continue to advance the body of scientific knowledge that will help launch NASA's human deep space exploration goals into reality.

Provided by NASA