Testimony
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Statement for hearing entitled, "The Case for Space: Examining the Value"

Statement of

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Mr. Chairman and Members of the Subcommittee:

I am Dr. Stephen Katz, Director of the National Institute of Arthritis and Musculoskeletal and Skin Diseases at the National Institutes of Health (NIH), an agency of the Department of Health and Human Services. I am proud to represent the NIH as its liaison to the National Aeronautics and Space Administration (NASA) and recently finished serving on the NASA Administrator's Advisory Council. I am pleased to testify about the opportunities that access to the laboratory of space provides to researchers who are committed to improving the health of people on Earth.

As the primary Federal agency for conducting and supporting medical research, the NIH manages a portfolio that addresses immediate public health needs while encouraging basic science research that may lead to improved health. Much of its budget supports basic research into the biological processes underlying health and disease. It fills a void in our Nation's research and development pipeline by encouraging basic, clinical, and epidemiological studies that the commercial sector would not pursue because they may not be immediately profitable.

NASA Technologies that Improve Health on Earth

Most of my testimony focuses on medical discoveries that our continued investment in space exploration may produce. But first, I am going to highlight two technologies that are well on their way to addressing serious public health threats to American lives.

About 5 million people in the United States have heart failure, which causes about 300,000 deaths each year. The NIH's National Heart, Lung, and Blood Institute is funding a grant[1], to improve a treatment for heart failure patients that is based on NASA's Space Shuttle technology. The original device began as a main-engine pump for the Space Shuttle that was the size of the Shuttle's deck but, over two decades, engineers miniaturized it into a 4-ounce version that surgeons can implant into patients to keep them alive until they can receive heart transplants. Now, NIH grantees are testing whether they can further modify it into a total artificial heart that would eliminate the need for risky transplants of human organs, which entail lifetime regimens of immunosuppressant drugs that leave patients susceptible to infections.

Earlier this year, researchers from the NIH's National Eye Institute demonstrated that a compact fiber-optic probe originally developed for the space program also has a medical application. The non-invasive probe detects cataracts well before doctors can diagnose them with conventional techniques. Cataracts are the leading cause of vision loss worldwide, but people can reduce their risk by making simple lifestyle changes. The new, non-invasive eye test detects the earliest damage. By providing a warning before vision-impairing damage occurs, the test could encourage people to take protective measures—such as decreasing sun exposure, quitting smoking, stopping certain medications, and controlling diabetes—that might preserve their eyesight by slowing or halting cataract formation.

[1] "A Novel Approach to Cardiac Replacement with Continuous Flow Pumps," NIH grant number R01-HL085054

The International Space Station's Potential Contribution to Biomedical Research and Technological Development

You may have heard of these, and many other, examples from NASA. The NIH is proud to continue its partnership with NASA to make additional discoveries through research activities such as the ones described above. The NIH also looks forward to the conceptual and technological breakthroughs that are likely to emerge from the unique environment of the International Space Station (ISS) National Laboratory, and expects some of these advances will speed progress toward important medical interventions.

In September 2007, the NIH and NASA entered into a collaboration that helps American scientists use the ISS. Chairman Nelson, Senator Hutchison, and Senator Mikulski joined the heads of both agencies at a ceremony at the U.S. Capitol to celebrate the signing of a Memorandum of Understanding. The event, which marked a milestone in a long partnership to advance scientific discovery, signaled the availability of the ISS as a platform for biomedical experiments that extend beyond NASA's core interests.

The NIH is an enthusiastic partner because the ISS offers an unprecedented opportunity for research that could benefit human health on Earth. Compared with the Earth-bound laboratories where more than 325,000 NIH-funded scientists conduct experiments every day, the ISS National Laboratory provides a virtually gravity-free environment that can unmask cellular and molecular mechanisms that underlie human diseases. It also provides an extreme environment for testing health care delivery and health monitoring technologies.

As Director of the National Institute of Arthritis and Musculoskeletal and Skin Diseases, I am especially interested in what space can teach us about human diseases of the bones and muscles. Since the beginning of the space program, researchers have known that prolonged periods of weightlessness cause bones and muscles to deteriorate. The ISS provides a stable platform on which scientists can study the molecular basis of these effects for the eventual benefit of people who suffer from fragile bones or from muscle-wasting diseases. Because the deterioration experienced in space is similar to conditions associated with aging, such findings could affect everyone who is fortunate enough to live beyond middle age.

The near-absence of gravity also provides researchers with opportunities to better understand the human immune system. In 2001, when the ISS was barely a year old, NASA astronauts and NIH-funded researchers were addressing important questions about the mechanisms that are involved as the immune function becomes compromised. The National Laboratory also can provide insights into how bacteria and viruses cause disease. For instance, experiments on the ISS already have shown that agents like the *Salmonella* bacterium become more infectious in microgravity and thus may become better inducers of immune responses.

NASA personnel have conducted all National Laboratory experiments thus far without the benefit of a fully operational ISS. The initial findings, however, have demonstrated that the weightlessness of space provides a unique platform from which scientists can do more than simply answer questions about the effects of space travel on the human body. The data have taught us that true microgravity cannot be simulated on Earth, and it affects individual cells and

multicellular organisms in ways Earth-based experiments can hardly predict. Moreover, they proved that the ISS has the potential to revolutionize how we view:

- basic biological or behavioral mechanisms associated with maintaining health or developing disease,
- normal or pathological physiology and metabolism, and
- cell repair processes and tissue regeneration that occur naturally or are enhanced through medical interventions following injury or aging.

NIH Activities to Encourage the Use of ISS Resources

Most ideas for NIH-funded studies come from investigators at universities and medical schools around the country. Therefore, as part of its partnership with NASA, the NIH is asking the Nation's biomedical research community to develop innovative hypotheses that astronauts could test on the ISS. The agency is encouraging a new cadre of health researchers from a variety of disciplines to incorporate the space environment into their experiments, and it will support them as they prepare their experiments for launch and analyze their data following a mission.

Grant applications will be subjected to NIH peer review consistent with Federal regulation[2]. However, the application process for grants to conduct research on the ISS will differ slightly from that for most other NIH grants. Because very few people outside of NASA have experience living and working in microgravity, applicants will need to work closely with NASA if they are to develop projects that are likely to give meaningful results. Astronauts have told us that life on the ISS is unlike anything most of us can imagine—flames burn differently, water flows differently, and chemical solutions mix differently. These distinctions, as well as the practical equipment, laboratory space, and personnel constraints facing every investigator who engages in collaborative research, will need to be considered as researchers who are looking to secure NIH dollars design their experiments. Ultimately, NASA personnel on the ISS will be using space-based laboratory equipment and data processing capabilities to conduct the experiments that the NIH funds—so the sooner biomedical researchers engage them in the process, the better their likelihood of success.

NIH is hosting three rounds of competitions. Results from the first should be announced in the summer of 2010. The NIH Institutes and Centers that agreed to participate in this initiative are the:

- National Cancer Institute
- National Center for Research Resources
- National Heart, Lung, and Blood Institute
- National Institute on Aging
- National Institute on Alcohol Abuse and Alcoholism
- National Institute of Arthritis and Musculoskeletal and Skin Diseases
- National Institute of Biomedical Imaging and Bioengineering
- *Eunice Kennedy Shriver* National Institute of Child Health and Human Development

[2] 42 CFR Part 52h

- National Institute of Neurological Disorders and Stroke

The diversity of their missions underscores the promise that the National Laboratory holds for human health. Any NIH-funded project that uses ISS resources will be consistent with existing NIH priorities and will be relevant to improving human health. Prospective researchers will articulate the questions they are asking, design the experiments that astronauts will perform in space, and provide cogent explanations as to why the microgravity environment of the ISS is essential for their studies.

In closing, the ISS provides a special microgravity environment that Earth-based laboratories cannot replicate. Congress's designation of the ISS as a National Laboratory speaks to the importance that the American people place on scientific discovery. Thank you for the opportunity to present this snapshot of how NIH activities with NASA should contribute to biomedical research and technological development. I will be happy to answer any questions that you may have regarding the potential of research in space to improve our public's health.