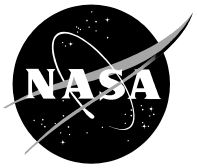

National Aeronautics and
Space Administration

Hold for Release Until
Presented by Witness

Sept. 21, 2021

Committee on Science, Space, and Technology
Subcommittee on Space and Aeronautics

U.S. House of Representatives

Statement of:
Dr. Kate Rubins
Astronaut
National Aeronautics and Space Administration

117th Congress

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Subcommittee on Space and Aeronautics
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Good morning Chairman Byer, Ranking Member Babin, and Members of the Subcommittee. I am Kate Rubins, a NASA Astronaut, veteran of two long-duration missions aboard the International Space Station (ISS), and a molecular biologist.

Thank you for the opportunity to share details of the cutting-edge science we are doing on the ISS, and to highlight the tremendous value in having a spaceborne laboratory, where we can do research not possible on Earth.

I have spent 300 days, combined on two six-month missions, living and working aboard the ISS. As a researcher, and sometimes simultaneously as the test subject providing biological samples for further study on the ground, I can share first hand the importance and the unique opportunity for scientific advancements and research made possible by having a research laboratory outside the bonds and limitations of gravity.

The ISS is the only place we can currently conduct long-duration research on how living in microgravity affects the human body, and test technologies that will take us farther into deep space. The ISS has offered over two decades of human research opportunities in a way that no other platform has been able to accomplish.

The things we have learned so far provide a great foundation for us as we reach even further away from our home planet. For the future exploration of the Moon and Mars, we need the capability to autonomously monitor the microbial health of spacecraft and planetary habitats, and to potentially identify DNA-based life as well. The ISS gives researchers an environment in which they can test DNA sequencing in microgravity and refine the sequencing processes.

During my first mission to the Space Station in 2016, I had the honor of being the first person to ever sequence DNA in microgravity, eventually sequencing more than two billion base pairs of DNA in collaboration with a world-class team of researchers on the ground. During my most recent expedition to space this past year, I was able to build on my past work conducting new DNA sequencing activities. With the ability to sequence DNA in space, astronauts could diagnose an illness, or identify microbes growing in the ISS or another habitable spacecraft and determine whether they represent a health concern.

I also spent many hours during my mission with my arms in the Life Science Glovebox conducting the Cardinal Heart experiment. My breath was taken away by the sight of beating heart cells in microgravity for the first time. Cardinal Heart studies how changes in gravity affect cardiovascular cells at the cellular and tissue levels. Not only will this research contribute to our success in future space exploration, but it could also impact how we develop treatments for heart disease on Earth. Results could provide new understanding of heart problems on Earth, help identify new treatments, and support development of screening measures to predict cardiovascular risk prior to spaceflight.

As a third example, I took hundreds of microbial samples for the Three-Dimensional Microbial Monitoring (3DMM) study. This experiment provides sequencing and analyses on samples collected from 1,000 different locations within the Space Station. By advancing our understanding of the Space Station microbiome, this work helps identify potential risks and supports developing countermeasures to mitigate those risks.

The ISS is a world-class research laboratory where we as astronauts are able to perform research developed by scientists across the world. It is also the most powerful example of collaboration that I have ever witnessed, and I believe one of the most (if not the most) powerful examples that exists. The world needs this example of nations coming together for the greater good and to see how many amazing things can be accomplished when we work together in harmony.

For more than 20 years, NASA has maintained a continuous human presence in Earth orbit, developing technology, skills, and knowledge needed for the human exploration of the Moon and Mars.

The ISS is an active, vibrant laboratory, where we are making the next steps of space exploration possible. As we set our sights on the Moon and beyond, it is the knowledge and practical experience we have gained from more than twenty years of continuous human presence and research on the Space Station that will pave a successful path forward. What we learn also has impacts on Earth in human health, technology development, and even commercial growth.

I hope the foregoing information regarding scientific research operations on the International Space Station has helped shed some light on the value and importance of having a space-based research platform for scientists like me to push the boundaries of the known world, and to learn how we as a species will adapt as we reach further into the universe. I appreciate the opportunity to appear before this Subcommittee. I look forward to answering any questions you may have.

ASTRONAUT BIOGRAPHY

National Aeronautics and Space Administration

Lyndon B. Johnson Space Center
Houston, Texas 77058

April 2021

Kathleen Rubins

(Ph.D.) NASA Astronaut

Summary:
Kathleen Rubins was selected by NASA in 2009. Rubins completed her first spaceflight on Expedition 48/49, where she became the first person to sequence DNA in space. She holds a Bachelor of Science in Molecular Biology from the University of California and a Ph.D. in Cancer Biology from Stanford University Medical School Biochemistry Department and Microbiology and Immunology Department. Dr. Rubins conducted her undergraduate research on HIV-1 integration in the Infectious Diseases Laboratory at the Salk Institute for Biological Studies. She worked as a Fellow/Principal Investigator at the Whitehead Institute for Biomedical Research and headed 14 researchers studying viral diseases that primarily affect Central and West Africa. Rubins most recently served aboard the International Space Station as flight engineer for Expedition 63/64. Across her two flights, she has spent a total of 300 days in space, the fourth most days in space by a U.S. female astronaut.

Personal Data:
Born in 1978 in Farmington, Connecticut, and raised in Napa, California, where her father, Jim, still resides. Her mother, Ann Hallisey resides in Davis, California. She enjoys running, cycling, swimming, flying, scuba diving and reading.

Education:
Graduated from Vintage High School in 1996, received a Bachelor of Science degree in Molecular Biology from the University of California, San Diego, in 1999 and a Ph.D. in Cancer Biology in 2005 from Stanford University Medical School Biochemistry Department and Microbiology and Immunology Department.

Experience:
Dr. Rubins conducted her undergraduate research on HIV-1 integration in the Infectious Diseases Laboratory at the Salk Institute for Biological Studies. She analyzed the mechanism of HIV integration, including several studies of HIV-1 Integrase inhibitors and genome-wide analyses of HIV integration patterns into host genomic DNA. She obtained her Ph.D. from Stanford University and, with the U.S. Army Medical Research Institute of Infectious Diseases and the Centers for Disease Control and Prevention, Dr. Rubins and colleagues developed the first model of smallpox infection. She also developed a complete map of the poxvirus transcriptome and studied virus-host interactions using both invitro and animal model systems.

Dr. Rubins then accepted a Fellow/Principal Investigator position at the Whitehead Institute for Biomedical Research (MIT/Cambridge, Massachusetts) and headed a lab of 14 researchers studying viral diseases that primarily affect Central and West Africa. She traveled to the Democratic Republic of Congo to conduct research and supervise study sites. Work in the Rubins Lab focused on poxviruses and host-pathogen interaction as well as viral mechanisms for regulating host cell mRNA transcription, translation and decay. In addition, she conducted research on transcriptome and genome sequencing of filoviruses (Ebola and Marburg) and Arenaviruses (Lassa Fever) and collaborative projects with the U.S.

Kathleen Rubins

Army to develop therapies for Ebola and Lassa viruses. Dr. Rubins has published and presented her work in numerous papers at international scientific conferences and in scientific journals.

NASA Experience:
Rubins was selected in July 2009 as one of 9 members of the 20th NASA astronaut class. Her training included scientific and technical briefings, intensive instruction in International Space Station systems, spacewalks, robotics, physiological training, T 38 flight training and water and wilderness survival training.

Spaceflight Experience:
Expeditions 48 and 49 (July 2016 through October 2016) On July 7th, 2016, Dr. Rubins launched from the Baikonur Cosmodrome in Kazakhstan to the International Space Station aboard the first test flight of the new Soyuz MS spacecraft. Together the international crew of Expeditions 48 and 49 conducted or participated in more than 275 different scientific experiments including research in molecular and cellular biology, human physiology, fluid and combustion physics, Earth and space science and technology development. Dr. Rubins was the first person to sequence DNA in space, eventually sequencing over 2 billion base pairs of DNA during a series of experiments to analyze sequencing in microgravity. Dr. Rubins also grew heart cells (cardiomyocytes) in cell culture, and performed quantitative, real-time PCR and microbiome experiments in orbit.

Dr. Rubins conducted two spacewalks totaling 12 hours, 46 minutes. During her first spacewalk, Rubins and Jeff Williams installed the first International Docking Adapter, a new docking port for U.S. commercial crew spacecraft. During the second, they performed maintenance of the station external thermal control system and installed high-definition cameras, enabling never-before seen images of the planet and space station. Jeff Williams and Rubins successfully captured SpaceX Dragon commercial resupply spacecraft and then returned science experiment samples to earth. During Expedition 49, Rubins and crewmate Takuya Onishi grappled Orbital ATK's Cygnus resupply spacecraft, providing several tons of supplies and research experiments for future work on the orbital outpost.

Expeditions 63 and 64 (October 2020 through April 2021) On October 14, 2020, Dr. Rubins launched from the Baikonur Cosmodrome in Kazakhstan to the International Space Station aboard the Soyuz spacecraft. Dr. Rubins spent hundreds of hours working on new space station experiments, building on investigations she conducted during her first mission, including heart research and multiple microbiology studies. She also advanced her work in DNA sequencing, which could allow astronauts to diagnose an illness in space or identify microbes growing at the space station. Rubins worked on the Cardinal Heart experiment, which studies how changes in gravity affect cardiovascular cells at the cellular and tissue levels. Results could provide new understanding of heart problems on Earth, help identify new treatments, and support development of screening measure to predict cardiovascular risk prior to spaceflight. She returned safely to Earth on April 17, 2021 spending 185 days in space and conducted two spacewalks.

During Dr. Rubins two spaceflight missions, she has logged in a total of 300 days in space and conducted four spacewalks.

Awards/Honors:
Popular Science's Brilliant Ten (2009), National Science Foundation Predoctoral Fellowship (2000), Stanford Graduate Fellowship - Gabilan Fellow (2000), UCSD Emerging Leader of the Year (1998), Order of Omega Honor Society Scholarship Award (1998).

ASTRONAUT BIOGRAPHY

Kathleen Rubins

Organizations:
American Association for the Advancement of Science (AAAS), American Society of Tropical Medicine and Hygiene (ASTMH), American Society for Virology (ASV), RNA Society, Chi Omega, American Institute of Aeronautics and Astronautics (AIAA).

Pronunciation:
KATH-lean ROO-bens