



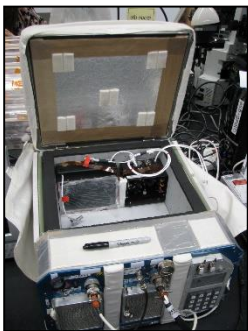
Managing Microbes in Space

Preflight

Welcome aboard our eleventh Orion's Quest (OQ) mission, "Managing Microbes in Space". We're excited to have you join this mission designed to have you, the student, assist NASA scientists conducting research in space. In preparation for this mission you will learn about the International Space Station (ISS) and its' crew, the recently completed Space Shuttle program that delivered all of the station components to low earth orbit, and a company called SpaceX which built the rocket that delivered this experiment to the ISS.

"Managing Microbes In Space" (MMIS) is a research project supporting the work of scientists at the Biodesign Institute at Arizona State University and is a **first of a kind** study of the interactions of germs and host organisms in real time while in microgravity. It is designed to study the interactions of a pathogen, *Salmonella*, and a host organism, *Caenorhabditis elegans* or *C. elegans*. Scientists are looking for ways to not only counteract or prevent illness in astronauts, but potentially assist in developing vaccines for preventing infections here on earth. The equipment used to conduct and support this investigation was carried in the Dragon spacecraft launched on a SpaceX Falcon 9 rocket in the winter of 2015 and delivered to the Destiny laboratory module section of the International Space Station.

This study was chosen by OQ because travel by astronauts back to the Moon and beyond is now being planned. Those flights could last several years and will require astronauts to handle any and all medical issues that arise along the way using only the knowledge and equipment available to them in the isolation of space. Of course the best way to do that is to try to prevent injuries and illness including infections and disease. Information gathered from this research and other experiments like it will allow NASA to provide the best possible chance for a successful mission.



Participating in this study will require accessing and analyzing video data downlinked from the experiment located in a suitcase sized device called the Commercial Generic Bioprocessing Apparatus or CGBA developed by BioServe Space Technologies in Boulder Colorado. Photographs and videos from the small chamber containing both the microbes and their host onboard the ISS and a ground-based experiment will be posted on the OQ website for analysis. By submitting this information to the Principal Investigator (PI) for this mission students will be adding to the body of knowledge related to long duration spaceflight.



CGBA

Several organizations are working together to get you involved in this real world science project and in the coming weeks you will participate in this mission by working with real information and data downlinked to Earth from the experiment onboard the ISS. You will learn much about microbes and host organisms as the mission progresses, but first let's take a brief look at each of the organizations making this mission possible and the role each one plays.

The organizations are:

- Orion's Quest - Education Component
- BioServe Space Technologies - Hardware, Technology, and Flight Integration
- NASA - Science Research and Space Flight Component

Orion's Quest (OQ) is a non-profit educational organization that works with elementary, middle and high school students and teachers throughout the United States and abroad. OQ educators use authentic research being conducted by NASA scientists to develop classroom activities and curriculum for student "missions". Each mission allows students to participate in some aspect of real-world research. The OQ staff is responsible for the development, coordination and delivery of each mission. Programs are supported and managed via the Internet. At the completion of each mission, OQ compiles information and data gathered by students and provides this information to the principle investigators and NASA for review and, if applicable, inclusion in research databanks and presentations.

BioServe Space Technologies is a non-profit, NASA-sponsored Research Partnership Center located at the University of Colorado with a mission of developing new or improved products through space life science research in partnership with industry, schools and government. Since 1991, BioServe payloads have flown on numerous Space Shuttle missions and have been placed aboard Mir and the International Space Station. The payloads are designed, built, tested and managed by faculty, staff, and students at BioServe in collaboration with industry and other partners. In addition to hardware development, BioServe handles all aspects of the space flight program including, pre-flight integration, launch preparation, real-time mission support, and post-flight sample recovery tasks.

NASA, or National Aeronautics and Space Administration, is an agency of the United States Federal Government dedicated to protect the home planet, explore beyond and reach the next generation of explorers. NASA conducts its work in four major areas or departments. The Space Shuttle and the International Space Station programs are a part of what is known as Space Operations. NASA also conducts work in, Aeronautics which deals with flight on Earth, Exploration Systems dealing with new spacecraft, and Science dealing with the benefits of Earth and space exploration. During the next 20 years NASA plans to, return humans to the moon, continue the exploration of Mars using robots, and develop a crew vehicle required to send people beyond low Earth orbit.



By combining the efforts of these organizations, OQ is making it possible for you to assist NASA scientists in gathering data related to this study and in a way become participants in America's space program.

This Preflight introduction is designed to have students learn about:

- The International Space Station and its crew.
- The Space Shuttle and SpaceX programs.
- The connection between the actual classroom experiment and the study being conducted in space.

To accomplish this we have included a list of resources and lessons available on the internet. Learning about the science and scientists, NASA's missions and crew of the ISS is fundamental to understanding the mission you are starting. Knowing how the experiment was prepared and sent into space and where it was located once there are also key elements.

While your individual role may seem small, you will find that by combining your work with the work of hundreds of other students, a large amount of data will be generated with many new findings possible. We look forward to providing you with a connection to NASA and the ISS as you support real world science being conducted in space.

ISS *The International Space Station*

The **International Space Station (ISS)**, a manned research facility assembled in space over three decades, is a joint project between five space agencies, those of the United States, Russia, Japan, Canada and the European Space Agency (ESA). In some ways the ISS represents a merger of previously planned independent space stations: Russia's *Mir 2*, the U.S. *Space Station Freedom* and the European *Columbus* and Japanese *Experiment Module*.

The ISS is located in orbit around the Earth at an altitude of approximately 220 miles (360 km), a type of orbit usually termed low Earth orbit. (The actual height varies over time). It orbits Earth in about 92 minutes. As a result of the ISS, there has now been a permanent human presence in space for almost 15 years. With a current crew of 6, there have always been at least two people on board dating back to the first permanent crew which entered in November, 2000. It is currently serviced primarily by the Russian Space Agency's Soyuz and Progress spacecraft and two private companies, SpaceX and Orbital Sciences, contracted by NASA. The ISS is now complete and has been designated a United States National laboratory.



Prior to an astronaut from the European Space Agency (ESA) who joined the crew in July 2006, all permanent crewmembers had come from the Russian or United States space programs. The **ISS** has however been visited by **astronauts from twelve countries**, was also the destination of the first four “**space tourists**” and has been continuously occupied by astronauts for the past 15 years.

The following websites are suggested resources in providing background material concerning the International Space Station.

General Information

http://www.nasa.gov/mission_pages/station/main/index.html

http://www.nasa.gov/mission_pages/station/main/onthestation/facts_and_figures.html

Tracking

<http://www.heavens-above.com/>

Assembly

http://i.usatoday.net/tech/graphics/iss_timeline/flash.htm

Virtual Tour

www.nasa.gov/mission_pages/station/main/suni_iss_tour.html

STS ***The Space Transportation System***

It all started with STS-1, launched on April 12, 1981, just twenty years to the day after Soviet cosmonaut Yuri Gagarin became the first human in space and for an entire generation, the space shuttle was NASA. In its twenty-five-year history, **NASA's Space Shuttle program (officially called Space Transportation System or “STS”)**, flew one hundred thirty five missions. It enjoyed extraordinary success including the building of the International Space Station, placing many satellites in Earth orbit and the repair of the Hubble Space Telescope.



Sadly it also suffered 2 tragic accidents. Two fateful missions, Challenger in 1986 and Columbia in 2003, resulted in the loss of fourteen crew members. Following the loss of Columbia, Space Shuttle missions resumed in 2005 and continued their aggressive schedule completing the International Space Station in 2013.

On July 8, 2011 Space Shuttle Atlantis lifted off on STS 135, the final mission of the American Space Shuttle program. During the 14-day mission, Atlantis carried the Raffaello multipurpose logistics module to deliver supplies, logistics and spare parts to the International Space Station returning to Earth for the last time on July 21, 2011.

The following websites are suggested resources in providing background material related to the Space Shuttle program.

NASA's Space Shuttle Program

http://www.nasa.gov/mission_pages/shuttle/main/index.html

Background/ History of the Space Shuttle Program

<http://history.nasa.gov/shuttlehistory.html>

Fun Facts about the Space Shuttle Orbiter

http://www.nasa.gov/externalflash/the_shuttle/

SpaceX *Falcon Rocket and Dragon Spacecraft*

SpaceX is a private company headquartered in Hawthorne, Ca founded in 2002 to revolutionize space technology, with the ultimate goal of enabling people to live on other planets. Their goal is to develop reusable rockets to transform space exploration by delivering reliable vehicles at greatly reduced costs. SpaceX designed, manufactured and launches the Falcon 9 rocket which carries the Dragon spacecraft to and from low-Earth orbit. SpaceX has had a series of historic milestones by so far being the only private company ever to return a spacecraft from low-Earth orbit, first accomplished in December 2010. The company made history again in May 2012 when its Dragon spacecraft attached to the International Space Station, exchanged cargo payloads, and returned safely to Earth. Since then Dragon has delivered cargo to and from the space station multiple times, providing regular cargo resupply missions for NASA.



Under a \$1.6 billion contract with NASA SpaceX spacecraft currently carry only cargo, including critical materials to support 256 science and research investigations that will take place on the space station during ISS Expeditions 42 and 43. However, modifications are underway to make Dragon crew-ready allowing it to also carry astronauts to the ISS in the future.



The following websites are suggested resources in providing background material related to SpaceX.

SpaceX Main page

<http://www.spacex.com/>

Commercial Resupply News and Features

http://www.nasa.gov/mission_pages/station/structure/launch/

Dragon and Falcon 9 two stage rocket used for transporting cargo to the ISS

<http://www.spacex.com/falcon9>