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Life in Space

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Written by Jennifer McStotts

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Weightless Living

You wake up just as the Sun is rising. Earth spreads outside the small window, a bright blue sphere. It takes a moment to untangle from the sleeping bag in the small space. Opening the door, you grab a handle and flip yourself over. With a gentle push, you fly from one end of the room to the other. Another crew member floats by, hands you a packet of coffee, and says, “Good morning,” in Russian. You thank him and yawn, tired because you haven’t slept much. Your stomach hasn’t adjusted to the lack of gravity yet—and you’re incredibly excited.

You’re about to begin your first full day working aboard the **International Space Station**. You’ve trained for years, but even the simplest activities, such as eating, bathing, and going to the bathroom, are complicated without **gravity**. It’s almost as if you have to learn how to do them all over again. The transport back to Earth isn’t coming for another six months, so you may as well get started.

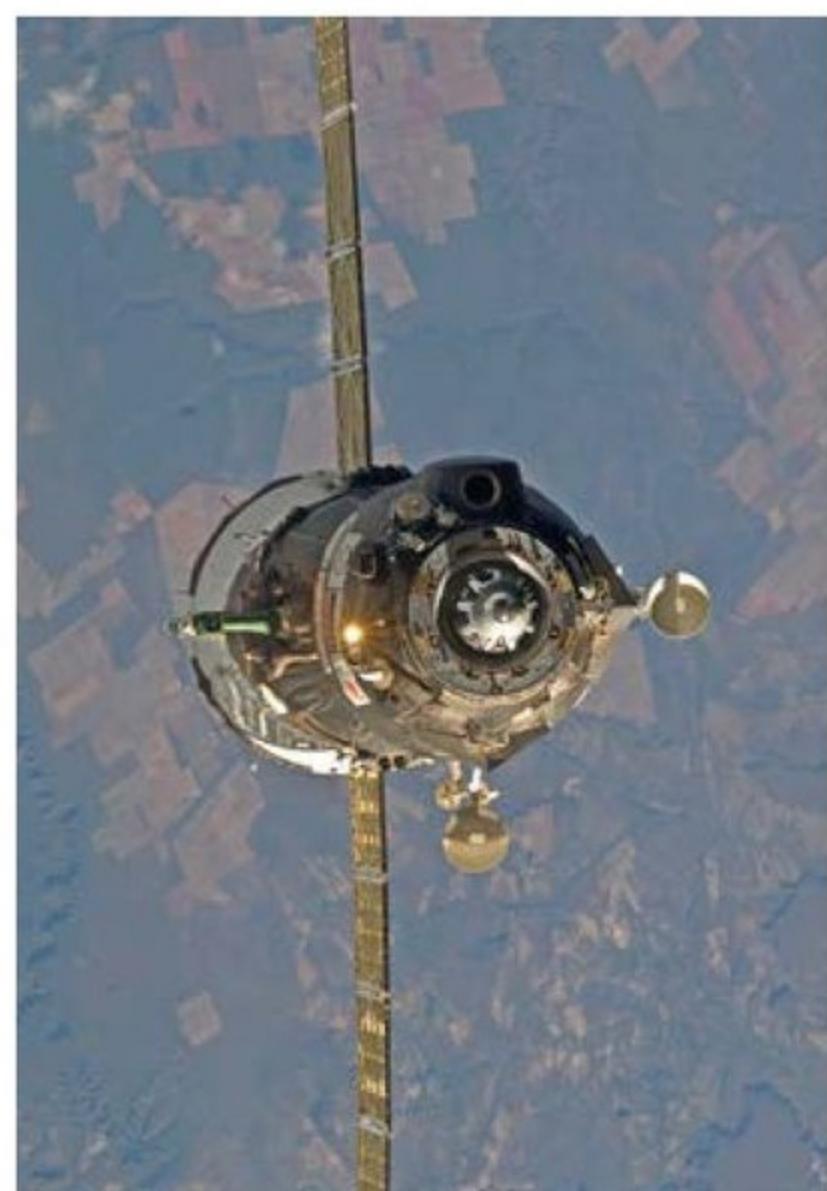


A space shuttle docks with the International Space Station.

The Race to Space

People began racing into space in the 1950s and 1960s. The first person in space was **cosmonaut** Yuri Gagarin, from Russia (then part of the Soviet Union). He **orbited** Earth once and landed safely after 108 minutes on April 12, 1961. In August of the same year, another Soviet cosmonaut, Gherman Titov, orbited Earth more than 17 times in about 25 hours. **Technology** advanced quickly, allowing people to go farther and stay longer in space. In 1968, U.S. **astronauts** aboard *Apollo 8* successfully orbited the Moon, and on July 20, 1969, the crew of *Apollo 11* stepped onto the Moon's surface.

Technology continued to advance as space programs developed vehicles that allowed people to stay in space for days or weeks. However, scientists were also working on a more permanent structure in space—one in which people could actually live for months, or even years.



The Soyuz spacecraft, first created in the 1960s, are still being used to take people to and from the International Space Station.

Space Stations



A space shuttle docks with Mir.

reentering Earth's atmosphere. In 1973, the United States launched Skylab, which supported three missions before being abandoned in 1974. It fell to Earth in 1979.

The Soviet Union **launched** the first space station in 1971. Salyut 1 hosted a crew of three cosmonauts for three weeks and spent 175 days in space before it fell out of orbit and burned up while

Not until the Soviet Union launched the first part of the Mir (MEER) space station in 1986 did the world have a space station that remained **operational** for more than a few years. Mir orbited Earth for fifteen years—three times longer than originally planned—and hosted scientists from many different countries.

Days in Space

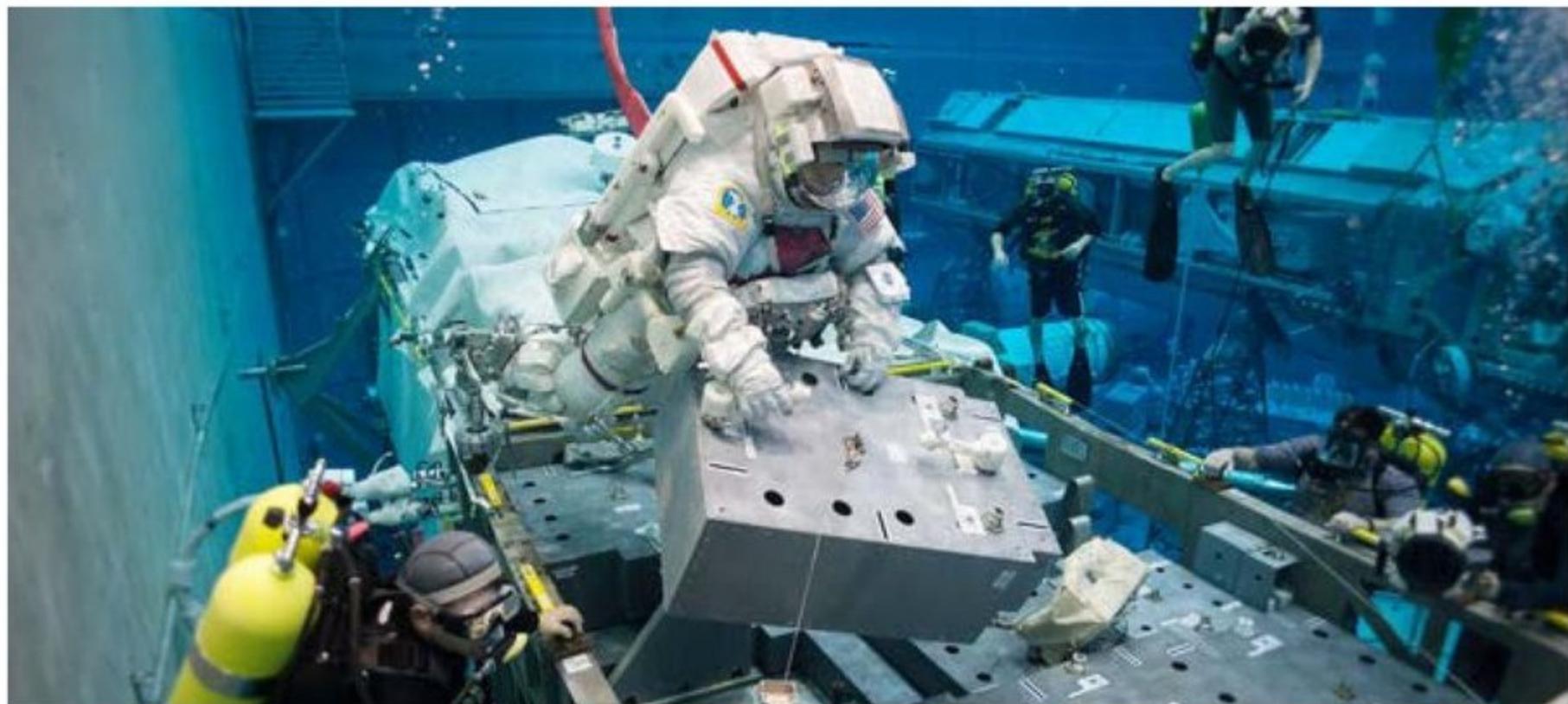
Russian scientist Dr. Valeri Polyakov spent 438 consecutive days in space in 1994 and 1995. During his record-setting stay, Dr. Polyakov lived on Mir and orbited Earth 7,075 times. Dr. Polyakov's record still stands.



Before Mir fell to Earth in 2001, work began on a new, larger space station. Countries from all over the world, including the United States, Russia, Japan, and Canada, worked together. In 1998, the first section of the International Space Station (ISS) was launched into orbit. More sections have been added over the years, and more are planned for the future. As of 2012, the ISS measured 357 feet (108.8 m) long and weighed almost 1 million pounds (453,592.3 kg). The largest human-made object in space, it can even be seen in the night sky without using a telescope.

The ISS has been continuously occupied since November 2, 2000. Over the years, more than two hundred people from fifteen countries have visited the station, which has more living space than the average five-bedroom house. The amount of time an astronaut spends on the ISS varies, with many staying for about three to six months.

That's up to six months of living and working without gravity in an enclosed space with three to six other people. The crew members might be from different countries and speak different languages, but they all have to work together as a team. This can be extremely stressful for the astronauts' minds and bodies.



An astronaut practices repairing part of the ISS on an underwater model. Working underwater helps prepare them for space walks.

An Astronaut's Life

Astronauts attend school for many years, often earning the highest degree in their field, before they begin training. The physical training involves **simulating** weightlessness while flying in an airplane. They also spend up to seven hours in a space suit, working underwater in a massive 6.2 million-gallon (23.5 million liter) pool on life-size models of space vehicles. Once on the ISS, however, astronauts still must adjust to a completely weightless way of life.

Sick in Space

When astronauts first get to the ISS, their bodies and minds need time to adjust to the weightlessness. The change can make some people ill. Fortunately, the ISS comes equipped with special bags for that purpose. They have a cloth side that can be used to clean up as well as an extra sealable bag attached for easy disposal.

Sleeping

Without gravity, astronauts can't jump into bed and curl up under a pile of blankets. Instead, the ISS has six small "sleep pods" that each contain a sleeping bag with armholes. Each bag is securely tied to the wall to keep the astronaut from floating away while snoozing. The lack of gravity often causes astronauts to experience dreams of falling.

Because of the space station's orbit, astronauts on board see sixteen sunrises and sunsets every day. Since people are used to sleeping at night and being awake during the day, this can cause serious sleep problems. The space station has a "shades down" period, during which it is dark and quiet to allow the astronauts to get the sleep they need.



Astronaut Alvin Drew prepares to sleep on the ISS.



An astronaut has a breakfast of eggs and sausage on a tortilla with coffee on the ISS.

Eating

Early astronauts ate gels, pastes, and freeze-dried food that, while it contained the nutrition they needed, didn't taste very good. Today, astronauts eat many of the foods most people enjoy, such as chicken, fruits, peanut butter, and brownies. The ISS has no refrigerator, so all food must be packaged in such a way that it won't spoil, but the station does have an oven. Some food, such as peanut butter, can be eaten as is; other food, such as spaghetti, must have water added. Salt and pepper come in liquid form because otherwise the particles would float away and damage the delicate space station equipment. Once the food is prepared, however, astronauts still have to get used to swallowing, which astronaut Piers Sellers equated to "eating while lying on one side."

Using the Toilet

With the way things float around in space, using the bathroom can be tricky business. In fact, astronauts need special training to use the toilet. The toilets on the ISS have two parts. For liquid waste, astronauts use a tube with a nozzle. For solid waste, astronauts must use foot straps and handles to stay in place as they position themselves over a 4-inch (10 cm) opening.

The average toilet on Earth has a 12- to 16-inch

(30.5–40.6 cm) opening. The toilet uses light suction to transport the waste from the opening or tube to where it is stored in another part of the station.



The tube hanging on the wall is for liquid waste. The base on the floor is for solid waste. The ISS has two toilets, which have stopped working more than once. To repair a toilet, astronauts must use parts sent from Earth, which can take months.



Astronaut Karen Nyberg shows how she washes her hair on the ISS.

Bathing and Teeth Cleaning

Astronauts use water and special soap on a cloth to wash their bodies. They wash their hair with shampoo that uses no water, and to clean their teeth, they use toothpaste that can be swallowed when they're finished. Previous space stations, including Skylab, had an actual shower. Astronauts stepped into an enclosed space with a tube that squirted water. They washed with soap and a cloth, and then used another tube to suck away the dirty water.

Free Time

Astronauts on the ISS have very little free time, but they do find ways to entertain themselves. They might play cards, read, or write, among other things. Keeping in touch with loved ones is also important, and astronauts are able to make calls and use video chat. Sometimes astronauts have live video chats in which they answer questions from students all over the world or give tours of the station. When they have nothing else to do, however, many simply look out the windows or take photos. Who can blame them? The view is pretty amazing.



Astronaut Chris Hadfield plays guitar on the ISS. During his last visit to the space station, he even made a music video.

Exercising

Exercise is incredibly important for astronauts. When people exercise on Earth, their bones and muscles must work against gravity, which makes them stronger. Because of the lack of gravity in space, it takes very little strength or effort to move things that might be extremely heavy on Earth. Because of this ease, astronauts' bones and muscles weaken over time.

To slow the decline, astronauts must work out at least two hours every day. The special equipment in the ISS gym includes a treadmill that uses straps to pull down on the astronauts

as they run. Other exercise equipment in the gym uses **resistance** to help the astronauts stay strong. Even with such a **grueling** daily workout, most astronauts lose 20 to 30 percent of their muscle mass during their six-month stay.



Astronaut Luca Parmitano exercises on a treadmill on the ISS.



Astronauts return to Earth from the ISS in 2013.

Back to Earth

When astronauts return to Earth from the ISS, the work isn't over. Recovery from an extended period in space takes a long time. For a six-month stay on the ISS, astronauts have about six weeks of **rehabilitation** to regain lost muscle. It can take a whole year for an astronaut's bones to fully recover. Despite all the hard work and inconvenience astronauts must endure, they know the time spent living and working in space is worth it.

During their time in space and rehabilitation afterward, scientists monitor the astronauts' physical and mental health. The information they gather has already helped astronauts live healthier and happier lives. As we look farther into space—to places that may take months, years, or even decades to reach—this vital information might mean the success or failure of future space exploration.

Glossary

astronauts (<i>n.</i>)	people trained to travel and work in space (p. 5)
cosmonaut (<i>n.</i>)	a person trained to travel and work in space; a Russian word for “astronaut” (p. 5)
gravity (<i>n.</i>)	the natural force that tends to pull objects toward each other, such as objects being pulled toward the center of Earth (p. 4)
grueling (<i>adj.</i>)	extremely difficult; exhausting (p. 14)
launched (<i>v.</i>)	used force to start something moving (p. 6)
operational (<i>adj.</i>)	ready or able to work or be used (p. 6)
orbited (<i>v.</i>)	revolved around another object (p. 5)
rehabilitation (<i>n.</i>)	the process of restoring to health or normal activity (p. 15)
resistance (<i>n.</i>)	force that slows motion (p. 14)
simulating (<i>v.</i>)	modeling or imitating the appearance or condition of something (p. 8)
space station (<i>n.</i>)	a spacecraft in which people can live for a long time, used for scientific research (p. 4)
technology (<i>n.</i>)	the use of scientific knowledge or tools to make or do something (p. 5)

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Front cover: Astronaut Scott Kelly floats in front of the windows on the ISS.

Title page: Astronaut Rick Sturckow gives a thumbs-up in front of a wall filled with the badges that represent the different crews who have worked on the ISS.

Table of contents: Astronaut Chris Hadfield poses in front of a floating water bubble.

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