

A photograph of an astronaut in a white space suit floating in space. The astronaut is giving a thumbs-up gesture. The background shows the Earth's horizon and the structure of the International Space Station. A portion of a SpaceX spacecraft is visible on the left side of the image.

50 THINGS TO KNOW ABOUT THE INTERNATIONAL SPACE STATION

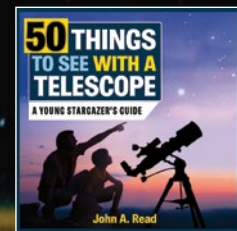
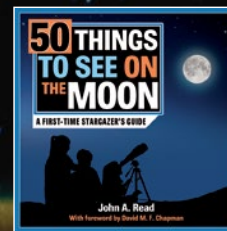
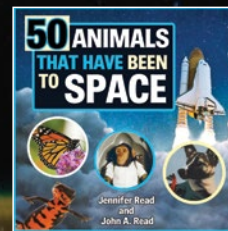
John A. Read

FIND OUT WHAT IT'S LIKE TO LIVE IN SPACE

You may be aware that there are people living on a space station 400 kilometres above the Earth. But what is it like to live in space? What do they do up there? And how does it make our lives better here on Earth? This book tells you everything you need to know about life onboard the International Space Station. Learn how space explorers from around the world celebrate holidays, sleep, call home, eat and drink, use the toilet and so much more.

JOHN A. READ is a telescope operator at the Burke-Gaffney Observatory, a member of the Halifax Centre of the Royal Astronomical Society of Canada (RASC) and recently graduated with a degree in astrophysics from Saint Mary's University. In 2020 he was presented with an RASC award for Excellence in Science Communication. He lives in Halifax, Nova Scotia.

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Introduction

The International Space Station (ISS), is a dream come true for space explorers. A space station expands humanity's reach into the Solar System. It is a permanent human presence in space, and a base for exploration. Humans have been living aboard the ISS continuously for over 20 years.

The ISS is a partnership between five space agencies and 15 nations. It is the most complicated project in history. Researchers from almost every nation have contributed to science on the ISS. Everyone on Earth has benefited, whether it's from better medicine, cleaner water or new technology. We can all thank the ISS for making our lives better and the Universe a lot more interesting.



Patch of the ISS showing the flags of member nations

ISS Space Agencies

- NASA (National Aeronautics and Space Administration)
- CSA (Canadian Space Agency)
- ESA (European Space Agency)
- JAXA (Japan Aerospace Exploration Agency)
- Roscosmos (Russian Space Agency)

Researchers have discovered many useful things about human, animal and plant biology. Some of the medical advances from ISS research include cancer-fighting drugs and treatments for Alzheimer's disease.

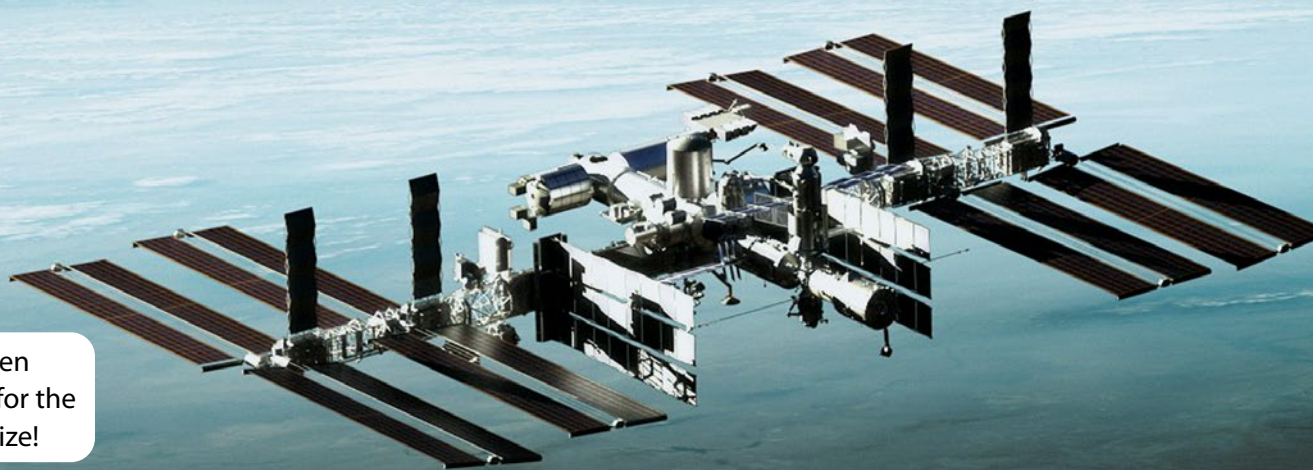
Advances in physics, chemistry and geology have also been made. These range from the discovery of a new state of matter to cold-burning fire. The ISS allows researchers to study the Earth below, observing natural disasters and monitoring climate change.

Technology built for the ISS helps prepare humanity to explore the Solar System. Astronauts have learned to make tools using 3D printing, grow food, recycle water and so much more.

ISS National Lab

Parts of the ISS are designated a United States National Laboratory. This means businesses can use the ISS to develop products, and teachers can use the space station to inspire kids.

The ISS has been nominated twice for the Nobel Peace Prize!



CHAPTER ONE

A DREAM COME TRUE

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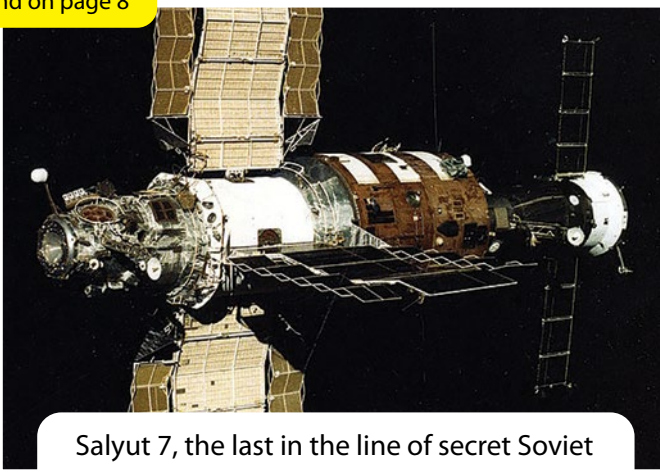
Illustration of Skylab, an American Space Station launched in 1973.

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Russian Mir Space Station in 1998, shortly before it reentered Earth's atmosphere over the Pacific Ocean.

Find on page 8



Salyut 7, the last in the line of secret Soviet space stations.

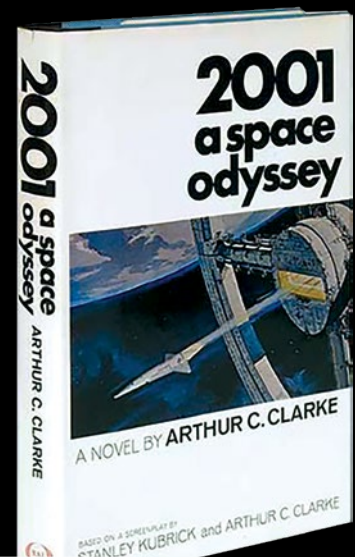
Astronauts and Cosmonauts

When this book refers to "astronauts," we're talking about anyone living or working in space. If we're talking about Russian astronauts specifically, we'll refer to them as **cosmonauts**.

1 Space Stations of Our Imagination

Space stations in science fiction often rotate to make gravity using **centripetal force**. So why doesn't the International Space Station (ISS) rotate? The ISS is designed for research in **microgravity**. A rotating space station would defeat the purpose of having the ISS in the first place.

That doesn't mean there will never be rotating space stations. Engineers have dreamed of rotating space stations since the early 1950s. Rotating spaceships may also be used on multi-year missions to the planets. This will help to keep astronauts' bones and muscles healthy and strong.



What's your favourite fictional space station?

This rotating space station was envisioned by the rocket scientist Wernher von Braun and painted by artist Chesley Bonestell.

If you were asked to design a space station, what would it look like?

2 The First Space Stations

If you're a kid reading this book, the International Space Station (ISS) has been around longer than you've been alive! But the ISS wasn't the first space station. The first space station was the Soviet-owned Salyut 1. Salyut 1 was launched to space in 1971. The first American space station, Skylab, was launched in 1973.



Skylab Space Station



Astronaut Alan Bean tests a "maneuvering unit" inside Skylab. Inventions like this were later used by space shuttle astronauts during spacewalks.

Secretive Space Stations

Between 1971 and 1986, the **Soviet Union** operated six space stations under a very secretive research program called Salyut.

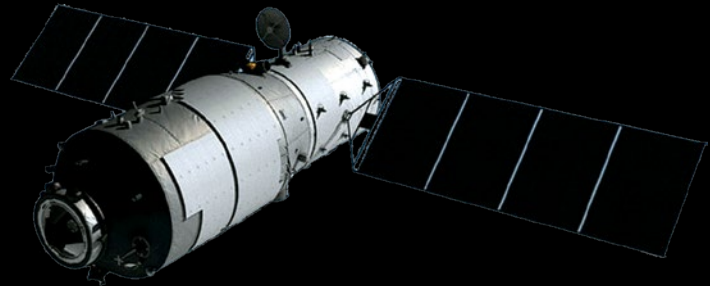
The first “big” space station was named Mir. It was built by the Soviet Union and operated from 1986 to 1998. NASA astronauts visited Mir on the space shuttle 10 times. This cooperation continues today with the partnership between Russia (part of the former Soviet Union) and NASA.

Tiangong

The ISS is not the only space station program today. The Chinese Space Agency had two space stations named Tiangong (Heavenly Palace). Tiangong-1 launched in 2011, and Tiangong-2 launched in 2016. Although Tiangong-1 and Tiangong-2 are no longer in orbit, China has a much larger space station planned, with the first **modules** launching in 2021.



Mir Space Station



3 Building the ISS

The International Space Station (ISS) is the largest object ever assembled in space. Assembly began with the *Zarya* module, which launched atop a Russian Proton rocket on November 20, 1998. It took 31 more assembly missions before the ISS was complete.

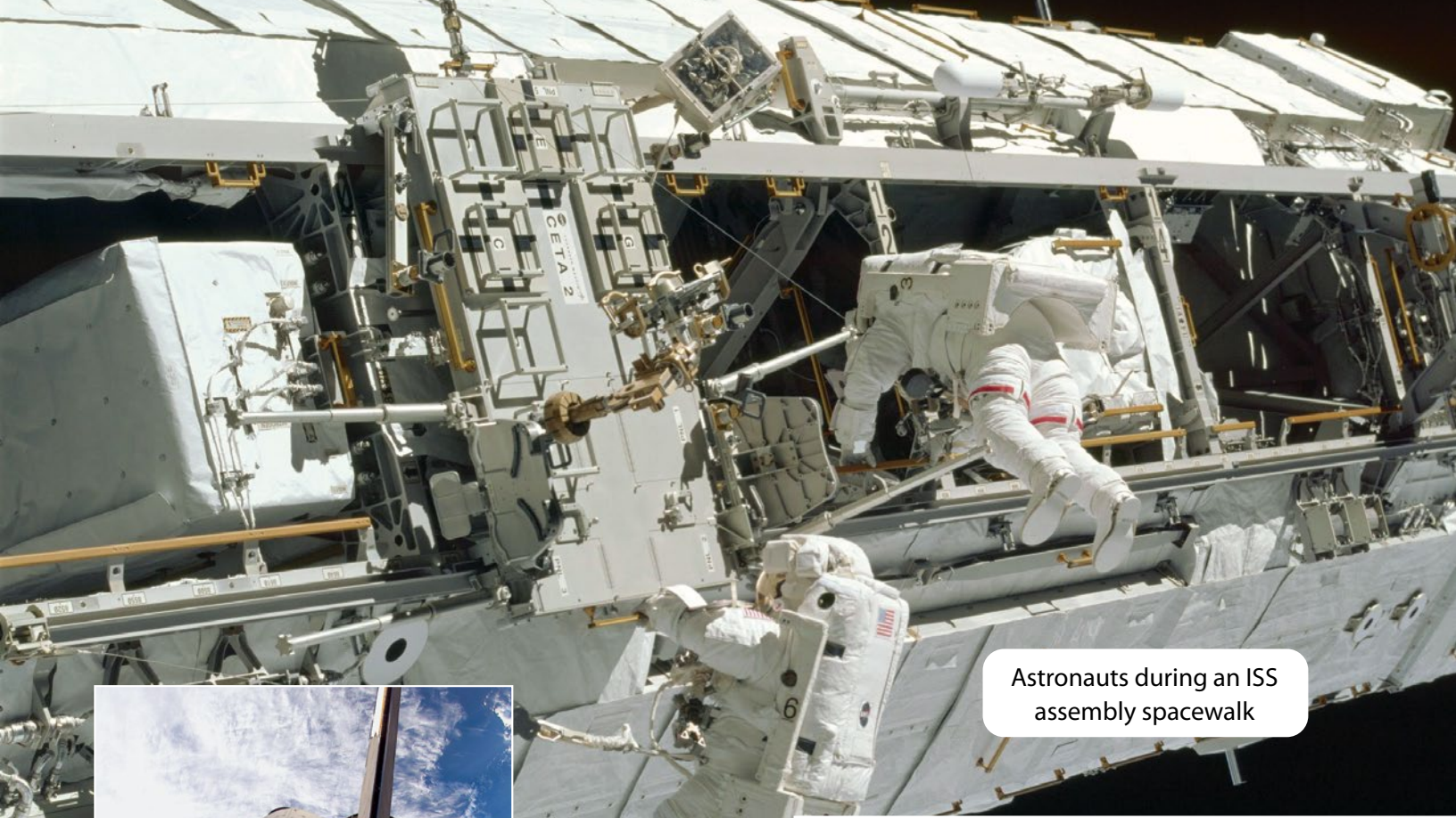
Most of the ISS was brought up in the space shuttle's cargo bay. The shuttle's Canadarm and the ISS's Canadarm2 were used to fix the parts in place. Spacewalking astronauts bolted the structure together and connected the wires and cables.



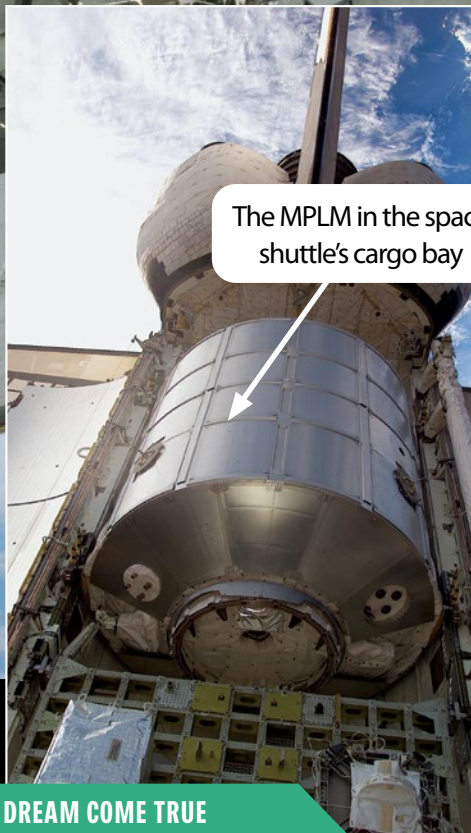
Space shuttle *Endeavour* on an ISS assembly mission with Canadarm2 and Canadarm.



Launch of a Russian Proton rocket containing *Zvezda*. *Zvezda* is the **command module** for the Russian side of the ISS.



Astronauts during an ISS assembly spacewalk



The MPLM in the space shuttle's cargo bay



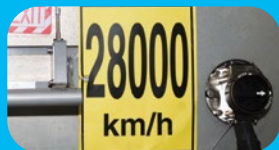
During construction, supplies were delivered using the Multi-Purpose Logistics Module, or MPLM. The MPLM launched in the shuttle's cargo bay. Once docked to the ISS, astronauts could go inside and unload the cargo. Here is Japanese astronaut Naoko Yamazaki inside the MPLM.

4 The ISS at a Glance

The first thing you notice about the International Space Station (ISS) are these massive solar arrays. Solar arrays use sunlight to provide power and charge the batteries for when the ISS enters the Earth's shadow. These panels rotate on **gimbals** so that they always face the Sun.

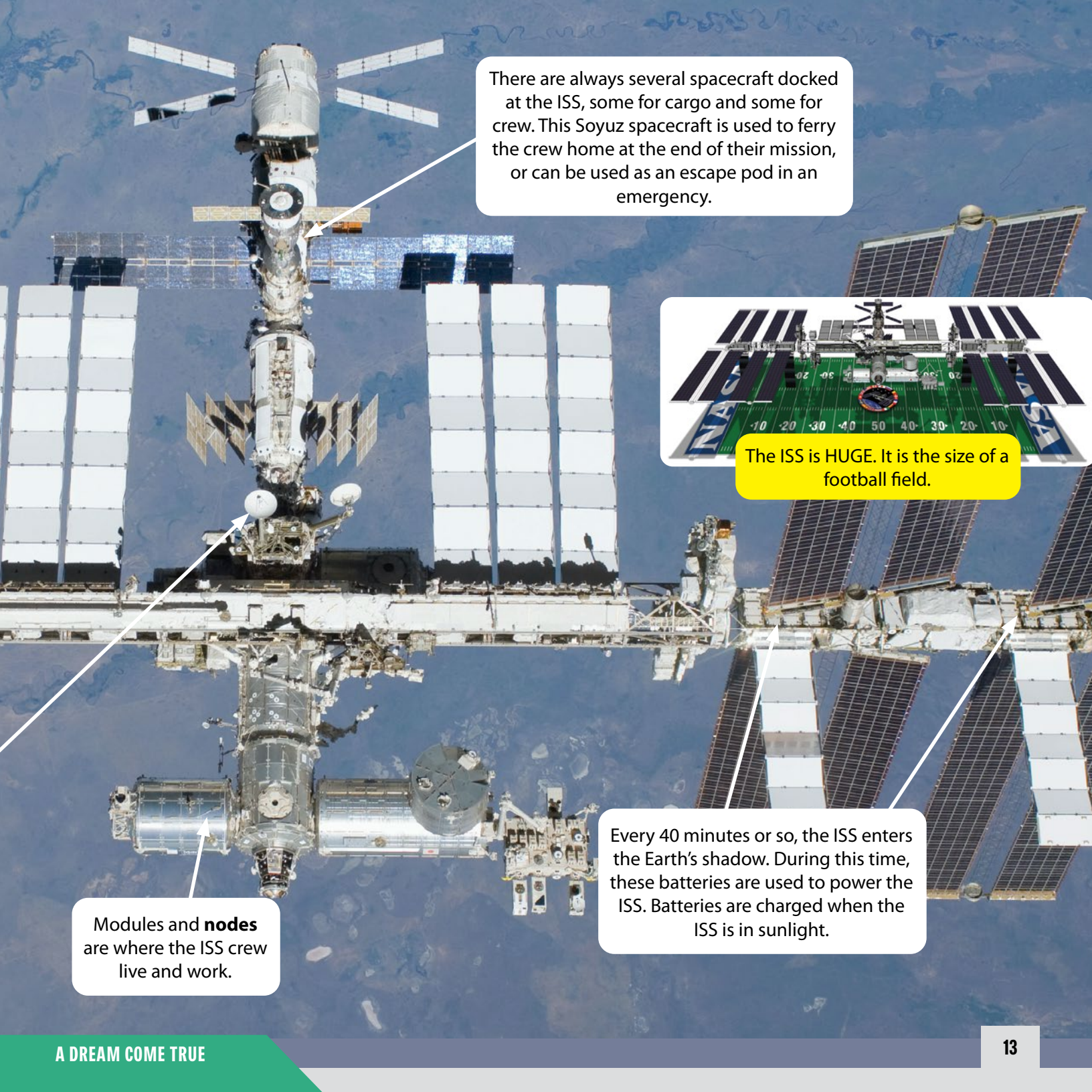
These white panels are radiators, used to release excess heat from the ISS into space. Radiators are used to cool the batteries as well.

The spine of the ISS almost looks like scaffolding. This is called **truss**, and it supports the large solar panels, the radiators and several scientific experiments. It also holds electrical and coolant lines. This truss on the ISS is 108.5 metres long!



The ISS orbits the Earth at over 27,500 kilometres per hour, at an altitude of around 400 kilometres, in a region of space called **Low Earth Orbit (LEO)**.

Antennas and dishes provide two-way communication with the Earth, such as voice, video and internet.



There are always several spacecraft docked at the ISS, some for cargo and some for crew. This Soyuz spacecraft is used to ferry the crew home at the end of their mission, or can be used as an escape pod in an emergency.



The ISS is HUGE. It is the size of a football field.

Modules and **nodes** are where the ISS crew live and work.

Every 40 minutes or so, the ISS enters the Earth's shadow. During this time, these batteries are used to power the ISS. Batteries are charged when the ISS is in sunlight.