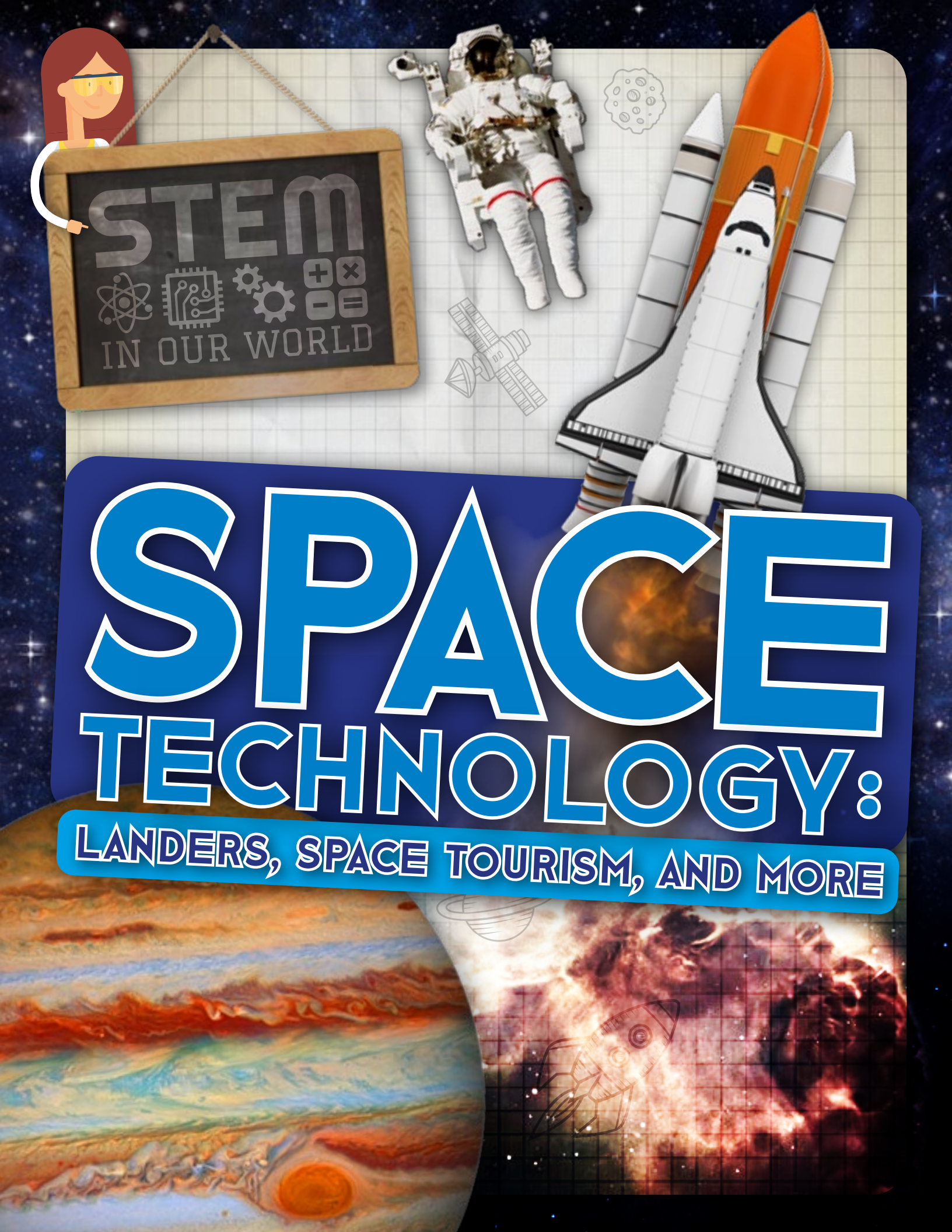
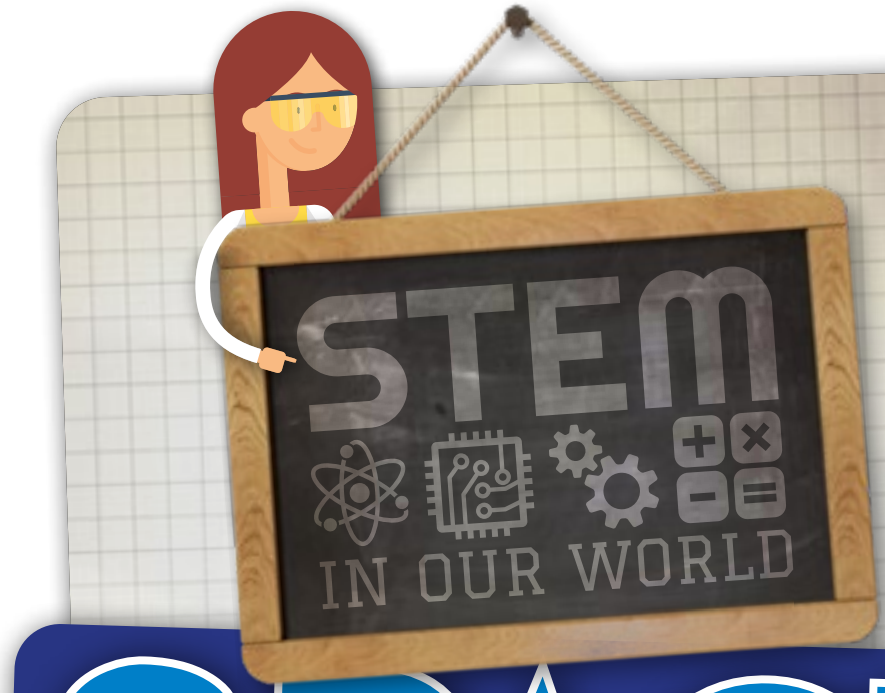


SPACE TECHNOLOGY:

LANDERS, SPACE TOURISM, AND MORE



SPACE TECHNOLOGY:

LANDERS, SPACE TOURISM, AND MORE

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BookLife
PUBLISHING

BookLife Publishing Ltd.
King's Lynn
Norfolk PE30 4LS

ISBN: 978-1-83927-660-6

A catalogue record for this book is available from the British Library.

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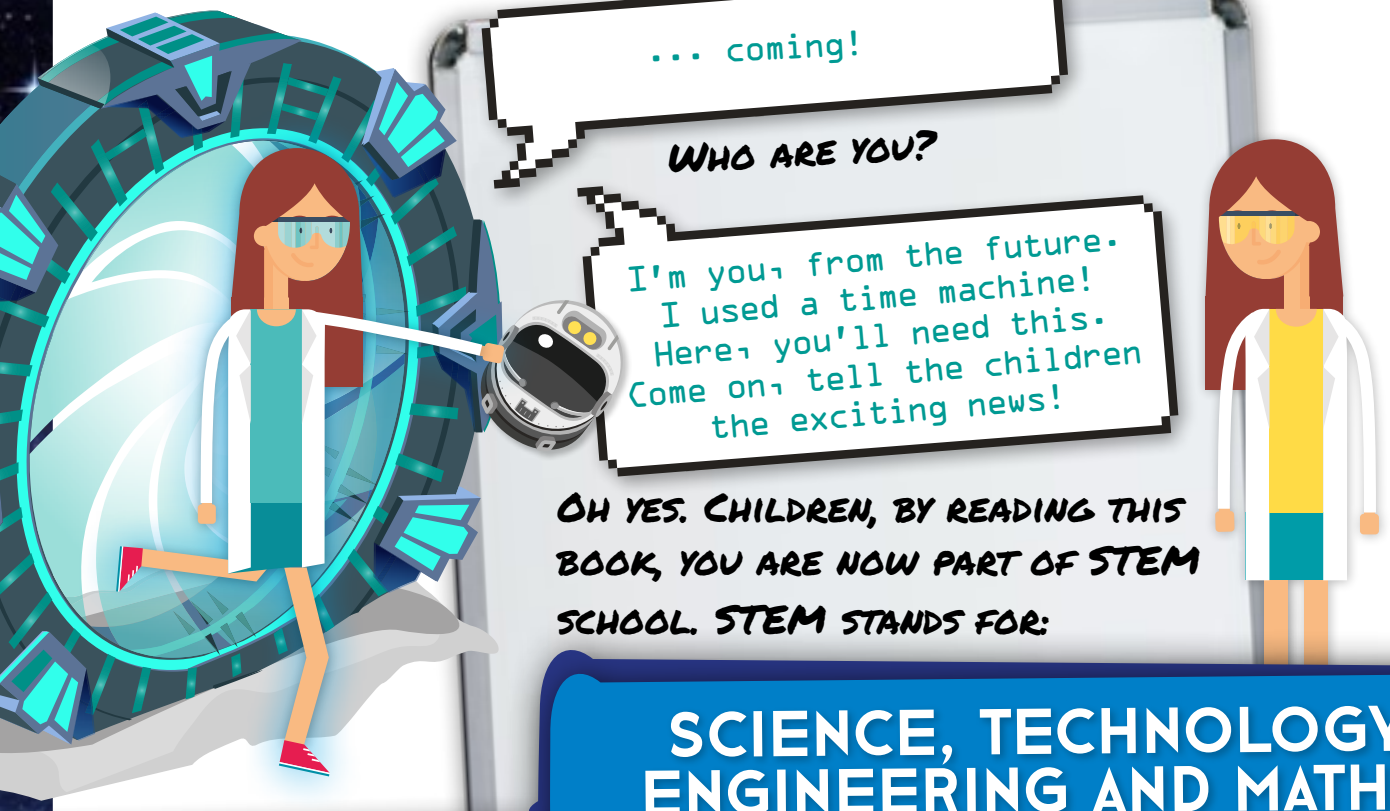
CONTENTS

WORDS THAT LOOK LIKE *THIS* ARE EXPLAINED IN THE GLOSSARY ON PAGE 31.

WELCOME TO STEM SCHOOL

MEET YOUR TEACHER

ATTENTION, STUDENTS. MY NAME IS PROFESSOR TESS TUBE, AND I AM YOUR TEACHER. TODAY WE ARE GOING ON A SCHOOL TRIP TO SPACE! I'VE GOT MY SPACE HELMET – OH, WHERE'S IT GONE?



OH YES. CHILDREN, BY READING THIS BOOK, YOU ARE NOW PART OF STEM SCHOOL. STEM STANDS FOR:

SCIENCE, TECHNOLOGY, ENGINEERING AND MATHS.

BUT STEM ISN'T ALL ABOUT TIME TRAVEL. STEM IS IMPORTANT IN ALL SORTS OF WAYS.

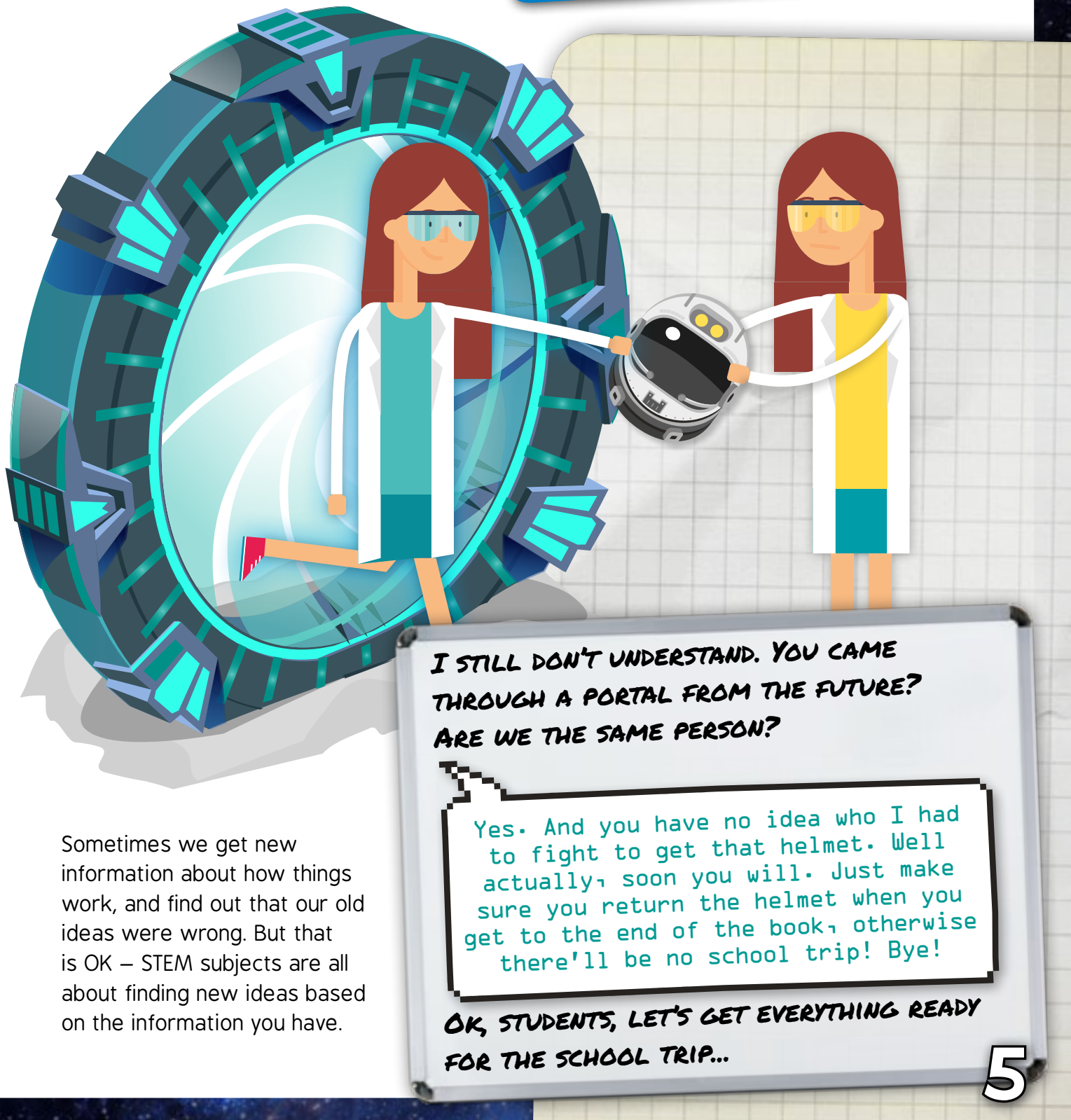
Why Is STEM Important in All Sorts of Ways?

You can probably find STEM in almost every part of your life. Here are a few examples:

- Computers at school, which help us learn
- Toasters, kettles and ovens at home, which help us make food and drink
- Hospital machines and medicine, which help us live longer
- Cars, boats and planes, which help us travel around the world quickly
- Weather reports that tell us what the weather is going to be like

It's All About the Facts

Studying STEM helps us understand and solve problems in the real world. When we have an idea of how something might work, we test it again and again to make sure it is right. Then we can create machines and ***systems*** to solve the problems we have.



Sometimes we get new information about how things work, and find out that our old ideas were wrong. But that is OK – STEM subjects are all about finding new ideas based on the information you have.

STEM AND SPACE

What Is Space?

Looking into the night sky, you might see stars, meteors and the big, bright Moon filling up space. But how far up is space? Most people agree that space starts at a point called the Karman Line, which is 100 kilometres (km) high. At that height there is very little air or **atmosphere**. On the other side of that line are the vast, cold depths of space.

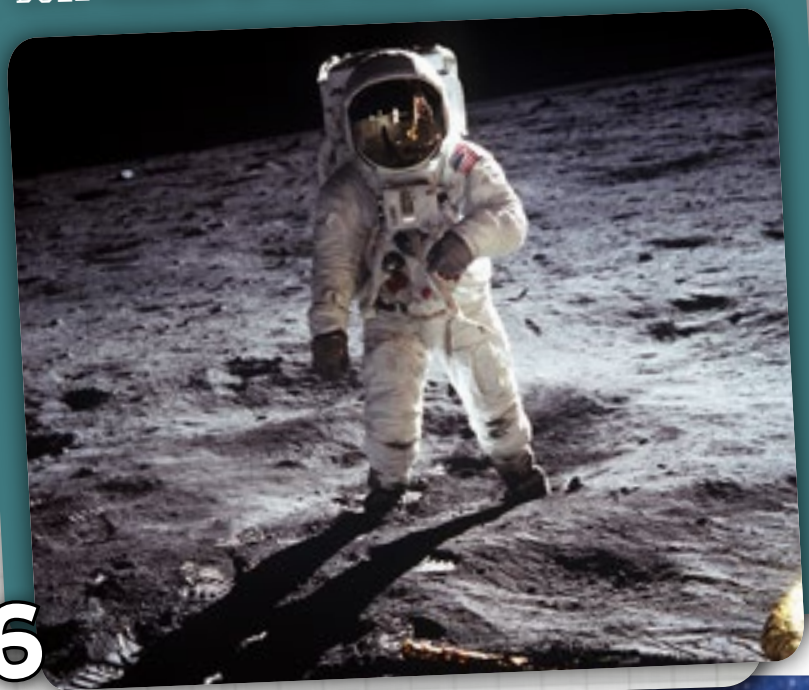
Important Space Travel Events

A satellite is an object that **orbits**, or goes round, a planet. The first satellite sent into space was called Sputnik in October, 1957.

A Model of Sputnik

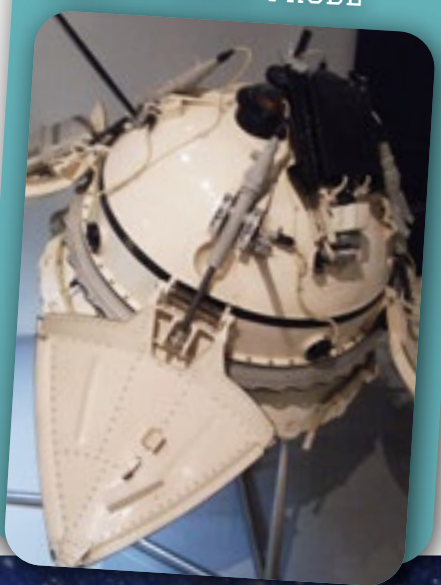
In July, 1969, Neil Armstrong became the first person to walk on the moon. Armstrong and his pilot, Buzz Aldrin, spent 21 hours on the moon, and collected lots of moon dust to bring back to Earth.

Buzz Aldrin on the Moon



Humans have not yet made it to Mars, but we have sent lots of space **probes**. In May 1971, Mars 3 became the first space probe to successfully land on Mars. However, it only lasted 20 seconds before it broke down.

Mars 3 Space Probe

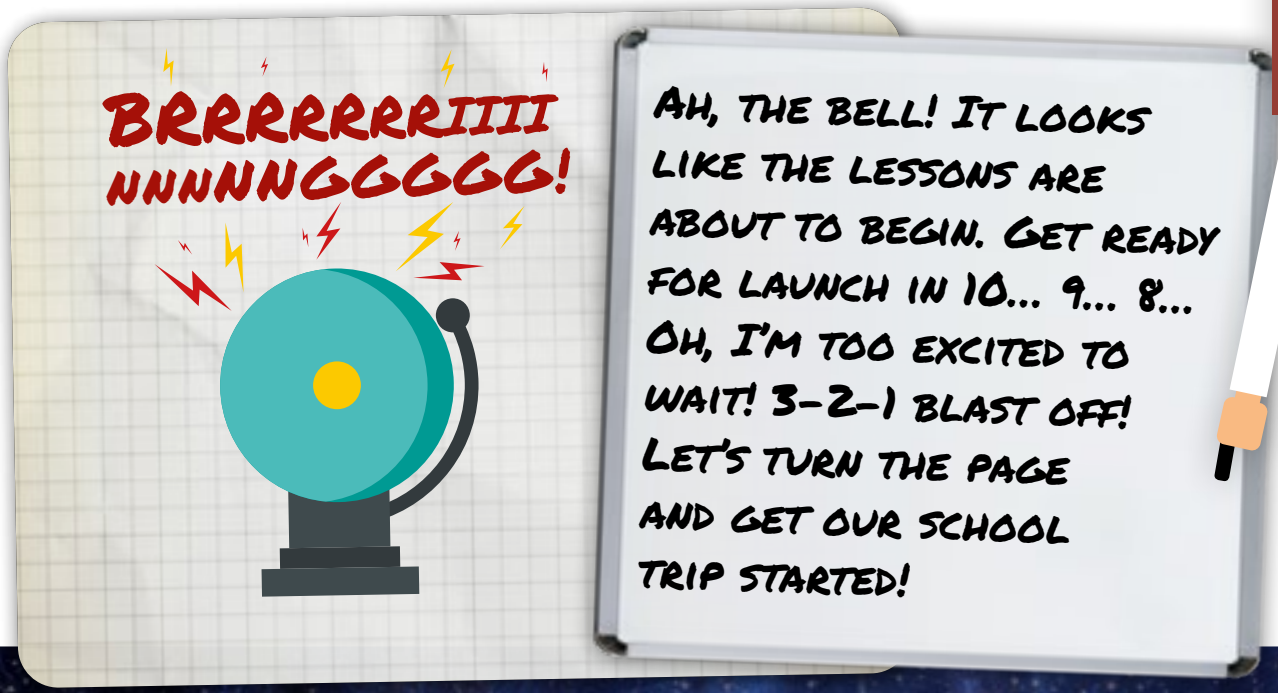


Still More to Do

Humans have a lot to learn about space. STEM research is very important because there is so much we do not understand. Exploring other planets and moons can tell us a lot about our own planet, and why things are the way they are. If we can find alien life, we might be able to learn and understand what life is and why we are here. These are some of the biggest questions scientists have, and there is only one way to find out: go and explore!

RESEARCH INTO SPACE TRAVEL MIGHT HELP US IN OTHER WAYS. FOR EXAMPLE, WE MIGHT LEARN HOW TO COLLECT RESOURCES FROM OTHER PLANETS.

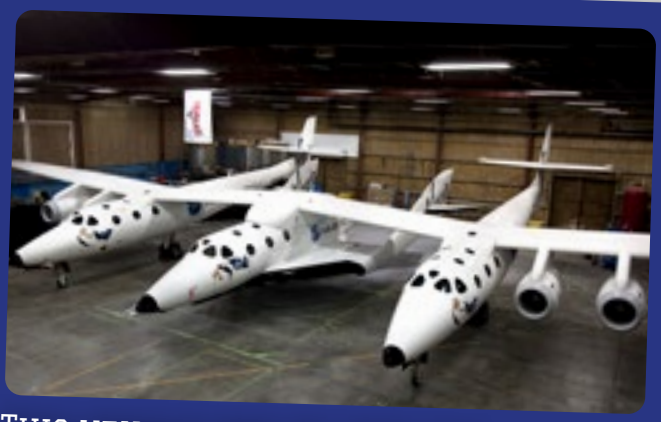
Humans have a need to explore. Before we rocketed into space, sailors and pirates sailed the seas to find out what was over the horizon. Divers go deep into the oceans to see what is at the bottom. Exploring and learning is just what we do. STEM research into space travel can help us go on the biggest and most mysterious adventure there is – an adventure around the universe.



SPACE TOURISM

What Is Space Tourism?

Today's astronauts are very clever scientists who have trained all their life for the chance to go to space. However, in the future, anyone might book a trip to distant moons and planets, just like they were booking a holiday. This idea is called space **tourism**, and it is the chance for ordinary people to go into space. Space holidays might take place on giant space-cruise ships, where people will be able to travel past Venus or get a picture with Saturn's rings. Today, only the richest people in the world would be able to afford it.



This vehicle may be used for space tourism in the future.

A Tourist in Space

The first space tourist was a man called Dennis Tito, who travelled to the International Space Station (ISS) in 2001. He spent eight days on board the ISS. Companies all over the world are working to make space tourism easier and cheaper. One idea is to carry the spacecraft up very high in the atmosphere with a plane, so the spaceship is closer to space when it launches.

The International Space Station

Dennis Tito

DENNIS TITO'S SPACE TRIP COST HIM AROUND 20 MILLION DOLLARS.

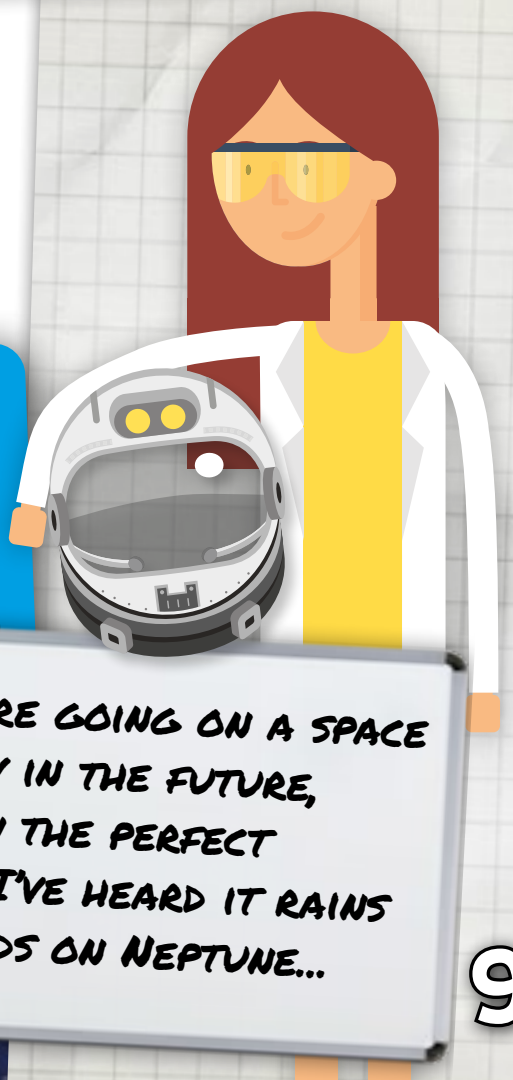
Training to Be a Tourist

Space tourists go through lots of training so they can deal with any problems when the experts are not around. Current tourist training lasts for eight months. The tourists must be very healthy, and must be comfortable in small spaces. Tourists are also tested to see how **vulnerable** they are to space sickness. This is a type of **motion sickness** like sea sickness. It can make people feel distracted, tired or even actually sick!

About two thirds of astronauts have had space sickness at some point. They call it 'space fog'.

This astronaut is training underwater because there is a similar feeling of weightlessness as there is in space.

One day, space tourism will be less like work and more like a holiday. At the moment it is difficult and very expensive to get into space. But as more companies begin to research into space tourism, the technology will become safer and cheaper. Future space tourists will still need a little bit of training, but hopefully the whole thing will probably be a bit more relaxing.



GRAVITY

What Is Gravity?

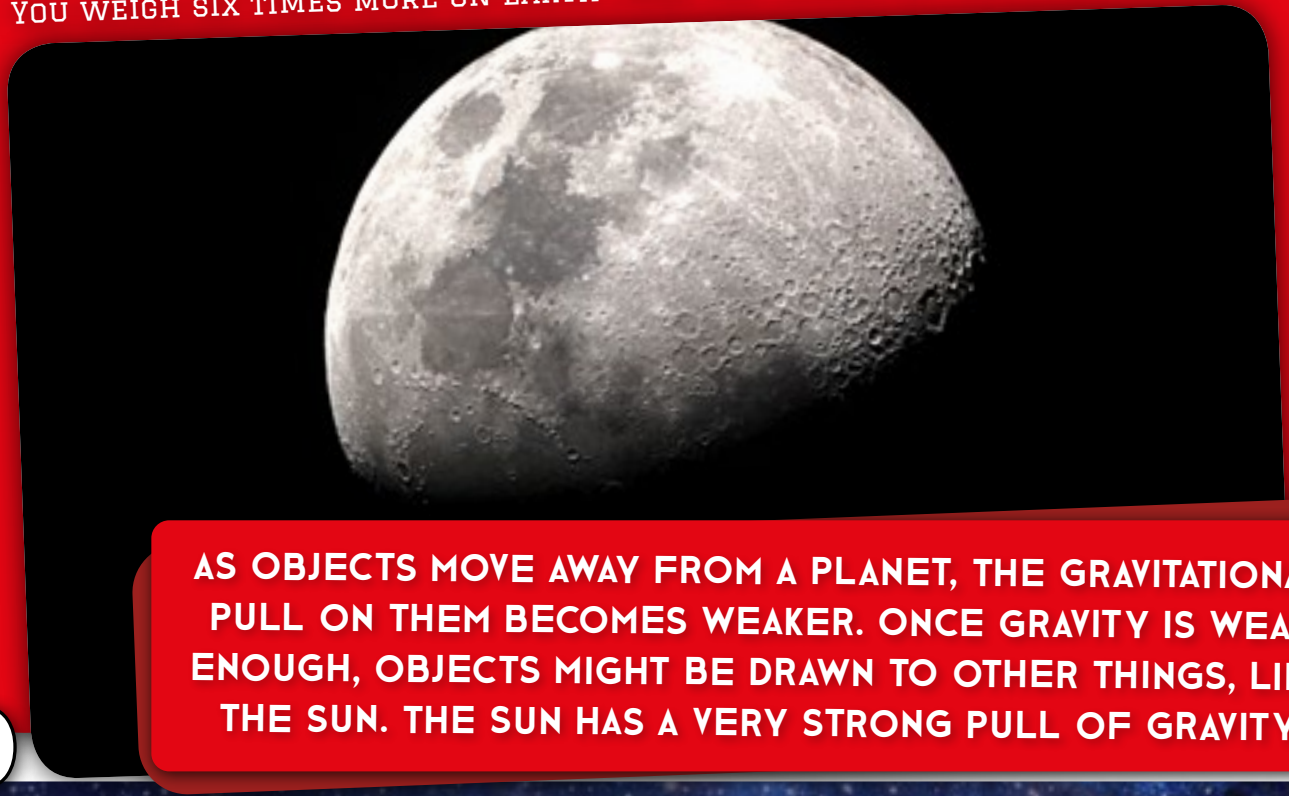
Gravity is an invisible force that pulls objects. Everything with **mass** has gravity. The more mass something has, the stronger its force of gravity is. People don't float around on Earth because the planet is so massive that its gravity is always pulling us down to the ground. The more mass an object has, the more it is pulled by Earth's gravity. This is why heavy objects like cars are impossible to pick up.

The brick has more mass than the feather, so is heavier.

Gravity on Other Planets

Because different planets are different sizes, they have different strengths of gravity. A planet like Jupiter is so big that it draws in things from much farther away. You would also be heavier on Jupiter because you would be pulled down by gravity more. However, on smaller planets, like Mercury, you would be lighter because the gravity would be weaker.

You weigh six times more on Earth than you would on the Moon.



As objects move away from a planet, the gravitational pull on them becomes weaker. Once gravity is weak enough, objects might be drawn to other things, like the sun. The sun has a very strong pull of gravity.

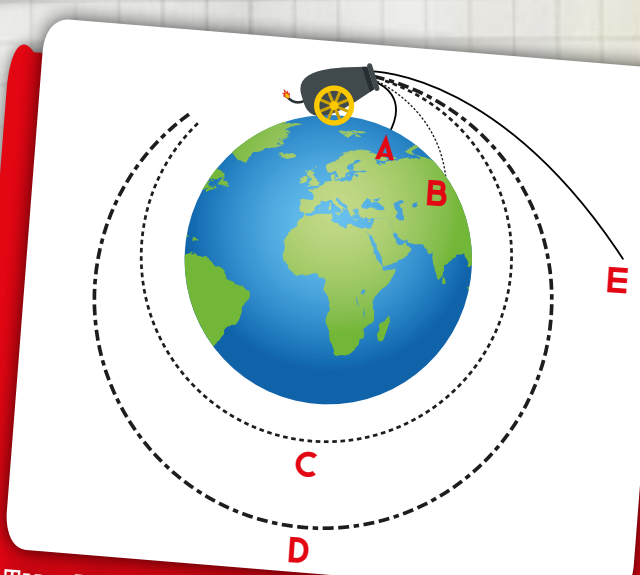
Weightlessness

Every astronaut who has been into space has felt weightless. This means they could float through the air and touch the ceiling as if they were swimming. However, there are problems with weightlessness – astronauts must learn how to eat, drink and sleep without letting everything float around.

Weightless Astronauts

I know what you're thinking: how do people go to the toilet in space? Let's just say it involves something that is a cross between a toilet and a hoover. Ew.

Astronauts on board the ISS float as they travel. However, this is not because there is no gravity – it is because the ISS is falling and quickly travelling forward at the same time. The downward pull of gravity and the forward thrust of the ISS keep the space station moving round the Earth in a circle. If an object travels fast enough, the ground curves away before it hits the floor. This is what the ISS is doing. Astronauts are falling with the ISS, so they don't touch the floor, making them feel weightless.



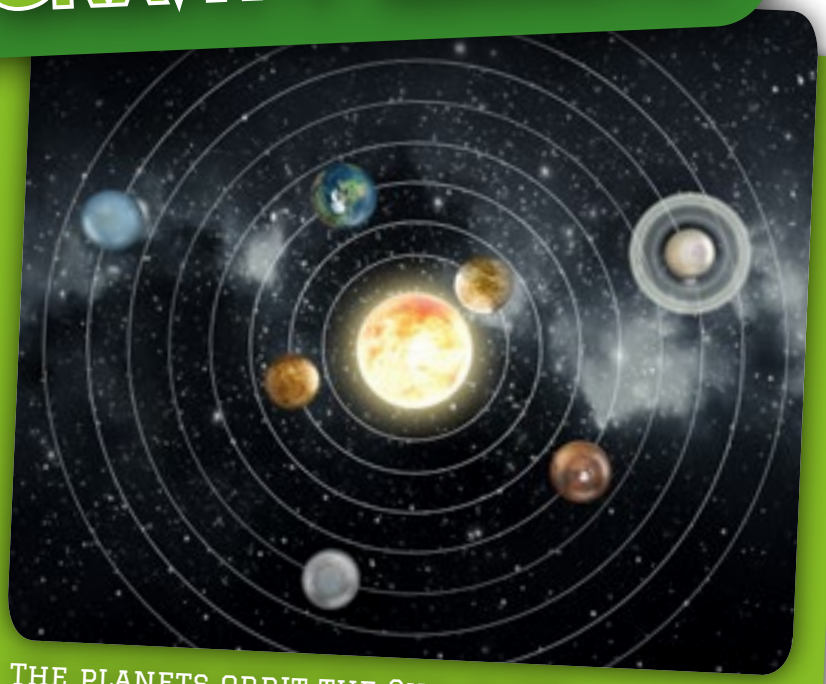
The ISS moves at 28,000 kilometres per hour (kph) to keep travelling, or falling, around the Earth.

Astronauts usually stay on board for around six months at a time. The longest single stay in space was done by Valery Vladimirovich Polyakov. He spent 438 days on another space station, called Mir.

Orbits and Gravity Assists

Orbits

When things like the ISS constantly fall around a planet or a sun, there is a special word used: orbiting. Natural and manmade objects, like moons and space stations, orbit when the force of gravity is balanced with the speed that they are going forward. It is like circling round a whirlpool. Bigger things, like the Sun, have stronger gravity, so lots of objects orbit them. Many planets have moons. A moon is a natural satellite which orbits a planet.



The planets orbit the Sun in our solar system.

Voyager 1 used a gravity assist around Jupiter to reach speeds of 17 kilometres per second.

Gravity Assists

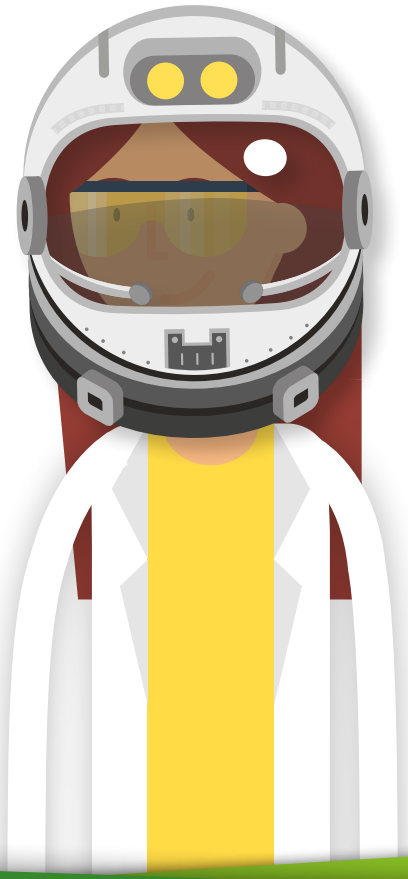
A gravity assist is a way of flying close to a planet or the Sun and using its gravity to get a speed boost or to change direction. Gravity assists are useful because they allow the spacecraft to travel faster without using any **fuel**.

The Earth speeds through space at 30 kilometres per second.

How Do Gravity Assists Work?

Imagine gravity is like a rope. The closer an object gets, the more the planet reels in the rope. But planets aren't sitting still. They are hurtling round a sun at surprisingly high speeds. Spacecrafts can use gravity like a rope to ride along with a planet for a while, and use the extra speed to zoom off in another direction.

It is important not to get too close to a planet, though. If you did, gravity would pull your spacecraft all the way down, and you would crash land and have to wait months and months to be rescued. You'd miss school and wouldn't get any homework and... what do you mean, this isn't as bad as it sounds...?



Jupiter

Jupiter is a very useful planet for gravity assists.

Jupiter is the biggest planet in our solar system, and so has a very strong pull of gravity. Probes and spacecrafts sometimes use Jupiter when going on missions farther out into the solar system, away from the Sun.

Jupiter has around 67 moons.

Jupiter's gravity ***affects*** many asteroids and comets which are flying around or near our solar system. Some scientists think that Jupiter acts as a protector for our solar system by hoovering up dangerous space rock. However, other scientists think that Jupiter is picking up and throwing more space rocks towards us than we would usually get. Either way, scientists agree that Jupiter's gravity has a huge effect on our solar system.

Jupiter is so large that all of the other planets in our solar system could fit inside it together.

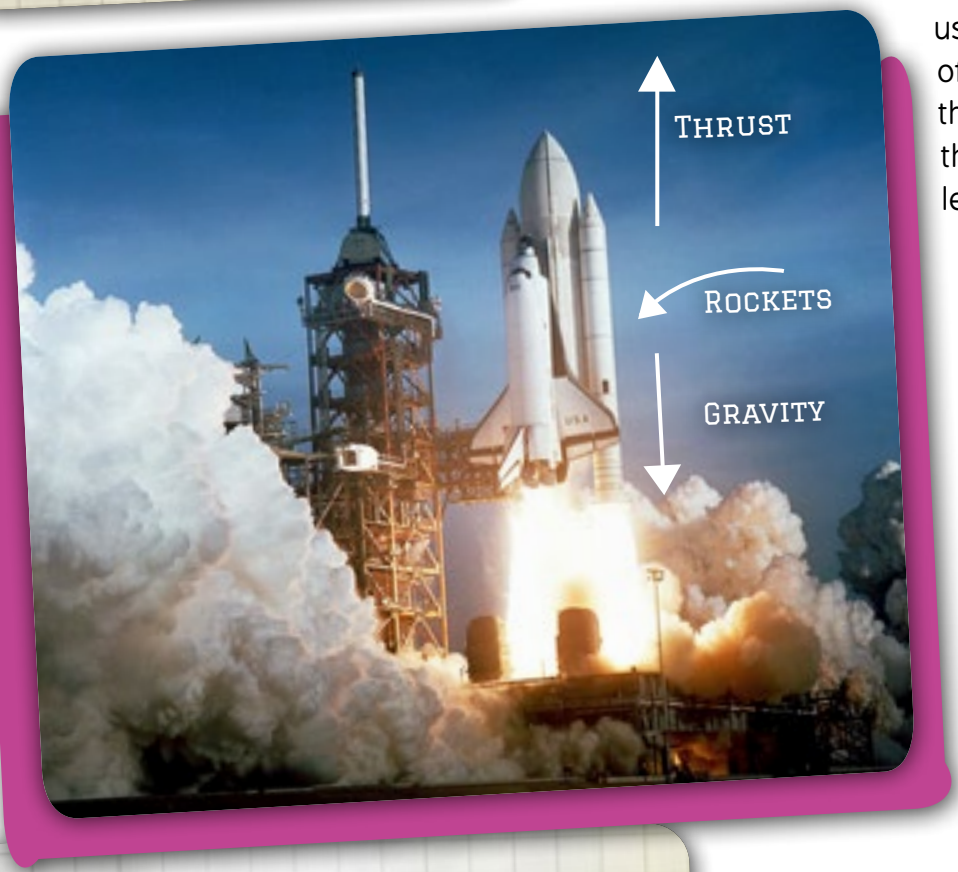
The Great Red Spot can be seen on pictures of Jupiter. It is actually a giant storm.

ROCKET SCIENCE

To fly a rocket into space, there is one thing you need to make sure of. The force of the rocket **BOOSTERS** need to be stronger than the force of gravity. Of course, rocket science can get a little more complicated than that.

The Force of Gravity Vs the Force of Thrust

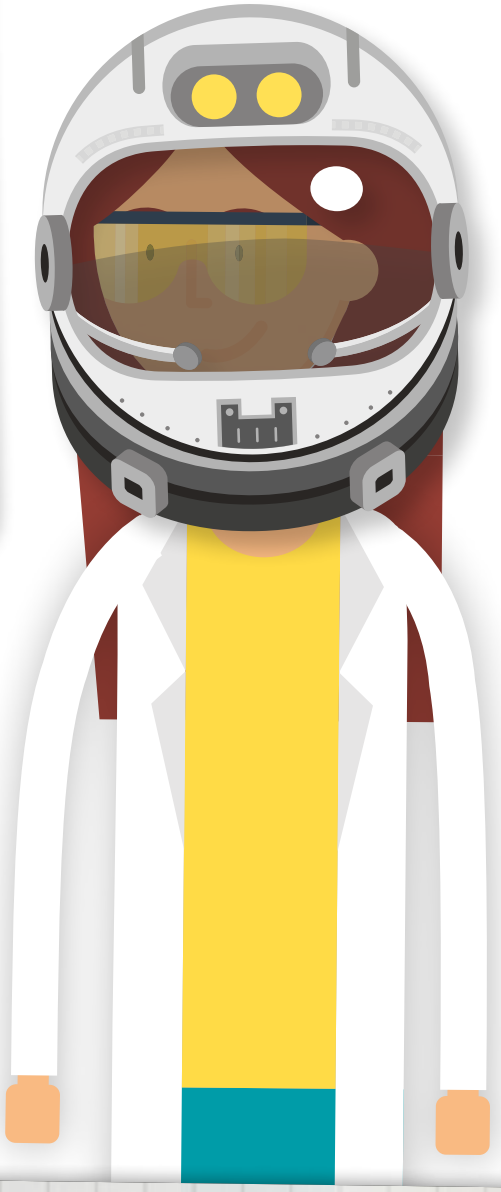
A force is an invisible flow of energy which pushes or pulls things. The force of gravity pulls objects in. Bigger, **DENSER** objects are pulled harder, and so are heavier. Thrust is the name of the force that pushes the spacecraft forward. Many spacecrafts use rockets, which burn **GAS** to create a fiery blaze. The blaze pushes the spacecraft in the direction it is pointing: usually up. If that force of thrust is bigger than the force of gravity, the spacecraft will leave the Earth.



One of the main problems in space travel is to do with fuel. Rockets need fuel. However, fuel is heavy, which means the spacecraft will be pulled even harder by gravity. This means even more thrust, and also fuel, is needed. A lot of spaceflight research goes into making spacecrafts light, without running out of fuel.

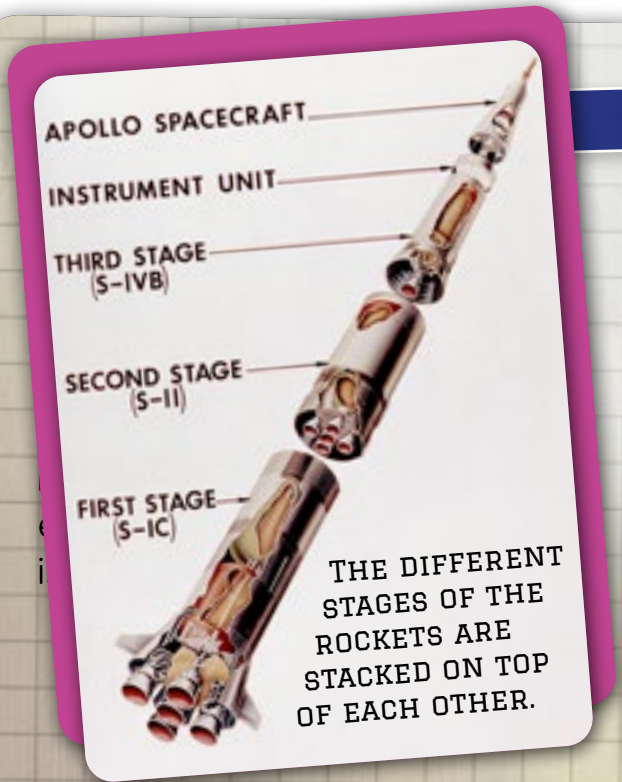
Rocket Boosters and Fuel Tank

WHENEVER I UNVEIL MY NEW SPACECRAFTS, THE ASTRONAUTS DON'T SEEM EXCITED BY THE GIANT ROCKETS FULL OF FIRE AND EXPLOSIONS. THEY DO SEEM EXCITED ABOUT THE SHIELDS THAT STOP THE SPACECRAFT MELTING, THOUGH. I WONDER WHY THAT IS?



Heatshields

Have you seen a meteor at night? They are bright flashes caused by rocks entering Earth's atmosphere. The rocks burn up because they are flying through the gases in the atmosphere. This causes **friction**, which creates a lot of heat. Too much heat can also melt a spacecraft coming back to Earth. To stop this, a heatshield is used. The heatshield, which is made out of **ceramic** materials, is stuck to the front of the spacecraft to absorb all the heat and keep the astronauts safe.



THE DIFFERENT STAGES OF THE ROCKETS ARE STACKED ON TOP OF EACH OTHER.

Multi-Stage Spacecrafts

A multi-stage spacecraft is a spacecraft that gets rid of certain parts when it is finished using them. For example, if a drum of fuel becomes empty, it is detached and thrown away. This makes the spacecraft lighter and easier to fly. Each detachable part is called a stage.

ALL SATELLITES AND SPACECRAFTS LAUNCHED FROM EARTH HAVE USED MULTI-STAGE ROCKETS.

LANDERS

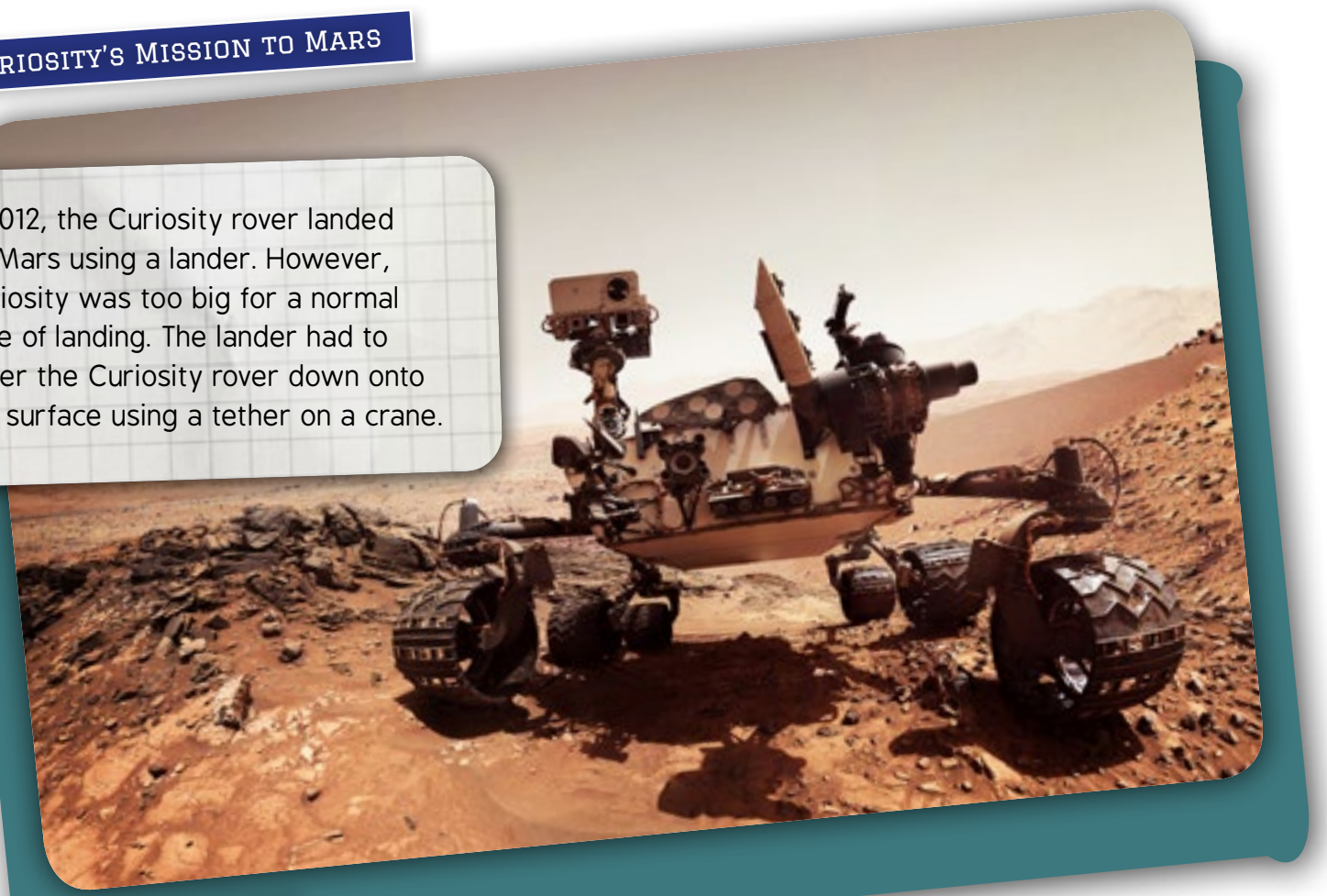

The Mars 3 Lander

A lander is the part of a spacecraft that lands on the **surface** of a planet or moon. It may carry astronauts or robots. Landers are often used as a protective outer layer for another spacecraft inside.

A lander has many ways to make sure it gets to the planet's surface safely. First of all, thrusters are fired in the opposite direction to the fall as the spacecraft nears the planet. When the spacecraft is low enough, a huge parachute may be used. If carrying a **rover** inside, landers might also have airbags inside, which protect the rover. After hitting the surface, the lander opens up like petals on a flower, allowing the rover to drive off.

Curiosity's Mission to Mars

In 2012, the Curiosity rover landed on Mars using a lander. However, Curiosity was too big for a normal type of landing. The lander had to lower the Curiosity rover down onto the surface using a tether on a crane.


Curiosity Rover

Where Have Landers Been?

The European Space Agency (ESA) sent a spacecraft called Rosetta to land on a comet in 2014. Its mission included studying what the comet was made from. A lander called Philae was used to get Rosetta to the surface. Unfortunately, some of Philae's thrusters and **harpoons** failed, meaning that the lander bounced and did not land where it was meant to.

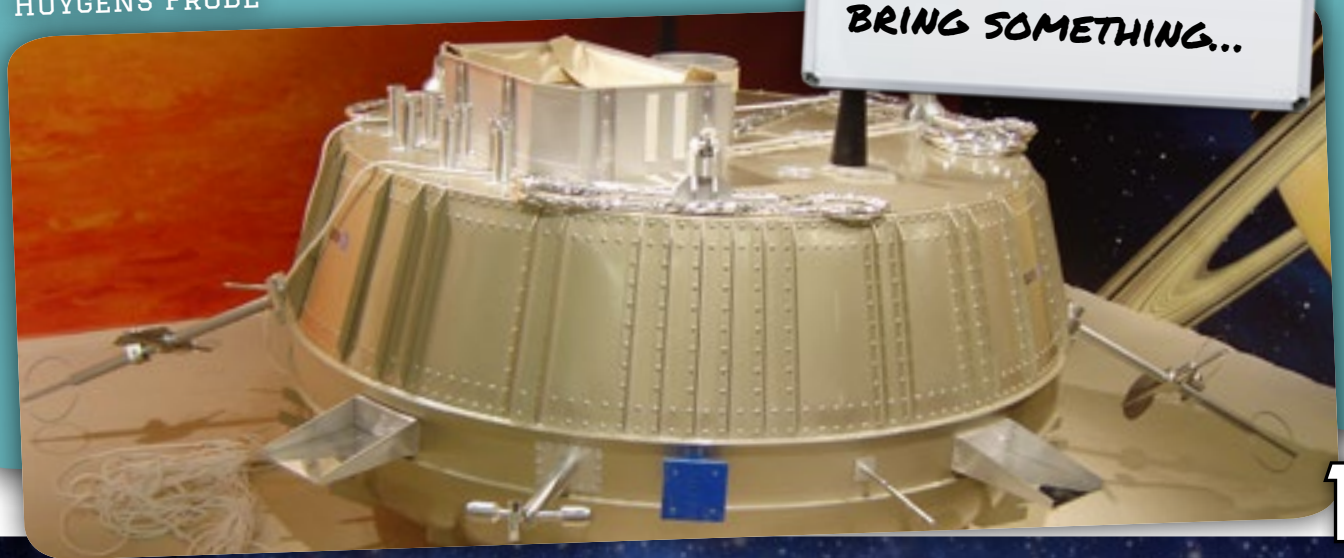
Rosetta was still able to complete most of its scientific experiments.

In 1970, Russia sent a lander to Venus called Venera 7. It was the first successful soft-landing on another planet in history. Although some data was transmitted back to Earth, there were a few problems which caused the spacecraft to stop working half an hour after it landed.

In 2005, the ESA sent a lander which travelled with Cassini. Cassini was a probe launched by **NASA** which went to Saturn. The lander was called Huygens, and it went to Titan, one of Saturn's moons. Huygens sent data back for 90 minutes. It is currently the farthest away a lander has ever landed.

Rosetta and Philae

Huygens Probe



SPACESUITS

Most of an astronaut's time in space is spent inside a spacecraft. However, sometimes they need to leave the spacecraft and do science experiments, or repair satellites or spacecraft equipment. These missions are called spacewalks. Astronauts have to wear special suits to survive in space, called spacesuits.

SPACEWALKS USUALLY LAST BETWEEN FIVE AND EIGHT HOURS.

BIG, BAD SPACE

Most of space is a **VACUUM**. Unlike an atmosphere, which is full of air, a vacuum is mostly empty. This makes space a dangerous place for humans. Not only is there no air to breathe, but there is no air pressure either. Air is made up of lots of tiny **PARTICLES** that are all bouncing around. These particles bounce and push against objects in the air. This push is called air pressure. Humans are used to living with air pressure pushing them from all around. But without air pressure, all sorts of gruesome things can happen. Spacesuits, however, can keep an astronaut completely safe in the vacuum of space.

A VACUUM WOULD CAUSE THE BODY TO SWELL TO TWICE ITS SIZE AND CREATE BUBBLES IN THE BLOOD.

IN 1966, A TECHNICIAN RIPPED HIS SUIT WHILE INSIDE A VACUUM TESTING CHAMBER. HE FELT THE SALIVA ON HIS TONGUE BOIL BEFORE HE PASSED OUT. HE WAS RESCUED, AND SURVIVED WITHOUT ANY LASTING INJURIES.

BLOOD BUBBLES? BOILING TONGUES? ASTRONAUTS HAVE TO BE SUPER SMART, BUT I'M STARTING TO THINK THE SMARTEST PEOPLE ARE THE ONES WHO STAY SAFE ON EARTH...

The spacesuit was invented to stop all of these things, and keep people in space safe. There are many types of spacesuit, but here are the main things that each one has:

There is a light on the helmet.

There is a straw that supplies the astronaut with water, and a type of cereal bar to eat.

The backpack sends oxygen to the helmet, and takes carbon dioxide away.

On the wrist is a mirror so the astronaut can see the display and control module

The backpack has a battery.

Astronauts have a two-way radio, so they can talk to their team.

The display and control module has lots of gauges and electronic screens which let the astronaut control the suit and check things like oxygen levels.

There is a network of tubes filled with water which can carry heat away from the skin and cool the astronaut down.

The suit is filled with air to create air pressure around the astronaut.

To stop themselves from floating away, spacesuits are usually connected to the spaceship and have small thrusters to help them move in space.

SPACE PROBES

Robots before Humans

A probe is a spacecraft with no astronauts on it. It has one mission: to explore and collect information, and send that information back to Earth. Probes can measure all sorts of things, such as temperature, strength of gravity, and what the atmosphere and ground is made up of.

This is the Galileo probe, which explored Jupiter.

Probes are a good way to explore the solar system without having to send humans. It can be dangerous to send humans into space. It is also much more expensive and complicated, because people need lots of things to survive. Robotic probes are simpler and lighter, which makes it easier for them to fly farther.

How Do Probes Send Data to Earth?

Probes have an ***antenna*** which they use to send information back to Earth in the form of radio waves. Earth has a system of huge radio antennas placed around the world, which are especially good at picking up the weak signals from faraway probes. This system of radio antennas is called the Deep Space Network (DSN), which was set up by NASA. There are antennas in Spain, America and Australia, and on satellites orbiting Earth.

It can take a while for radio signals to reach Earth. Probes collect and send a lot of information, and the radio waves might need to travel for billions of kilometres before they reach Earth.

Meet Voyager 1

On September 5th, 1977, NASA launched a space probe called Voyager 1. Its mission was to visit the four biggest planets in our solar system: Jupiter, Saturn, Uranus and Neptune. The planets were lining up in a way that would make Voyager 1's journey much easier. Voyager 1 was equipped with all sorts of instruments to collect information, including a camera, a magnetic field **sensor**, and a 'cosmic ray subsystem', which looks for high-energy particles.

Voyager 1

Voyager 1's journey would only have been possible every 176 years.

Voyager 1 is the farthest human-made object from Earth. After travelling for more than 40 years, Voyager 1 is now outside the solar system, collecting information about **interstellar** space. Over the years, more and more of Voyager 1's instruments have been shut down to save power. It is thought that in 2036 the power supply will be too weak to do anything at all, and Voyager 1 will just be an empty machine, slowly drifting through the blackness of space.

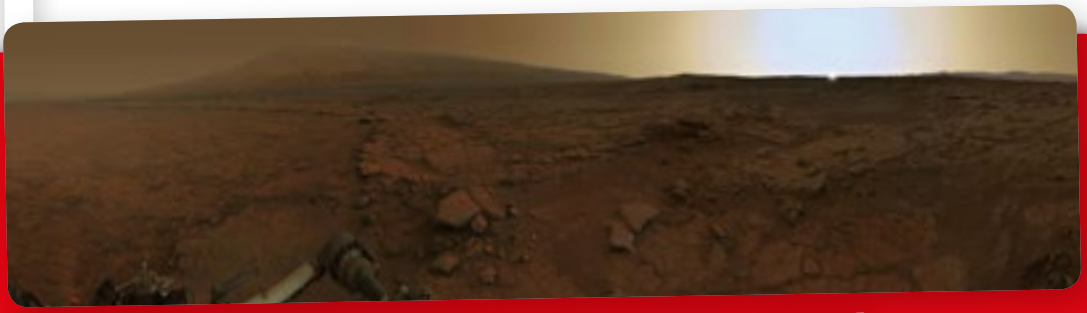
In 2025, the last of the instruments will be shut down, and Voyager 1 will stop sending information back to Earth.

HOW TO POWER A SPACE PROBE

OH DEAR, I SEEM TO HAVE LOST MY HELMET. MAYBE I LEFT IT WITH THOSE SPACE PROBES ON THE LAST PAGE. WHILE I FIND IT, YOU ARE GOING TO LEARN ABOUT RADIO-ISOTOPE THERMOELECTRIC GENERATORS – YOU MIGHT WANT TO CALL THEM RTGS FOR SHORT. GOOD LUCK!

POWER TO THE PROBE

Many probes have solar panels, which turn the Sun's light into electricity. However, as the probe gets farther away from the Sun, the light becomes less **CONCENTRATED**, and less electricity is made. Instead of solar panels, probes heading away from the Sun into the depths of the solar system and beyond use RTGs. To understand RTGs, we need to learn about atoms.



THE SUN'S LIGHT CAN ALSO BE BLOCKED WHEN LANDING ON PLANETS WITH LONG NIGHTS AND DUSTY ATMOSPHERES.

THIS IS A MODEL OF AN ATOM. THE CLUSTER OF PARTICLES IN THE MIDDLE IS CALLED THE NUCLEUS.

ANOTHER ATOM BITES THE DUST

Atoms are the building blocks which make up everything you touch. The centre of an atom is made up of particles, called protons and neutrons. These protons and neutrons are held together very tightly by invisible nuclear forces. Different types of atoms have different numbers of neutrons and protons.

ATOMS ARE VERY SMALL. THERE ARE AROUND 78 000 000 000 000 000 000 ATOMS IN A GRAIN OF SAND.

Radioactive Atoms

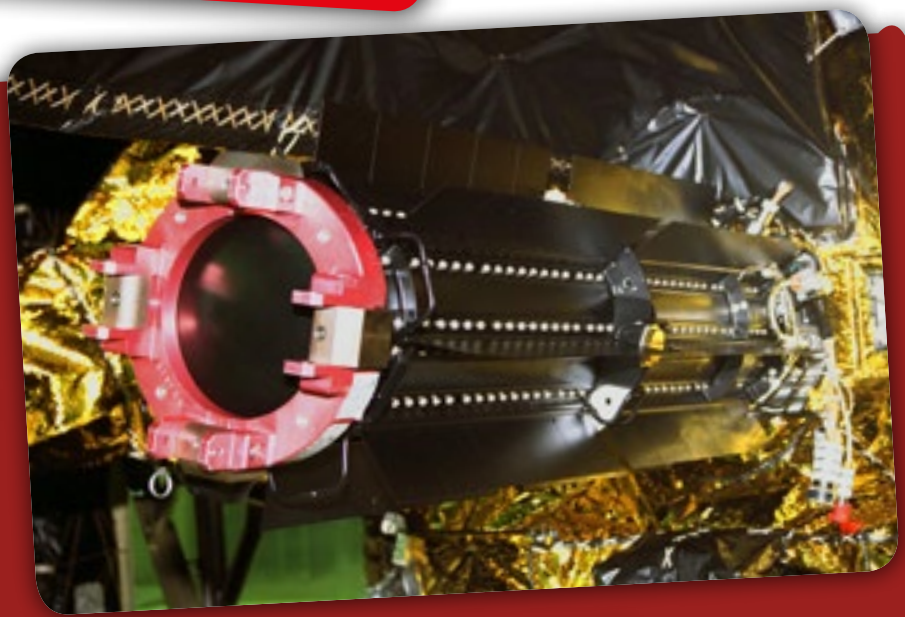
If an atom has an uneven amount of neutrons and protons, it might become unstable. Unstable atoms can randomly split up, and the energy that was holding them together is released. This is called radioactive decay.

This symbol means that something is radioactive. Radioactive materials can be dangerous.

RTGs have to be kept separate from the other equipment so the radiation doesn't damage anything else.

RTGs use radioactive materials as power sources. The heat energy that is given off is changed into electrical energy for the spacecraft to use. RTGs are used because they are simple and reliable – radioactive materials will naturally give off heat for a very long time, so RTGs do not need to be looked after or repaired.

Almost every spacecraft which goes beyond Mars uses RTGs. For example, Voyager 1, Voyager 2 and Cassini all used RTGs. A spacecraft called Ulysses, launched in 1990, went to study the Sun. This spacecraft also had to use RTGs to make electricity.



This is a picture of an RTG used by Cassini.

SPACE TELESCOPES

In 1990, the Hubble Space Telescope was launched into orbit. Its mission is to look out at the universe and take pictures. High above all the clouds and dust of the atmosphere, the powerful Hubble telescope is able to see tiny details which are billions of light years away.

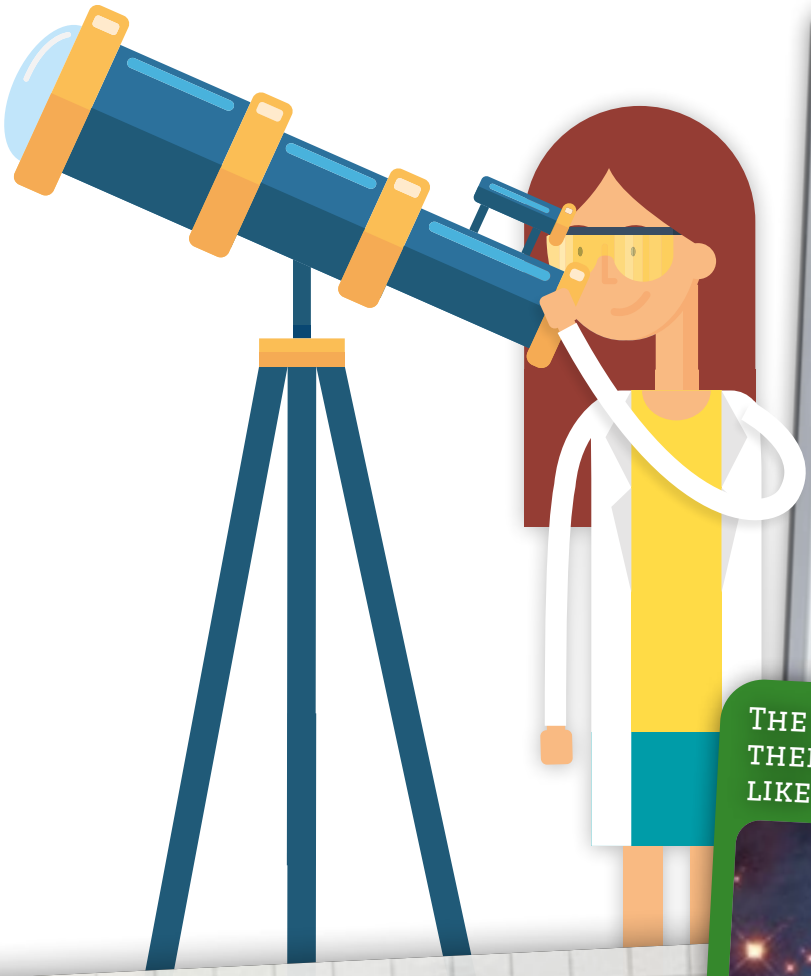
Hubble is 13.3 metres long, about the size of a bus.

THE HUBBLE TELESCOPE HAS TAKEN AROUND 570,000 PICTURES. THE FARTHEST OBJECT IT HAS SEEN WAS A GALAXY 13.4 BILLION LIGHT YEARS AWAY.

Light Years

To see into the distance, the Hubble telescope detects the light coming from that direction. Light is a wave of energy that travels at an incredibly high speed. There is nothing faster than light. When things are very far away, we measure that distance by how long it would take light to travel there. So if it takes light 50 years to get from Earth to a distant planet, we say that planet is 50 light years away. When you look at an object, you are seeing the light bouncing off it as it hits your eyes. If there is no light, you won't be able to see the object.

Light that comes from millions of light years away will be millions of years old by the time it reaches Earth. If somebody saw this old light, they would see the object it came from as it existed millions of years ago. This means that, if an alien planet that was 65 million light years away looked at Earth, they would see dinosaurs roaming around! This is because the light that reflected off the dinosaurs has taken 65 million years to get to the alien planet.



I CAN'T FIND MY SPACE HELMET ANYWHERE! HMMM, I KNOW THIS IS REALLY NOT WHAT THIS SPACE TELESCOPE WAS MADE FOR, BUT IF I JUST BORROW... AHA! THERE IT IS! AN ALIEN HAS STOLEN IT! NOT SO FAST, ALIENS!

THE PILLARS OF CREATION GOT THEIR NAME BECAUSE THEY LOOK LIKE PILLARS.

The Pillars of Creation are a collection of interstellar gas around 6,500 light years away. Even though the Hubble telescope can see them, some scientists think that they have already been destroyed. We can't see this yet because the light from the destroyed pillars hasn't reached us.

TALKING TO ALIENS

Alongside their space missions, astronauts and space probes are looking for another very important thing – signs of alien life. This might be non-intelligent, such as alien bacteria or germs, or it might be intelligent life, able to communicate with humans. What would intelligent aliens look like? Would they have language and cities? Would they have better technology than us? Humanity would have a lot of questions.

What Technology Do We Use to Talk to Aliens?

The record was placed on the side of Voyager 1.

On board Voyager 1 is a **golden record**, which contains music, 115 pictures and recordings of natural sounds, such as whale song, thunder and wind. It also has 55 **greetings**, each in a different language. Scientists hope that, if Voyager is found by aliens, the record might teach them about Earth.

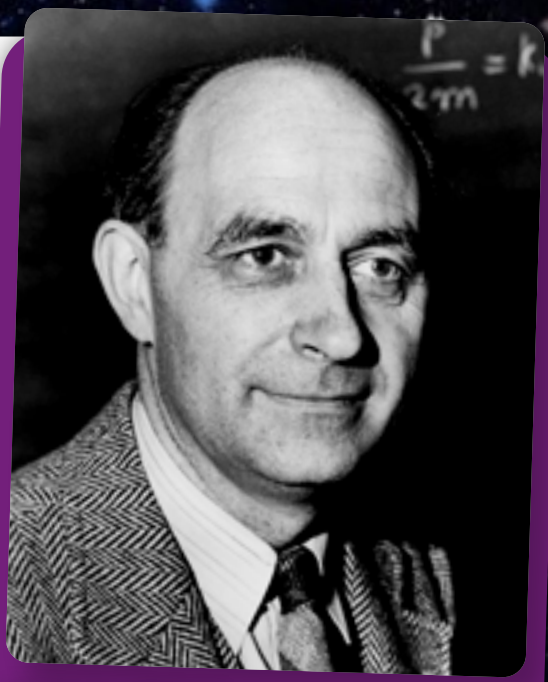
Humans have sent radio signals out into space, too. In 1974, the Arecibo message was the first and most powerful radio signal ever sent with the hopes of finding alien life. Since then, more messages have been sent. Most of these messages were sent by a team called SETI, which stands for the Search for Extra Terrestrial Intelligence.

If we ever did talk to aliens, the conversation would be very slow. The nearest star to ours is 4.2 light years away. That means that any message to planets around that star would take 4.2 years to send or receive.

Some scientists think we shouldn't talk to aliens, in case they are dangerous. What do you think?

Silent Space

In 1950, a scientist called Enrico Fermi asked an important question: if the universe is so big and there are so many planets that aliens might live on, why haven't we heard from anybody? This is called the Fermi Paradox.
A paradox is a thing that is too **conflicting** to be true.



Enrico Fermi

Many people have come up with ideas about why we haven't met aliens, such as.

- Aliens are so advanced that they have created perfect lives living in computer programs. Instead of talking to anyone, they are just living a nice life.

- Aliens are scared of other, dangerous aliens. Nobody is speaking because nobody wants to be found and destroyed.

- Aliens treat us like we treat animals in a **nature reserve**. They have laws that say they can't disturb us too much.

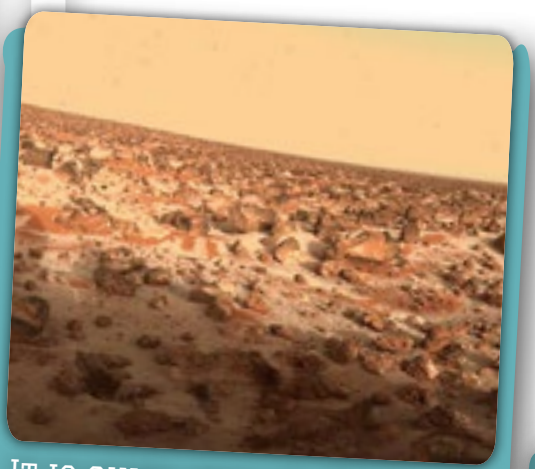
- Maybe life doesn't grow anywhere else.

THE FUTURE OF STEM IN SPACE

That'll teach that cheeky alien. How dare he call me an [illegible] ? [illegible]! Thank goodness I got my helmet back. There's only one thing more exciting than the space travel of today: the space travel of tomorrow! Let's have a look what's coming up...

Mars

Most of NASA's efforts are focused on Mars. In the future, more robots and satellites will be sent to Mars to collect even more information. NASA also hopes to send people to Mars as early as the 2030s. The astronauts will probably arrive on NASA's Orion spacecraft. Maybe one of you will get to go!



It is quite cold on Mars. The maximum temperature on the surface is around 20 degrees Celsius, but at night it can be around -63 degrees Celsius.

One day, a colony of people may even be sent to the planet to build human cities and civilisation. However, we will first have to work out how to make Mars more comfortable. The current atmosphere makes it impossible for life to survive for very long, so scientists would need to make it more like Earth.

THE TEMPERATURE ON MARS QUICKLY GETS COLDER AWAY FROM THE SURFACE. IN FACT, IF YOU STOOD ON MARS IN THE DAYTIME, YOU WOULD NOTICE THAT YOUR FEET WERE WARMER THAN YOUR HEAD.

Asteroid Mining

Humans are running out of resources. As our population grows, we use more and more resources. One solution to this problem involves something called asteroid mining. This will mean that we may land on asteroids and mine for rocks, metals and clay. This is too expensive to do at the moment, but missions such as NASA's OSIRIS-REx is hoping to change that. This mission, which launched in 2016, will explore an asteroid called Bennu, and test out the technologies that might be involved in asteroid mining.

Asteroid

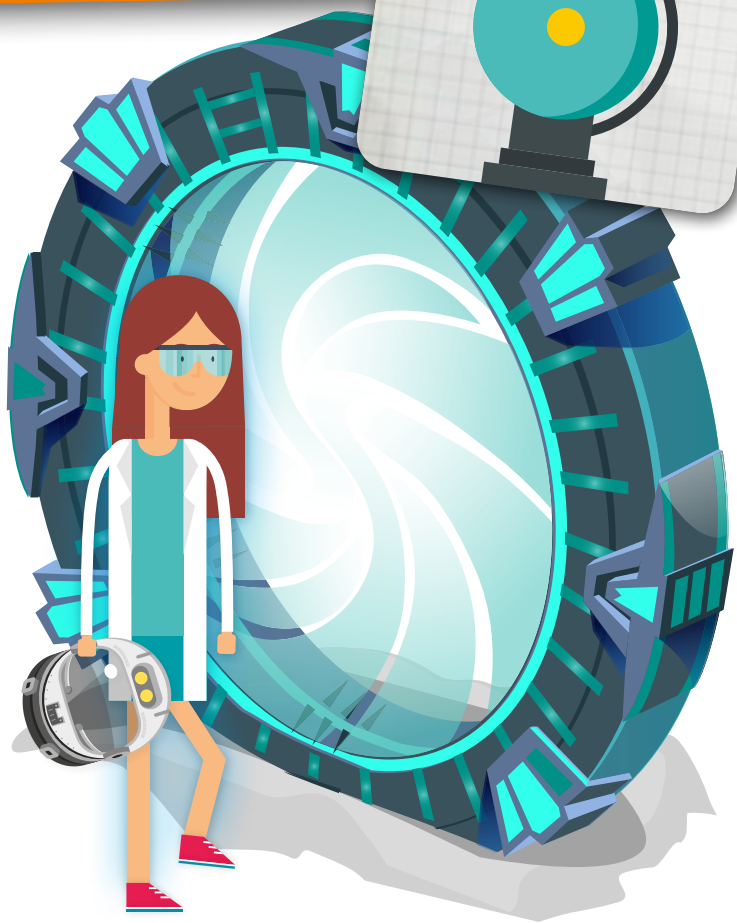
Reusable Rockets

Exploring space is expensive, partly because many parts can only be used once before they are detached from the main craft and either lost in space or burnt up in the atmosphere. However, companies such as SpaceX are trying to change this, by building **REUSABLE** rockets. These are rockets which could come back to land after the mission is complete. The technology is still being tested, but if it is successful, this will make space exploration a lot cheaper and easier.

A Reusable Rocket

HOME TIME

There's the bell. It looks like another day in STEM school has come to an end. And here's the time machine! Well done today, children. If you like STEM and want to learn more, then read on below. Right, I had better travel back in time to page 4! Don't worry, me-from-the-past, I'm –



Find Out More

You could see if your school has any after school STEM programs. Try talking to your teacher or your parents about how to get involved in STEM. You could also try thinking like a scientist, mathematician or engineer yourself! STEM is all about solving problems – next time you see a problem, think about how it can be solved. You might be able to test your idea and see if it works. That is what STEM is all about.

Follow These Links to Carry On Learning Online:

Science Experiments
– www.funology.com/science-experiments/
BBC Science
– http://www.bbc.co.uk/education/subjects/z6svr82
BBC Maths
– http://www.bbc.co.uk/education/subjects/zjxhfg8
Crashcourse Science videos
– www.youtube.com/user/crashcoursekids

GLOSSARY

AFFECTS	has an effect on
ANTENNA	a piece of wire that transmits radio signals
ATMOSPHERE	the mixture of gases that make up the air and surround the Earth
BOOSTERS	large rockets that lift a spacecraft out of the atmosphere
CARBON DIOXIDE	a natural, colourless gas that is found in the air
CERAMIC	a hardened material made from clay
CONCENTRATED	the strength or amount of something in one space or area
CONFLICTING	disagreeing or not making sense together
DENSER	more tightly packed
FRICTION	the force or resistance between two things that rub together
FUEL	something that can be used to produce energy or power
GAS	air-like substance that expands freely to fill any space available
GAUGES	instruments that show the amount of something
GOLDEN RECORD	a golden piece of technology which is used to play sound, such as music
GREETINGS	a word or sign that welcomes somebody
HARPOONS	spear-like missiles that hooks onto something
INTERSTELLAR	between solar systems
MASS	the amount of matter that a body or object contains
MOTION SICKNESS	a sick feeling in the head and stomach caused by travelling in some vehicles
NASA	the North American Space Agency
NATURE RESERVE	an area that is managed so plants and animals are protected
ORBITS	take a path around a larger object in space
PARTICLES	extremely small pieces of a substance
PROBES	types of spacecraft designed to explore other planets and send back information
RESOURCES	supplies of money, materials or people
REUSABLE	able to be used again straight away
ROVER	a type of spacecraft built to drive along the surface of a planet
SENSOR	technology that can sense and record things
SURFACE	the outer part of something
SYSTEMS	sets of things that work together to do specific jobs
TOURISM	the actions and industry behind attracting people to visit new places
VACUUM	an area or space with nothing in it, not even matter
VULNERABLE	exposed to the possibility of being attacked or harmed

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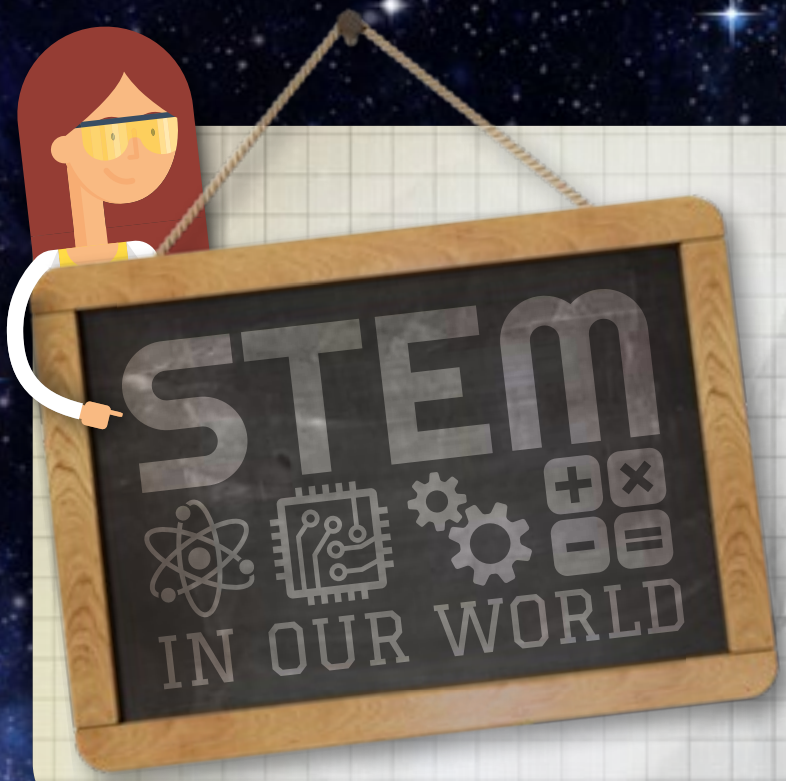
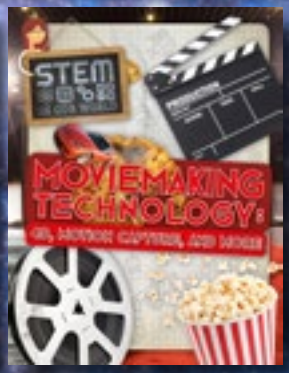


Can you imagine going a trip into space? What about flying along at 300 miles an hour in a levitating train? Or clinging onto your seat at a 4D movie? Thanks to STEM, soon you can do all this and more! Science, technology, engineering and maths are bringing new toys, tools and technological gadgets into our everyday lives. Come and meet Professor Tess Tube, and join her STEM School, where you will learn about the amazing gadgets and gizmos that are all around us.

STEM IN OUR WORLD IS AN EXCITING AND ENGAGING SERIES LOOKING AT NEW AND FUTURE TECHNOLOGIES. COMBINING CURRENT SCIENCE WITH FUTURISTIC IMAGINATION, THIS INFORMATIVE SERIES AIMS TO REACH OUT TO THE ENGINEERS AND INVENTORS OF TOMORROW WITH STEM SUBJECTS TODAY.



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ISBN 9781839276606
9 781839 276606