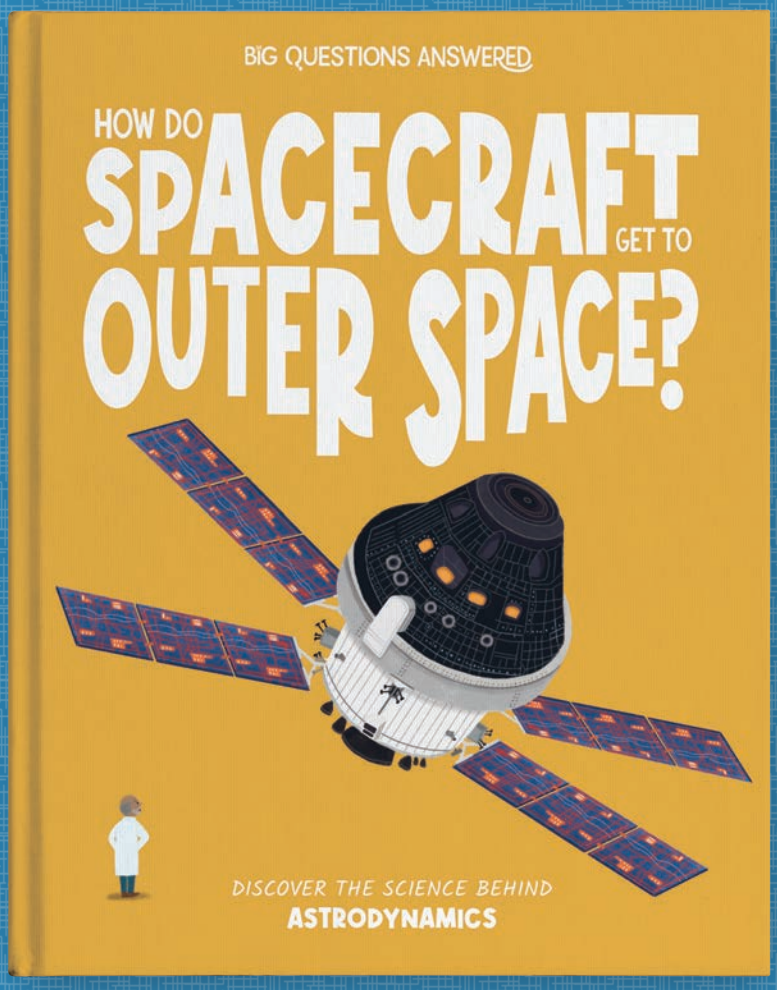
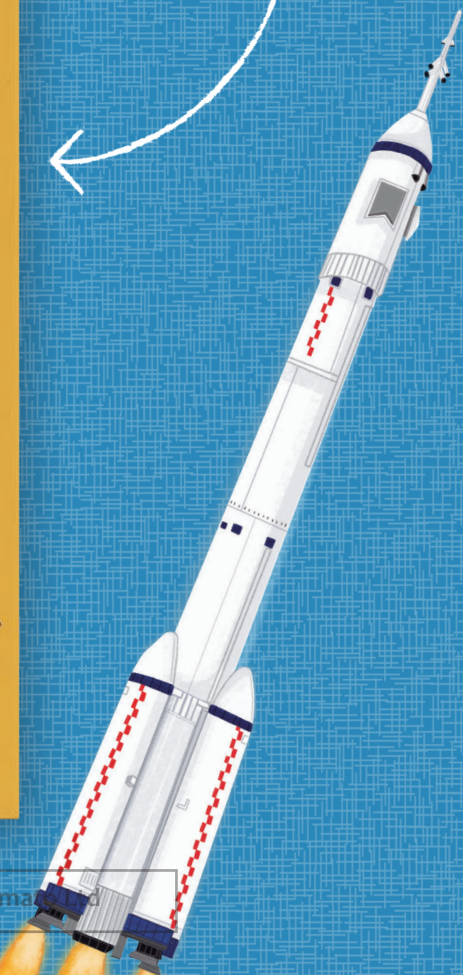
BIG QUESTIONS ANSWERED

TEACHERS' & PARENTS' RESOURCES

Full of thought-provoking questions and fascinating extra information to accompany this book!





CONTENTS:

INTRODUCTION

NOTES FOR TEACHERS, HOME EDUCATORS AND PARENTS

Inspire children's natural curiosity, improve literacy, and have fun learning about different sciences with The Big Questions Answered. Each book in the series is accompanied by a selection of fantastic, **FREE** downloadable resources.

Our **Teachers' and Parents' Resources** booklets are full of ideas for discussions, extra facts, and links to hands-on activities – all great ways to help children explore each field of science and the key topics surrounding them.

Our **Young Scientists' Activity Packs** are a real bonus. They're full of soft-learning, fun activities, all subtly linked to the field of science, that will encourage independent learning. Visit the 'Kids' Zone' to find out more.

Don't forget, on the website you can also download our **'Meet the Scientist' pages** – there's one to accompany each book – and sign up to our newsletter to follow what's coming up next for The Big Questions Answered. Download all these and more at: **www.thebigquestionsanswered.com**

How Do Spacecraft Get to Outer Space? book

Young Astrodynamics Engineers' Activity Pack

KEY CURRICULUM TOPICS

The resources related to *How Do Spacecraft Get to Outer Space?* tie in with key curriculum topics including:

- Animals, including humans
- Earth and space
- Everyday materials
- Forces
- Rocks
- States of matter
- Working scientifically

The most relevant topics are indicated throughout this guide.

HOW DO SPACECRAFT GET TO OUTER SPACE?

This book explores the extraordinary world of astrodynamics. As well as covering key facts about the ways that scientists are searching for helping spacecraft travel through outer space, the book also explores the wider field and logistics of space travel. It looks at a spacecraft's journey from start to finish, natural satellites such as the Moon, and the future of exploring and understanding outer space.

PRE-READING QUESTIONS

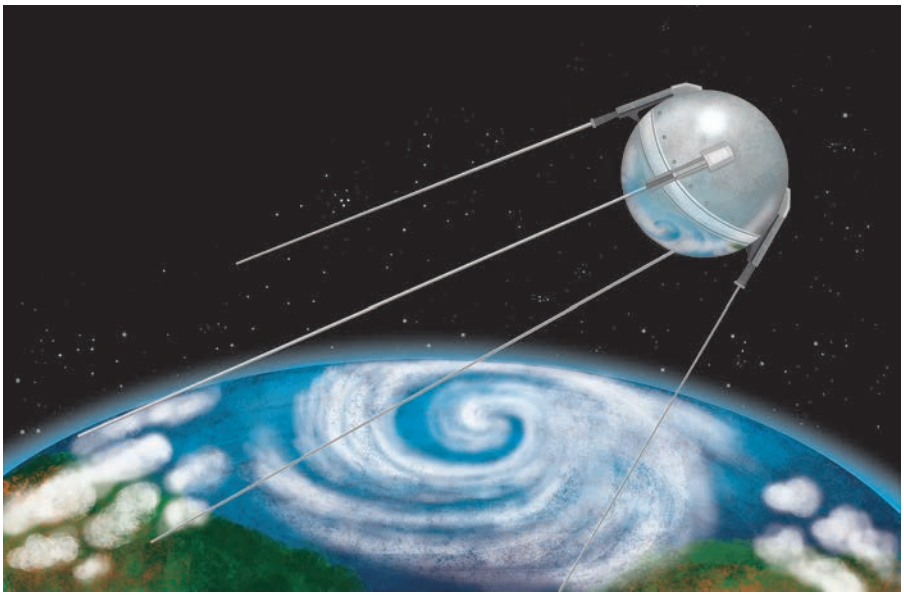
Engage in discussion about the general topic of astrodynamics and spacecraft with the suggested questions below.

- **What do you know about spacecraft and space travel already?**
- **What would you like to learn about astrodynamics?**
- **If you had the chance, would you travel to outer space? Why or why not?**

THE FIRST EVER SPACECRAFT: SCENE 1

The material for this scene can be linked to curriculum topics, including:
Earth and space; forces; working scientifically.

Introduce children to the incredible world of astrodynamics, and discuss what they know about outer space, including any spacecraft they know of that have explored outer space.



DISCUSSION PROMPTS

- **What do you know about outer space already? What are you curious about?**
  Encourage children to discuss what they know about outer space, and what they may be curious about in outer space.

- **What is astrodynamics?**
  Information overleaf

- **What was the first spacecraft, and what did it discover about outer space?**
  Information overleaf

ACTIVITY

Corresponding activity on page 3 of the activity pack: 'Out-of-this-World Words' is a fun and engaging word search activity that introduces children to astrodynamics-related words.

THE FIRST EVER SPACECRAFT: SCENE 1

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

WHAT IS ASTRODYNAMICS?

Astrodynamics is the study of how objects move in space, like **satellites**, **spacecraft**, and **planets**. It combines **physics** and **maths** to understand and predict these movements. For example, it explains how a satellite stays in **orbit** around Earth or how a rocket reaches the Moon or Mars.

Engineers and scientists use astrodynamics to plan space missions. If they want to send a satellite to orbit Earth or a **rover** to explore Mars, they need to know the best time to launch, the right direction to aim, and how much **fuel** is needed.

Astrodynamics is vital for exploring space. Without it, we wouldn't have **GPS** (navigation on Earth), weather satellites, or missions exploring beyond our solar system. It's the science that makes space exploration possible!

ALL ABOUT SPUTNIK 1: THE FIRST SPACECRAFT

Sputnik 1 was the first human-made object to orbit Earth, launched by the Soviet Union (now Russia) in 1957. This historic event marked the start of the **Space Age** and changed the world forever...

Sputnik 1 was a small, shiny sphere with four long **antennas**. Once in orbit, it circled Earth at a speed of around 17,500 miles per hour (28,000 kilometers per hour), completing one orbit in just 96 minutes.

The satellite didn't carry any scientific instruments, but instead let out a steady radio signal that could be picked up by radio operators on Earth. This 'beep-beep' signal confirmed that Sputnik was in space.

Sputnik 1's success sparked the **Space Race**, a period of competition between the Soviet Union and the United States to achieve major milestones in space exploration. Its launch proved that humanity could reach beyond our planet.

THE IMPORTANCE OF GRAVITY: SCENE 2

The material for this scene can be linked to curriculum topics, including:
animals; including humans; Earth and space; forces, working scientifically.

Introduce children to the concept of gravity, and why understanding this force is important for understanding astrodynamics. Discuss Isaac Newton and how his early studies helped us to understand gravity today.

DISCUSSION PROMPTS

- **What is gravity?**
Information overleaf

- **Who was Isaac Newton? What did he discover?**
Information overleaf

- **Who are astrodynamics engineers?**
Information overleaf

ACTIVITY

Corresponding activity on page 4 of the activity pack: 'A Hidden Message!' is a decoding challenge where children must figure out the hidden message using the code provided.

THE IMPORTANCE OF GRAVITY: SCENE 2

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

WHAT IS GRAVITY?

Gravity is the invisible **force** that pulls objects towards each other. It's why things fall to the ground when you drop them, why the Moon **orbits** Earth, and why planets stay in their paths around the Sun. Without gravity, everything would float away into space!

Earth's gravity pulls objects to its core, making things feel heavy. In space, **astronauts** experience **microgravity**, which makes them float because they're falling around Earth rather than being pulled straight down.

Gravity is also what makes stars, planets, and galaxies form. It pulls **gas** and dust together to create stars and keeps planets in stable orbits around their stars. Without gravity, the universe as we know it wouldn't exist!

ALL ABOUT ISAAC NEWTON

Isaac Newton was a brilliant scientist and **mathematician** who lived in the 17th century. He's most famous for discovering the laws of motion and gravity, which are the foundation of modern **physics**.

It's believed that Newton saw an apple fall from a tree and wondered why it fell straight down instead of sideways or up. This led him to think deeply about gravity. He understood that the same force pulling the apple to the ground also keeps the Moon in orbit around Earth and the planets around the Sun.

WHO ARE ASTRODYNAMICS ENGINEERS?

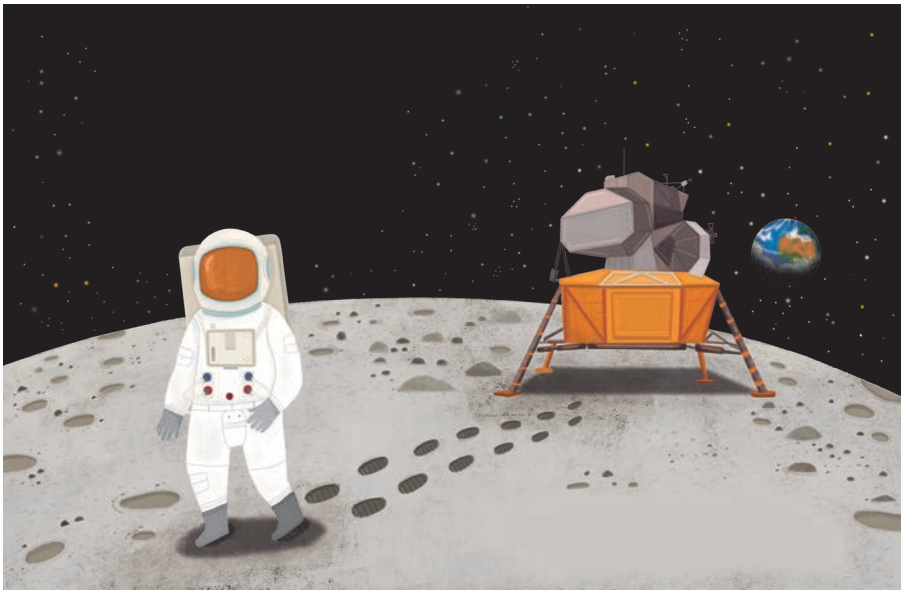
Astrodynamics engineers are the experts who plan and control how spacecraft move through space. Their work involves designing orbits, plotting routes, and ensuring that satellites, space probes, and rockets reach their destinations.

To do their job, astrodynamics engineers use clever **software** to test their plans before launching anything into space. Their work is crucial to the success of space missions, from sending astronauts to the International Space Station (ISS) to exploring the far corners of the solar system!

FIRST MAN ON THE MOON: SCENE 3

The material for this scene can be linked to curriculum topics, including:
animals; including humans; Earth and space; forces; working scientifically.

Introduce children to how the study of astrodynamics has allowed spacecraft carrying humans to land on the Moon! Learn more about the first man on the Moon, and what this incredible achievement meant for science.



DISCUSSION PROMPTS

- **Who was the first human on the Moon?**
Information overleaf

- **What spacecraft first took humans to the Moon?**
Information overleaf

- **What do you imagine it might be like to stand on the Moon?**

Encourage children to discuss how it might feel to walk on the Moon, such as how the ground might feel, how easy it is to move, what you might be able to see, and so on.

ACTIVITY

Corresponding activity on page 5 of the activity pack: 'Look Out for the Astronaut' is an odd one out activity where children must spot the astronaut that stands out from the rest of the crew.

FIRST MAN ON THE MOON: SCENE 3

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

THE APOLLO MISSION

The Apollo programme was a series of space missions run by NASA between 1961 and 1972 with the goal of landing humans on the Moon and safely returning them to Earth.

It was a major part of the space race between the United States and the Soviet Union, now Russia. The programme included a total of 17 missions, with six successfully landing astronauts on the Moon.

The most famous mission, Apollo 11, in 1969, was the first to put humans on the Moon.

The Apollo missions also gathered scientific data, tested new technology, and brought back samples of Moon rocks.

NEIL ARMSTRONG: THE FIRST MAN TO WALK ON THE MOON

Neil Armstrong was an American astronaut and the first person to walk on the Moon.

Born in 1930 in Wapakoneta, Ohio, he developed a love for flying early in life and went on to become a skilled pilot.

Armstrong joined **NASA** as a test pilot before becoming an astronaut in 1962.

On July 20, 1969, as commander of the Apollo 11 mission, he made history by stepping onto the Moon's surface and saying the iconic words, 'That's one small step for [a] man, one giant leap for mankind.'

After Apollo 11, Armstrong continued to inspire people as an advocate for space exploration and education.

He taught **engineering** at university and worked on projects to advance science and technology. Neil Armstrong remains a symbol of human exploration and achievement, remembered for his bravery and historic first steps on the Moon.

LAUNCHING A SPACECRAFT: SCENE 4

The material for this scene can be linked to curriculum topics, including:
Earth and space, forces, working scientifically.

Introduce the impressive science behind launching a rocket into the sky, including what is needed and why. Discuss what it might be like to experience a rocket launch.

DISCUSSION PROMPTS

- **What is involved in launching a rocket?**
Information overleaf

- **What is propellant?**
Information overleaf

- **What do you think it would be like to be part of a rocket launch?**
Encourage children to discuss how they might be feeling, what they might need to do, and what the launch would look and sound like.

ACTIVITY

Corresponding activity on page 6 of the activity pack: 'Draw Your Own Rocket Launch' which is a creative drawing activity where children can get creative and draw their own rocket launching into the sky.

LAUNCHING A SPACECRAFT: SCENE 4

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

WHAT IS A ROCKET?

A rocket is a special kind of vehicle that can travel into space!

Unlike cars or planes, which drive or fly through the air, rockets are built to push through the Earth's **atmosphere** and beyond.

Rockets use powerful engines that blast out **gas** at very high speeds. This force pushes the rocket upwards, making it fly into space. Rockets are often used to send **astronauts** to the Moon or even to explore faraway planets.

They are also used to launch **satellites** that help us with things like weather **forecasting** and communications.

Rockets come in all shapes and sizes, but they all have one thing in common: they need to go fast enough to escape Earth's **gravity** and travel into space.

WHAT IS PROPELLANT?

Propellant is a special type of **fuel** used in rockets and other vehicles to make them move. In short, it's what makes the rocket go whooshing into the sky!

When a rocket's engine uses propellant, it creates a lot of hot gas that pushes out the back of the rocket. This makes the rocket move in the opposite direction.

Propellant can be a liquid or solid, and it's carefully mixed with other **chemicals** to make sure it burns safely and gives the rocket enough power to lift off.

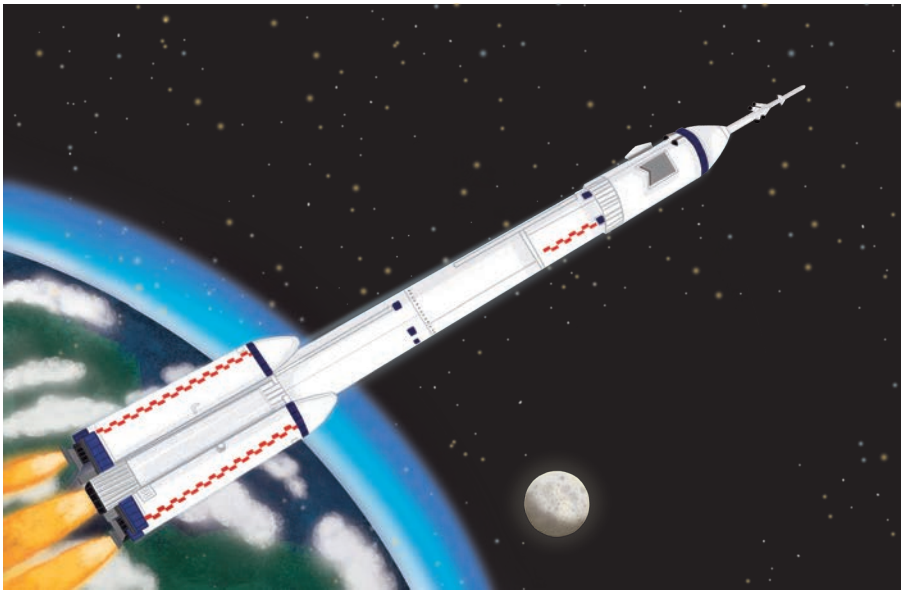
Without propellant, rockets wouldn't be able to escape Earth's gravity or travel to space.

Scientists work hard to design the best propellants because they need to be powerful, but also safe to use.

THE KÁRMÁN LINE: SCENE 5

The material for this scene can be linked to curriculum topics, including:
Earth and space, forces.

Introduce children to the Kármán line and the next stage of a rocket's journey, where it leaves Earth's atmosphere and enters outer space. Discuss the speed at which a rocket needs to travel to overcome Earth's gravity.



DISCUSSION PROMPTS

- **What is the Kármán line?**
  Information overleaf

- **How fast does a rocket need to be going to overcome Earth's gravity?**
  Information overleaf

ACTIVITY

Corresponding activity on page 7 of the activity pack: 'Rocket Power' is a symmetry drawing activity which children must complete the drawing of the Shenzhou 5 rocket.

THE KÁRMÁN LINE: SCENE 5

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

THE KÁRMÁN LINE

The Kármán Line is an imaginary boundary located 62 miles (100 kilometres) above sea level. It is widely known as the point where Earth's **atmosphere** ends and outer space begins!

At this height, the air becomes so thin that airplanes cannot fly because their wings need air to create **lift**. Instead, spacecraft or rockets, which don't rely on air for movement, are needed to travel beyond this line.

The Kármán Line is important for scientists, space agencies, and countries because it provides a clear definition of where space exploration officially starts.

While the Kármán Line is commonly used, some companies, like **NASA**, define the edge of space at a slightly lower altitude of 50 miles (80 kilometers).

OVERCOMING EARTH'S GRAVITY

To overcome Earth's **gravity**, a rocket must reach incredible speeds!

To stay in orbit around Earth, a rocket needs to travel at 17,500 miles per hour (28,000 kilometres per hour). This is called **orbital velocity** and allows the rocket to balance the pull of **gravity**, creating a continuous path around the planet.

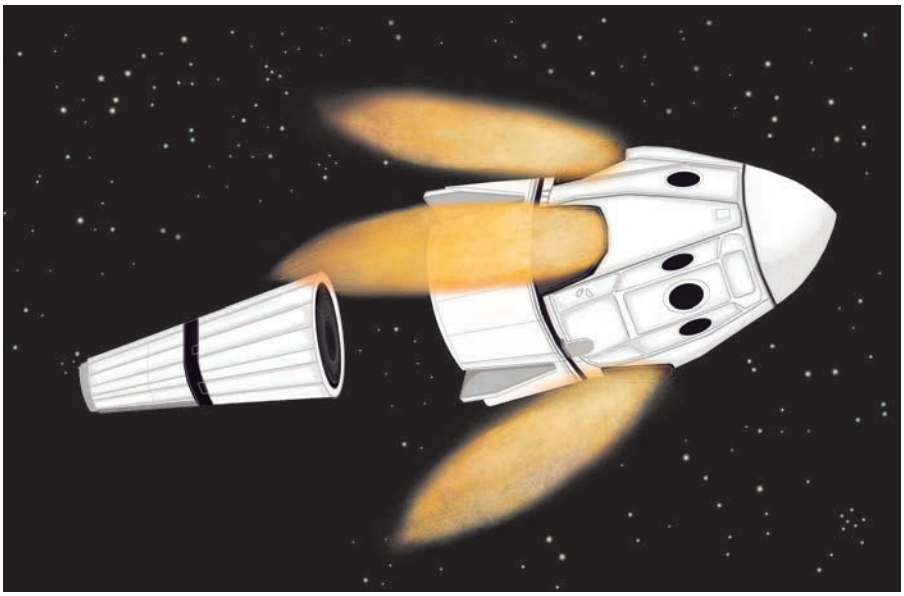
However, if a rocket wants to completely escape Earth's gravity and travel deeper into space, it needs to reach an even faster speed: 25,020 miles per hour (40,270 kilometres per hour)! This is called **escape velocity**.

These speeds are necessary because Earth's gravity is very strong and pulls objects back towards its surface. Achieving these velocities requires powerful engines and a lot of fuel!

RELEASING THE SPACECRAFT: SCENE 6

The material for this scene can be linked to curriculum topics, including:
Earth and space, forces

Introduce the next step in a spacecraft's journey, which is being released from the rocket once it's entered outer space. Discuss the different reasons humans travel to outer space.



DISCUSSION PROMPTS

- **Who are astronauts, and what do they do?**
Information overleaf

- **Why do astronauts travel to outer space?**
Information overleaf

- **How do you think a rocket might release a spacecraft?**
Encourage children to discuss how they imagine a rocket might release a spacecraft, for example, shoot it out, break apart, etc.

ACTIVITY

Corresponding activity on page 8 of the activity pack: 'Whooshing Through Space' is a creative writing activity where children must write a diary entry as if they were on a spacecraft, hurtling through outer space.

RELEASING THE SPACECRAFT: SCENE 6

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

ASTRONAUTS

Astronauts are highly trained people who travel to space to explore and study it!

They come from different backgrounds, such as science, **engineering**, medicine, or the military, and spend years preparing for their missions.

Astronauts learn how to operate spacecraft, live in zero **gravity**, and conduct scientific experiments in space. They also train for emergencies, so they are ready for anything that might happen during their missions!

In space, astronauts work on tasks like fixing equipment, testing new technologies, or studying how space affects the human body. They also conduct experiments that can't be done on Earth, like growing plants in **microgravity** or observing distant stars.

WHY DO ASTRONAUTS TRAVEL TO OUTER SPACE?

Astronauts travel to space for many reasons:

One important goal is to learn more about our universe, such as studying planets, stars, and galaxies to understand how they work.

They also study Earth from space to learn about weather, **climate**, and natural disasters, which helps us take better care of our planet. In space, astronauts conduct experiments that are impossible to do on Earth.

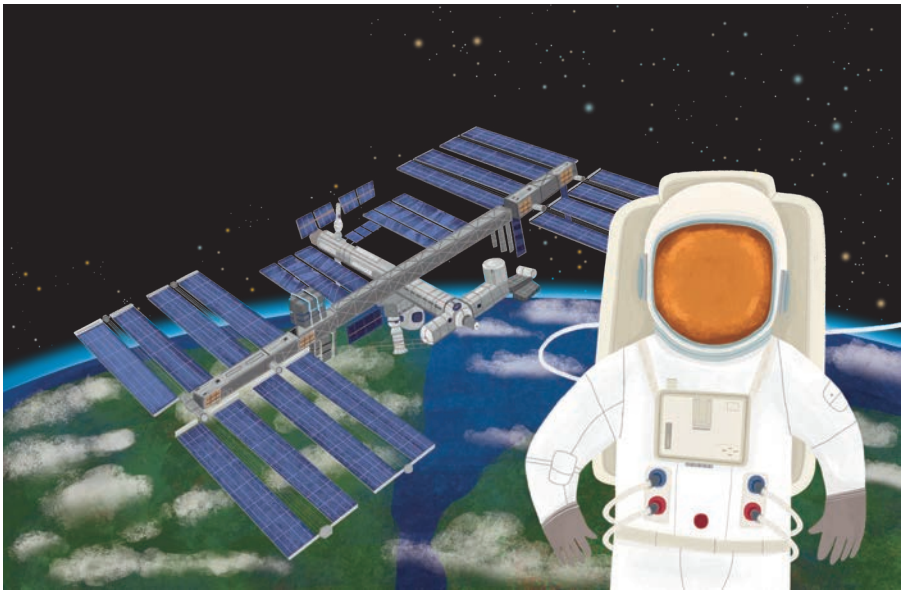
For example, they test new technologies that might be used in space or on Earth, such as advanced materials or new ways to grow food.

Exploration is another reason astronauts travel to space. They help us prepare for the future by learning how humans can live and work on the Moon, Mars, or beyond, opening the door to even greater discoveries!

THE INTERNATIONAL SPACE STATION (ISS): SCENE 7

The material for this scene can be linked to curriculum topics, including:
Animals, including humans, Earth and space, forces, working scientifically.

Introduce the International Space Station, also known as ISS, and why it is such an important place for space travel. Discuss the way astrodynamics engineers designed and built this spacecraft.



DISCUSSION PROMPTS

- **What is the International Space Station?**
Information overleaf

- **How was the International Space Station built? How did astrodynamics engineers play a part?**
Information overleaf

- **What do you think it would be like to spacewalk?**
Encourage children to discuss how it might feel, sound, and look like to be walking in space.

ACTIVITY

Corresponding activity on page 9 of the activity pack: 'Space Station Spotting' is a spot the difference activity where children must spot the ten differences in the two scenes provided.

THE INTERNATIONAL SPACE STATION (ISS): SCENE 7

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

THE INTERNATIONAL SPACE STATION

The International Space Station (ISS) is a large spacecraft that **orbits** Earth at a height of about 253 miles (408 kilometres). It is where **astronauts** live and work.

The ISS was built by many countries working together, including the United States, Russia, Japan, Canada, and European nations. It has been in space since 1998 and is around the size of a football field!

The ISS is used to study how living in space affects people and to carry out experiments that aren't possible on Earth.

The ISS orbits Earth every 90 minutes, meaning the crew sees up to 16 sunrises and sunsets each day!

HOW WAS THE INTERNATIONAL SPACE STATION BUILT?

The International Space Station was built in space, piece by piece, starting in 1998.

Rockets carried sections into space, where astronauts and robots joined them together! These sections include things such as living areas, **laboratories**, and **solar panels**.

Over 30 missions using rockets and shuttles from different countries were needed to complete it.

Astrodynamics engineers played a critical role in building the ISS:

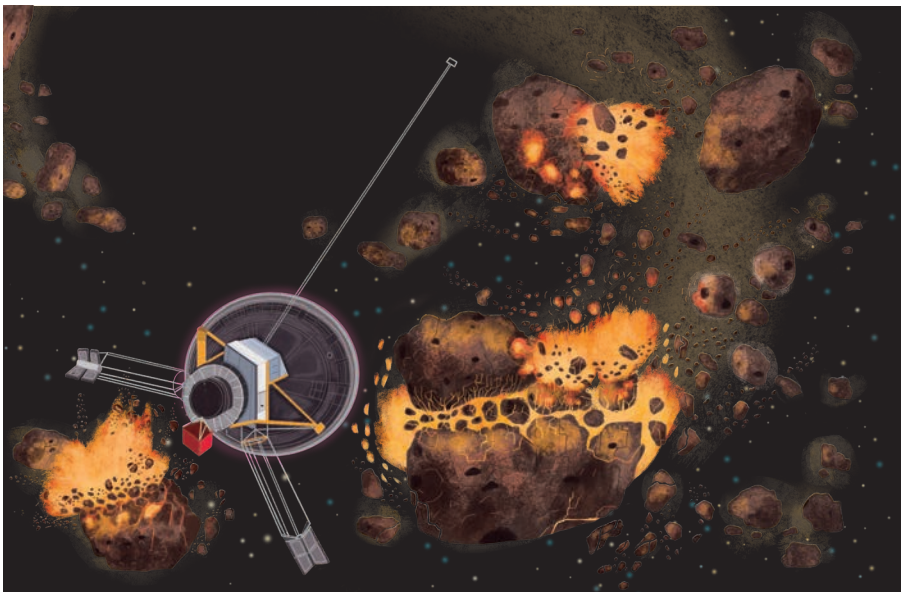
They calculated the best orbits for the ISS and the spacecraft delivering its parts. They made sure the modules launched at the right time and place to meet the ISS as it travelled around Earth.

Engineers also designed **docking systems** and helped plan **spacewalks** for astronauts to safely install parts.

DANGERS IN SPACE: SCENE 8

The material for this scene can be linked to curriculum topics, including:
Earth and space, everyday materials, forces, rocks, working scientifically.

Introduce the dangers that spacecraft may face once in outer space, such as incoming asteroids! Discuss what asteroids are and how they may affect the way spacecraft travel.



DISCUSSION PROMPTS

- **What are asteroids?**
  Information overleaf

- **What other dangers might spacecraft face in outer space?**
  Information overleaf

ACTIVITY

Corresponding activity on page 10 of the activity pack: 'Asteroid Attack!' is a maze activity where children must help the spacecraft reach safety from the incoming asteroid.

DANGERS IN SPACE: SCENE 8

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

ASTEROIDS

Asteroids are rocky objects that **orbit** the Sun, like planets, but they are much smaller. They are sometimes called minor planets or space rocks.

Most asteroids are found in the **asteroid belt**, a region between Mars and Jupiter, where millions of them orbit. Some asteroids can be as small as dogs while others are the size of cities!

Asteroids are made of different materials, like rock, metal, and sometimes ice.

Scientists think they are leftover pieces from when our solar system formed over 4 billion years ago!

Occasionally, asteroids come close to Earth. Most are small and burn up in the **atmosphere**, but larger ones could cause damage if they hit.

This is why scientists watch them carefully. Some space missions even visit asteroids to study them or collect samples.

OTHER DANGERS IN SPACE

One danger is **space debris**, which includes old **satellites**, rocket parts, and fragments from **collisions**. Even tiny pieces of debris can damage spacecraft because they travel at such high speeds!

Radiation from the Sun and **cosmic rays** is another hazard. Earth's atmosphere protects us from most radiation, but spacecraft and astronauts are exposed to it in space, which can affect equipment and health.

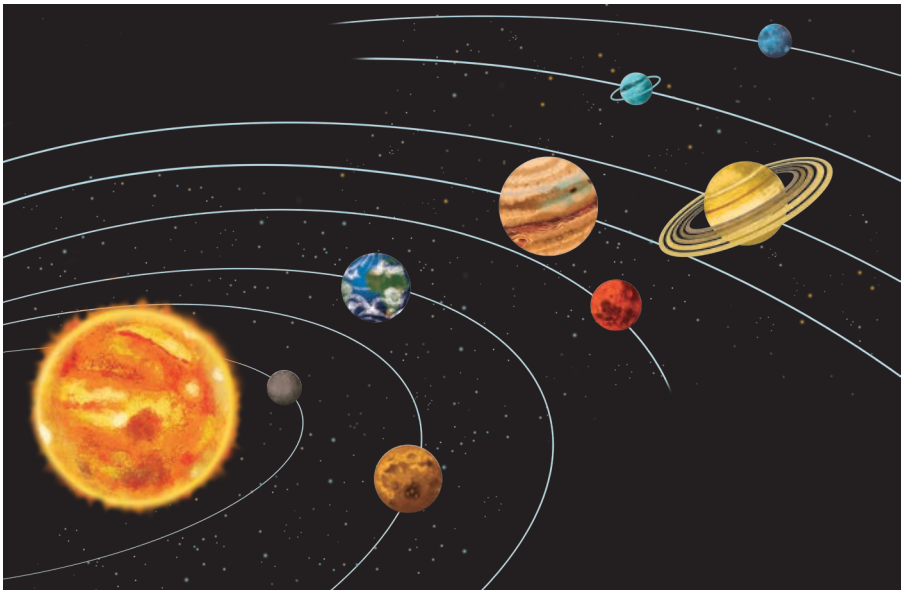
Spacecraft also face extreme temperatures. In sunlight, they can get very hot, and in shadow, they can become extremely cold.

Finally, **micrometeoroids**, tiny pieces of rock or dust, can strike spacecraft. Even though they are small, they travel so fast that they can cause damage!

EXPLORING NEARBY PLANETS: SCENE 9

The material for this scene can be linked to curriculum topics, including:
Earth and space, rocks, forces.

Introduce children to how spacecraft are used to explore and understand nearby planets. Discuss the different things that satellites are able to do and how important they are for helping us better understand our own solar system.



DISCUSSION PROMPTS

- **What planets are in our solar system?**
Information overleaf

- **If you could travel to any planet in our solar system, which one would you most like to visit?**
Encourage children to discuss what they know about outer space and the planets in our solar system, and what they may be curious about.

- **What do satellites do in our solar system?**
Information overleaf

ACTIVITY

Corresponding activity on page 11 of the activity pack: 'Pick a Favourite Planet' is a fact file activity where children must research their favourite planet and find out as many fun facts as they can.

EXPLORING NEARBY PLANETS: SCENE 9

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

PLANETS IN OUR SOLAR SYSTEM

Starting closest to the Sun, the planets in our solar system include:

MERCURY: The smallest planet and closest to the Sun. It has no **atmosphere** and is very hot during the day and freezing at night.

VENUS: Similar in size to Earth but covered in thick clouds of **gas**. It is the hottest planet due to its thick atmosphere trapping heat.

EARTH: Our home planet, the only one known to support life! It has water, land, and air.

MARS: Known as the 'Red Planet' because of its rusty surface. It has the largest **volcano** and **canyon** in the solar system.

JUPITER: The largest planet, made mostly of gas. It has a famous storm called the Great Red Spot and over 90 moons!

SATURN: Famous for its stunning rings made of ice and rock.

URANUS: A **gas giant** that spins on its side and looks blue due to **methane** gas.

NEPTUNE: The farthest planet, known for being deep blue and having strong winds.

WHAT DO SATELLITES DO?

Satellites are objects that orbit planets, moons, or the Sun.

They can be **natural** or **artificial** –

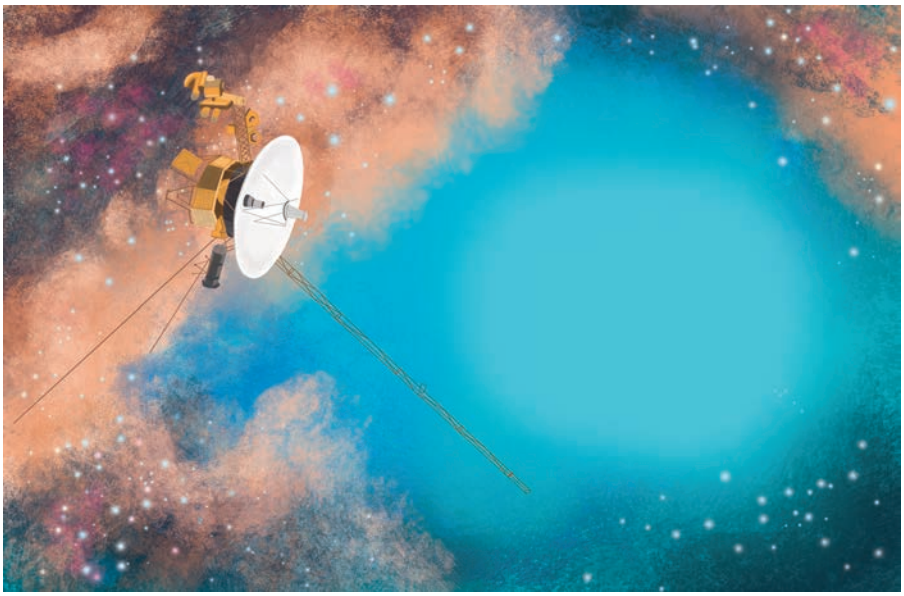
- Natural satellites, like moons, orbit planets and can influence them; for example, Earth's Moon controls the tides.

- Artificial satellites are human-made and have various purposes. Some stay near Earth to help with communication, **GPS**, or weather tracking. Others travel further to explore planets, moons, and asteroids.

EXPLORING INTERSTELLAR SPACE: SCENE 10

The material for this scene can be linked to curriculum topics, including:
Earth and space, forces, working scientifically.

Introduce children to the mysterious realm of interstellar space, and what scientists believe can be found there. Discuss how Voyager 1 is helping us learn more about this vast region.



An A4 copy of the scene is provided on page 34 that you can open full screen on a computer or projector, or print off. Alternatively, find this scene in the physical book.

DISCUSSION PROMPTS

- **What is interstellar space?**
  Information overleaf

- **What do you think might be found in interstellar space?**
  Encourage children to discuss what they imagine might be found in interstellar space, such as alien life, planets, new galaxies, and so on.

- **What is Voyager 1?**
  Information overleaf

ACTIVITY

Corresponding activity on page 12 of the activity pack: 'Exploring Interstellar Space' is a creative drawing activity where children must draw what they think they might find in this mysterious place outside our solar system.

EXPLORING INTERSTELLAR SPACE: SCENE 10

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

INTERSTELLAR SPACE

Interstellar space is the large region between stars in a galaxy. It begins where a star's influence ends.

For our Sun, this boundary is called the **heliopause**, located about 11 billion miles (18 billion kilometres) from Earth.

Beyond this point, the Sun's particles no longer dominate, and the spacecraft must interact with particles and **radiation** from other stars.

Interstellar space is believed to be mostly empty, but it contains thinly spread **gas**, dust, and **cosmic rays**.

Studying this area helps scientists learn more about the space between stars and the boundaries of our solar system.

VOYAGER 1

Voyager 1 is a NASA spacecraft launched in 1977 to explore the outer planets and beyond.

It flew past Jupiter and Saturn, sending back stunning images and valuable data.

After completing its planetary mission, Voyager 1 continued travelling outwards and, in 2012, became the first human-made object to enter interstellar space. It now sends information about this distant region back to Earth.

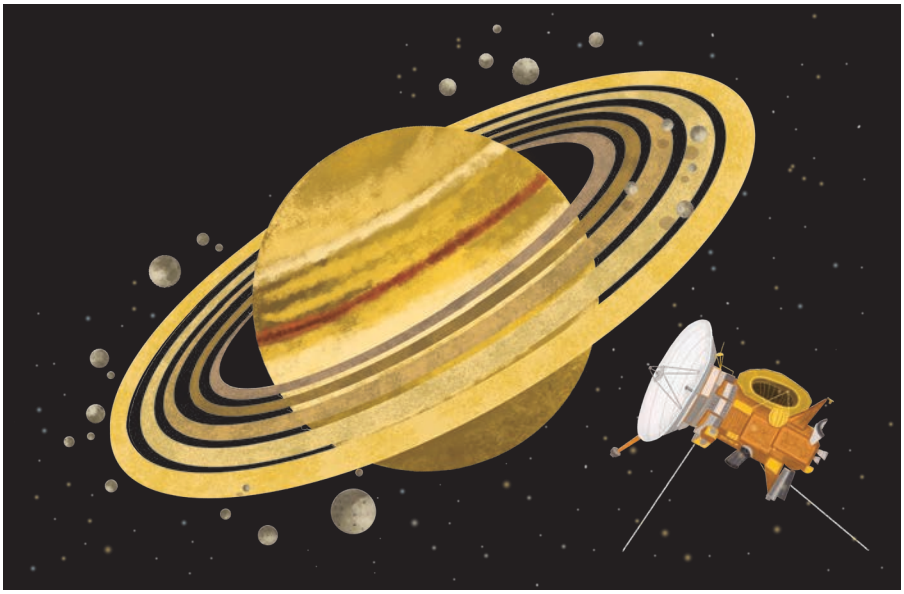
Voyager 1 carries the Golden Record, a message for any **extraterrestrial** life, containing sounds, music, and images from Earth.

Travelling over 14 billion miles (23 billion kilometres) from Earth, it remains one of humanity's greatest achievements!

NATURAL SATELLITES: SCENE 11

The material for this scene can be linked to curriculum topics, including:
Earth and space, forces, working scientifically.

Introduce children to the other areas that astrodynamics engineers work in, such as studying natural satellites like moons. Discuss how scientists often use artifical satellites to discover more about natural satellites.



DISCUSSION PROMPTS

- **Why do you think it's important for scientists to study natural satellites?**

Encourage children to discuss why it may be important for scientists to know about natural satellites, such as our Moon, other planets, asteroids, comets, and so on.

- **What do you know about Saturn?**

Information overleaf

- **What is the Cassini spacecraft?**

Information overleaf

ACTIVITY

Corresponding activity on page 13 of the activity pack: 'Space Jumble' is a word scramble and word within words activity where children must unscramble the space-related words.

NATURAL SATELLITES: SCENE 11

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

WHAT WE KNOW ABOUT SATURN

Saturn is the sixth planet from the Sun and the second-largest in our solar system.

Known for its stunning rings, which are made of ice, rock, and dust, Saturn is a **gas giant** primarily composed of **hydrogen** and **helium**.

It has over 200 moons, including Titan, the second-largest moon in the solar system, which has rivers and lakes of liquid **methane**.

Saturn is about 886 million miles (1.4 billion kilometres) from the Sun and takes 29.5 Earth years to complete one **orbit**.

Its winds are incredibly fast, reaching up to 1,100 miles per hour (1,800 kilometres per hour) near the **equator**. Despite its size, Saturn is very light for a planet – it could float in water!

THE CASSINI SPACECRAFT

The Cassini spacecraft was a **NASA** mission launched in 1997 to study Saturn and its system of rings and moons.

It reached Saturn in 2004 and spent 13 years orbiting the planet, capturing incredible images and gathering important data.

Cassini revealed many discoveries, including geysers of water ice on Saturn's moon Enceladus, which hinted at an underground ocean that could support life.

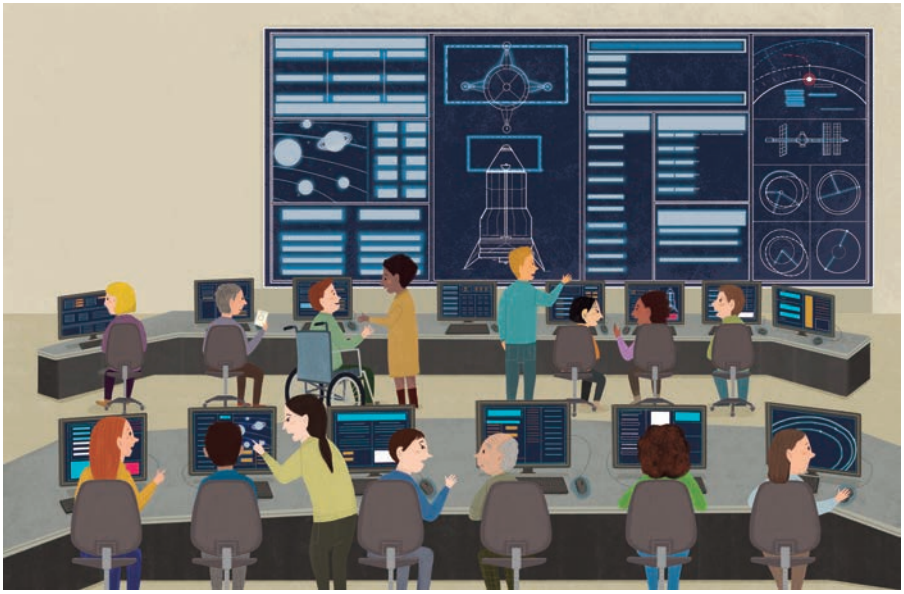
It also studied Titan, mapping its surface and exploring its methane lakes.

Cassini transformed our understanding of Saturn and its moons!

PLANNING IS KEY: SCENE 12

The material for this scene can be linked to curriculum topics, including:
Animals, including humans, Earth and space, forces, working scientifically.

Introduce children to the work astrodynamics engineers do on Earth, and why this work is so critical for successful missions in outer space. Discuss what happens in mission control and how they manage and direct spacecraft.



DISCUSSION PROMPTS

- **What is mission control? What happens there?**
  Information overleaf

- **What do you think it would be like to be working in mission control when a rocket was being launched into the sky?**
  Encourage children to discuss how they would be feeling on rocket launch day in mission control, such as excited, nervous, and so on.

ACTIVITY

Corresponding activity on page 14 of the activity pack: 'Exploring the Cosmos' is a reflective writing activity where children must think about what they have learnt so far and answer the questions provided.

PLANNING IS KEY: SCENE 12

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

MISSION CONTROL

Mission Control is the command centre where space missions are managed.

It is staffed by teams of engineers, scientists, and experts who monitor spacecraft and **astronauts** during their missions.

NASA's Mission Control, for example, is located at the Johnson Space Center in Houston, Texas, and is often called the 'Houston' astronauts refer to in space.

In Mission Control, teams oversee every detail of a mission, from launch to landing.

They communicate directly with spacecraft, tracking its position, speed, and health. They also monitor systems like power, navigation, and life support to ensure everything is running smoothly.

Mission Control is prepared to respond to emergencies, deal with issues like system failures or unexpected problems in real time.

For **crewed missions**, Mission Control is the main link between astronauts and Earth, providing updates, instructions, and support.

For **robotic missions**, they control the spacecraft remotely, sending commands and receiving data.

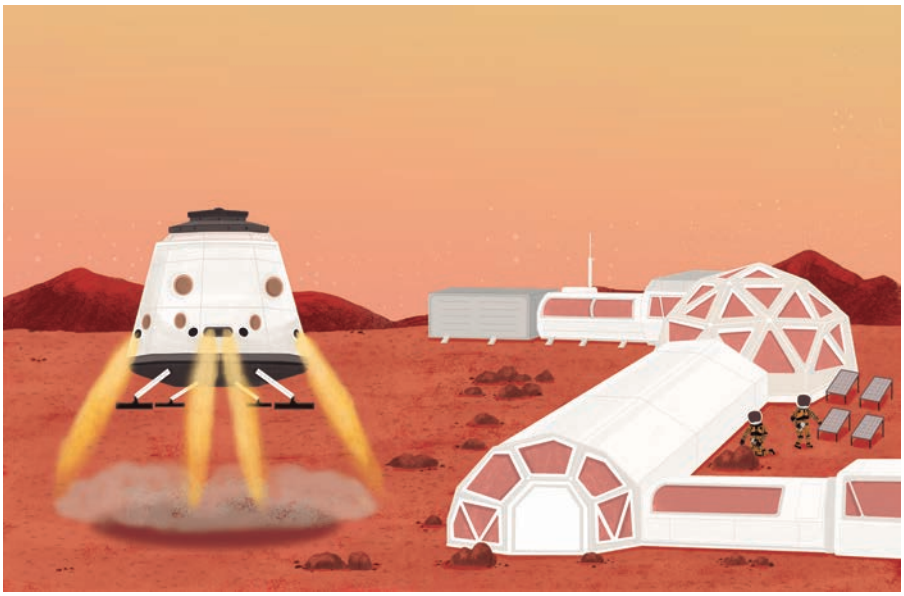
Mission Control also plans and schedules tasks, such as experiments, **spacewalks**, or launching **satellites**.

Without Mission Control, space missions could not succeed!

THE FUTURE OF ASTRODYNAMICS: SCENE 13

The material for this scene can be linked to curriculum topics, including:
Earth and space, forces, working scientifically.

Introduce children to the future of space travel, and how astrodynamics engineers are helping to make this possible. Discuss the possiblity of humans walking and living on Mars one day.



DISCUSSION PROMPTS

- **What do you think it would be like to live on Mars?**

Encourage children to discuss what they think it might be like to live on Mars, such as what a day might look like there, how humans might get around, and so on.

- **What do you know about Mars?**
Information overleaf

- **Will it be possible to live on Mars one day?**
Information overleaf

ACTIVITY

Corresponding activity on page 15 of the activity pack: 'Lost on Mars' is a line maze activity where children must help the spacecraft safely reach Mars.

THE FUTURE OF ASTRODYNAMICS: SCENE 13

RELEVANT INFORMATION

Keywords that you may want to pull out and explain have been put into bold.

ALL ABOUT MARS

Mars, often called the Red Planet, is the fourth planet from the Sun and the second smallest in the solar system.

Its reddish tones comes from **iron oxide**, or rust, on its surface.

Mars has a thin **atmosphere** made mostly of **carbon dioxide**, so it cannot support naturally human life. Temperatures are cold, and there's little liquid water on the surface, though ice exists at the poles and underground.

Mars has incredible features, including Olympus Mons, the largest volcano in the solar system, and Valles Marineris, a canyon system much larger than the Grand Canyon!

WILL WE LIVE ON MARS ONE DAY?

Living on Mars is a challenging idea, but it might be possible one day with advanced technology!

The main challenges include its thin atmosphere, which offers no breathable air, freezing temperatures, and high levels of **radiation**. Also, Mars has no ready supply of food, drinkable water, or materials for creating homes.

To live on Mars, humans would need **habitats** with controlled **environments** to provide air, warmth, and protection. Scientists are studying ways to grow food in **Martian soil** and extract water from underground ice or the atmosphere. They are also testing technologies to create **oxygen** from **carbon dioxide**.

Mars missions like NASA's Perseverance rover and SpaceX's are helping us to prepare for future human settlement. While living on Mars is still a long way off, every discovery brings us closer to making it a reality and creating a second home for humanity!

POST-READING QUESTIONS

Engage in discussion about the journey taken throughout the book and the facts that were uncovered.

- **Were you surprised to learn how spacecraft get to outer space?**
- **If you were given the chance, would you visit outer space?**
- **Did anything in the book surprise you?**
- **What's the coolest thing you've learnt from this book?**

ACTIVITY

Corresponding activity on page 16 of the activity pack: 'Write Your Own Astrodynamics Strory' is a creative writing activity where children must write a piece of descriptive writing including the three words or phrases provided.

DISCLAIMER:

Every effort has been made to ensure the information in this booklet is correct as of the time of publication, Spring 2025.

THE BIG QUESTIONS ANSWERED

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