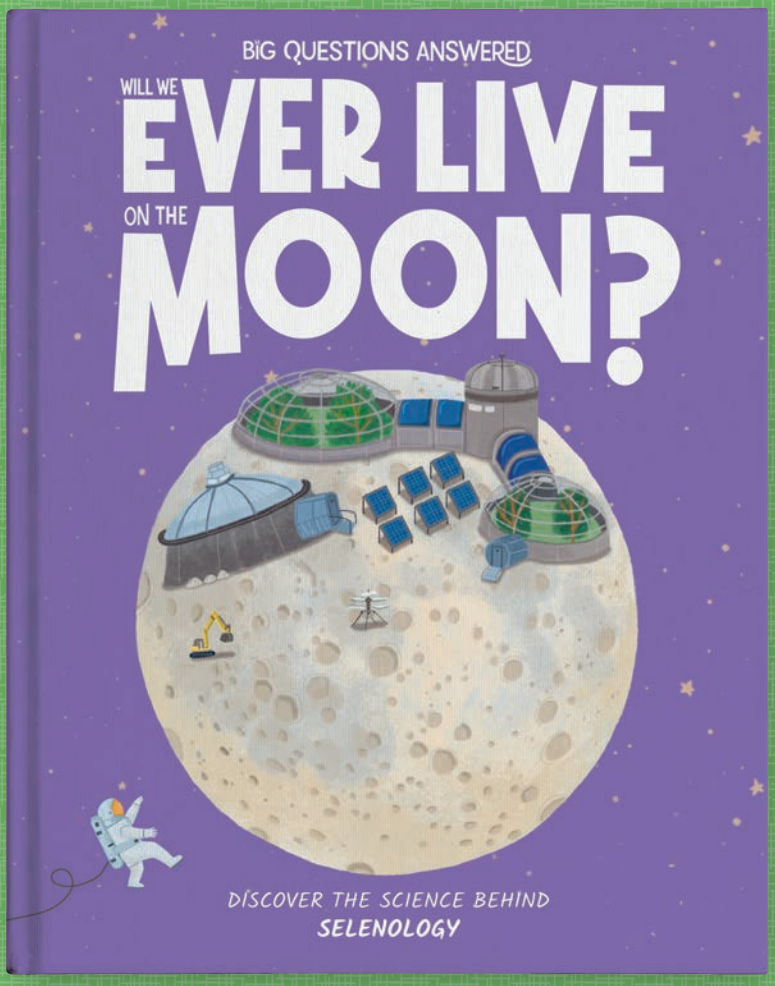
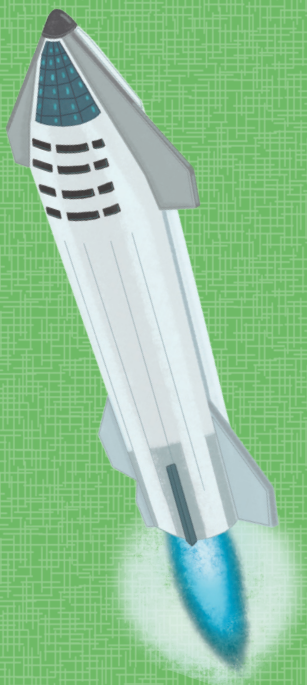
BIG QUESTIONS ANSWERED

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

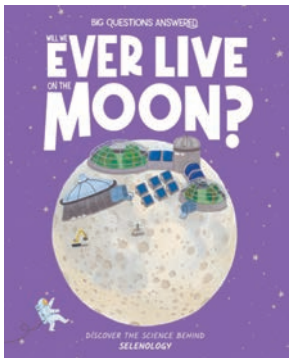
Inspire children's natural curiosity, improve literacy, and have fun learning about different sciences with The Big Questions Answered. Each book in the series is accompanied by a selection of fantastic, **FREE** downloadable resources.

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**

Will We Ever Live on the Moon? book



Young Selenologists' Activity Pack

KEY CURRICULUM TOPICS

The resources related to *Will We Ever Live on the Moon?* tie in with key curriculum topics including:

- Animals, including humans
- Earth and space
- Electricity
- Everyday materials
- Forces
- Light
- Living things and their habitats
- Rocks
- States of matter
- Working scientifically

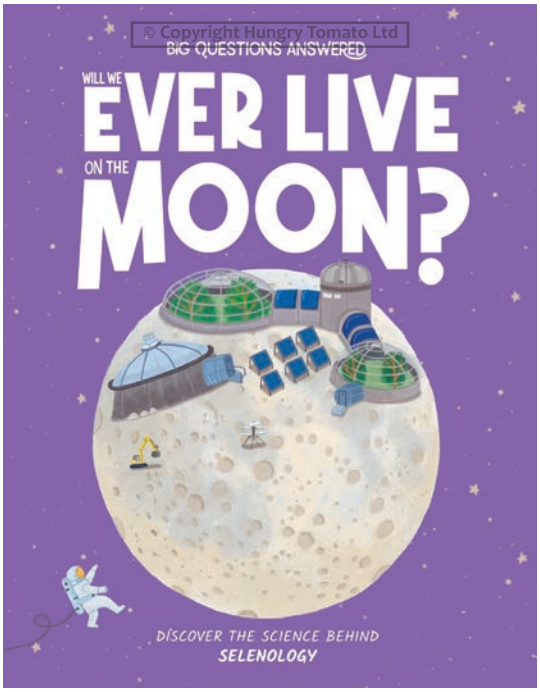
The most relevant topics are indicated throughout this guide.

WILL WE EVER LIVE ON THE MOON?

This book explores the extraordinary world of selenology. As well as covering key facts that scientists have discovered about the Moon, the book explores the wider field of space science by looking at the development of rockets, the challenges of space exploration, and the tools and equipment that scientists rely on to do their research.

PRE-READING QUESTIONS

Engage in discussion about the general topic of selenology and the Moon with the suggested questions below.



- **What do you know about the Moon already?**
- **What would you like to learn about the Moon?**
- **If you had the chance, would you go to the Moon? Why or why not?**

OUR AMAZING MOON: SCENE 1

The material for this scene can be linked to curriculum topics, including:
Earth and space; everyday materials; living things and their habitats.

Introduce the topic of Earth's Moon with discussion about what it's made of and how old it is. This is a good time to pose the question of whether we may be able to live there one day; this is answered by the end of the book.

DISCUSSION PROMPTS

- **What do you think the Moon is made of?**

Encourage children to write down their answers. This information is revealed in the fifth and sixth scenes of the main book, and they'll then be able to see if they were right!

- **How old do you think the Moon is?**

Information overleaf

- **Do you think we would be able to live on the Moon? Why or why not?**

Encourage children to write down their answers. This information is revealed throughout the main book.

ACTIVITY

Corresponding activity on page 3 of the activity pack: 'A Trip to the Moon' is a creative thinking and drawing activity. Children imagine they're going on a trip to the Moon and have to decide what 10 items they would take with them.

OUR AMAZING MOON: SCENE 1

RELEVANT INFORMATION

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

EARTH'S MOON

Earth has one **moon**. We call it 'the Moon' because long ago, when it was named, people thought there was only one moon in the **universe**! It wasn't until an Italian man called **Galileo Galilei** discovered four moons around Jupiter in the 1600s that people realised there were more moons out there.

WHAT IS A MOON?

A moon is a **natural satellite** that **orbits** a planet or another space object that is not a star. It is held in **orbit** by **gravity**. Most moons are rocky, but some in our **solar system** have been found to be covered in ice or underground oceans.

Moons aren't the only kinds of satellites that exist. Humans have created **artificial** satellites and **launched** them into Earth's orbit. We use these for different tasks. Here are just a few examples of the amazing things satellites do:

- **Navigation** satellites - these satellites beam signals up and down to Earth and can help show exactly where something is on the planet.
- **Communication** satellites - these are used for **transmitting** internet, television, and phone signals.
- Weather satellites - these machines help with weather forecasting.
- The **International Space Station** (ISS) - this is a science lab in the sky! Astronauts live on the ISS, carrying out science experiments in low gravity.

AGEING THE MOON

Through clever experiments and tests, scientists have estimated that the Moon is approximately 4.46 billion years old!

There are different **theories** about how it came to be, but the most supported theory is that there was a collision between the Earth and another planet that was a similar size to Mars. The **debris** that was floating in space slowly collected together to form the Moon.

ASTRONOMERS LONG AGO: SCENE 2

The material for this scene can be linked to curriculum topics, including:
Earth and space; light; living things and their habitats.

This scene flashes back to early humans and explores how, even thousands of years ago, people used the Moon to track time. Uncover the reason the Moon has phases which make it look like it can change shape.

DISCUSSION PROMPTS

- **Do you know how long it takes the Moon to go through all its phases?**
Information overleaf

- **Can we only see the Moon at night?**
Information overleaf

- **This scene is set thousands of years ago. What differences can you think of between the people and their cave-home compared to people that live today and their modern houses?**

- **How do you think the light of the Moon affected the lives of people back in the Stone Age?**

ACTIVITY

Corresponding activity on page 4 of the activity pack: 'Back in Time' is a spot the difference activity where there are 10 differences for the children to find across 2 scenes.

ASTRONOMERS LONG AGO: SCENE 2

RELEVANT INFORMATION

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

PHASES OF THE MOON

There are 8 different **phases** of the Moon. It takes a month for the Moon to go through all 8 phases, from almost invisible in the sky (**new Moon**), to a slither that grows until we can see the **full Moon**, back to a slither and then almost invisible again.

The Moon isn't actually changing shape. What's happening is a result of **sunlight** and **shadows**. The Moon doesn't produce its own light - when we see its surface lit up, it's because sunlight is shining on it. As the Moon **orbits** Earth, how much of the Moon's lit-up side we can see changes - this is why we see the phases change over time.

OTHER STRANGE MOON EVENTS

There are many other times where the Moon looks different. For example:

- **Lunar eclipse** - sometimes, Earth comes between the Sun and the Moon, and casts a shadow on the Moon. You might think the Moon would disappear from view, but it doesn't! The colour of the light reaching the Moon changes, making it look red instead!

- **Blue Moon** - sometimes the Moon appears blue! This can happen after a volcanic eruption or a big forest fire, when lots of dust and ash is floating around Earth's **atmosphere**. These particles scatter light, causing the Moon to look blue.

- A Moon in the day - we might think of the Moon as only coming out at night, but it can often be seen in the daytime too. It depends on the phase of the Moon and its position in the sky. If these things line up, it usually shines bright enough to spot in the day.

TRACKING THE MOON

There is evidence that older **civilisations** used the phases of the Moon as a way of tracking and planning time. Historians think that early humans as far back as 37,000 years may have done this. They've found scratchings in cave walls that they interpret as showing the phases of the Moon and star patterns.

One of the first **calendars** was the Sumerian calendar which was divided into months of 29 or 30 days, depending on when the full Moon was spotted - this was the first day of a new month. This allowed them to divide the year into 12 months (12 Moon cycles), which is not too different from how we divide the year up to track time today. The Sumerians lived around 4,000 years **BCE**.

THE INVENTION OF TELESCOPES: SCENE 3

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

Discover the fantastic telescopes that have helped scientists make huge advancements in their understanding of the Moon, including what it's like and the many ways it impacts life on Earth.

DISCUSSION PROMPTS

- **Can you point out the telescope in the scene?**
Hint: it's seen in the drawing.

- **Telescopes today can look very different from Galileo's telescope. Can you name any telescopes that scientists use today?**
Information overleaf

- **We know that the Moon orbits Earth, but do you know what else the Moon does for Earth?**
Information overleaf

- **Which is the dark side of the Moon? Why is it dark?**

ACTIVITY

Corresponding activity on page 5 of the activity pack: 'Design Your Own Telescope' is a creative drawing activity where children can design and decorate their own telescope picture. A basic telescope outline is provided.

THE INVENTION OF TELESCOPES: SCENE 3

RELEVANT INFORMATION

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

TELESCOPES THROUGH THE YEARS

A colour drawing of **Galileo**'s **telescope** is in the top right of the scene. The picture has been twisted clockwise by 90 degrees (the bottom of the telescope is to the left). This telescope would have been more elaborate than many other telescopes of the 1600s.

The telescopes that scientists use today can look very different. They are created using much more **advanced technology**, which makes them stronger and able to see things in more detail.

Lots of the world's strongest telescopes today operate from **outer space** rather than from Earth. This gives them a clearer view of things in outer space because there is no **interference** from **Earth's atmosphere**.

Examples of famous modern-day telescopes include the Hubble space telescope, the James Webb space telescope, and the Arecibo telescope.

HOW THE MOON AFFECTS LIFE ON EARTH

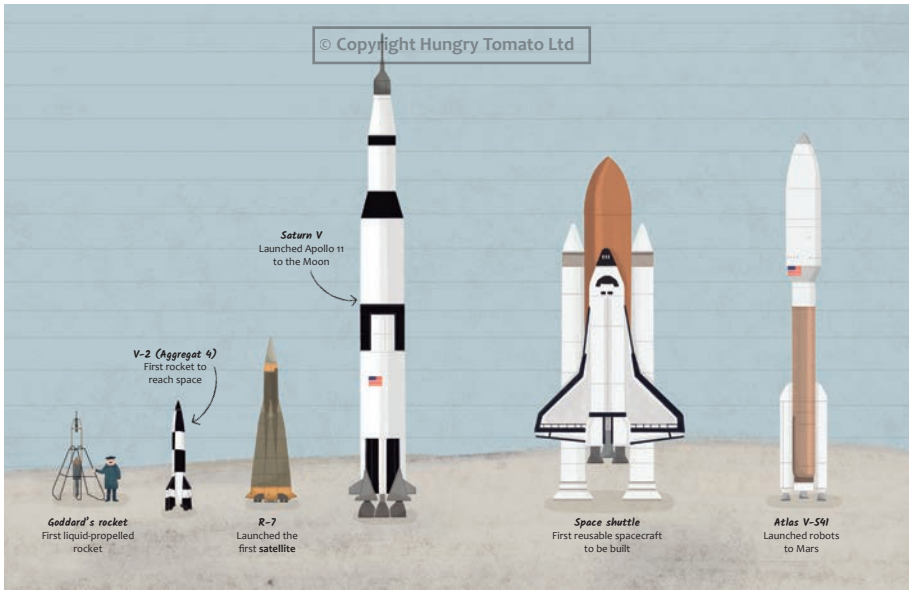
Thanks to scientists, we know that the Moon affects life on Earth and has the potential to be even more useful in the future. Some examples of what the Moon does for us include:

- **Measuring time** - we can track the passage of a month by watching and recording the **phases of the Moon**.
- **Tides** - the Moon's **gravity** causes many of Earth's oceans to have high and low tides.
- **Seasons** - the giant **impact** that formed the Moon is thought to have tipped Earth to spin on an angle. It is this **tilt** that gives some places on Earth seasonal weather.
- **History** - by studying the Moon, scientists are able to learn lots about ancient Earth and the ancient **solar system**.
- **Space exploration** - scientists are looking into exploring outer space in the near future and think that the Moon would be a great place to build a base from which to carry out scientific research and travel deeper into the solar system.

BUILDING ROCKETS: SCENE 4

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

Take a look into some of the most significant rockets that have ever been built and learn how our understanding of the Moon, and outer space as a whole, has changed over the last 100 plus years thanks to these incredible machines.



DISCUSSION PROMPTS

- **All of these machines in the scene are rockets. How many similarities and differences can you spot?**
  Encourage children to talk about features such as overall size, shape, number of rocket boosters, and so on.

- **If you were an astronaut going on a mission into space, which rocket would you rather travel in? Why did you choose this rocket?**

- **How do you think astronauts feel when they take off from Earth on their space mission?**
  Give examples of emotions such as feeling excited, nervous, curious, and so on.

ACTIVITY

Corresponding activity on page 6 of the activity pack: 'Rocket Power' is a 'draw the other half' activity where children are given images of rockets split down the middle. Multiple rockets have been provided.

BUILDING ROCKETS: SCENE 4

RELEVANT INFORMATION

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

ROCKETS THROUGH TIME

This scene shows some of the most significant rockets ever built. They span a period of just over 100 years and show how far **space exploration** has come within that short amount of time. Here is some key information about each rocket in the scene:

GODDARD'S ROCKET

Physicist Dr. Robert Goddard is often called the 'father of modern **rocket propulsion**'. His first successful rocket launch was in 1926. His rockets may have been tiny, but they did something important - they showed how powerful **liquid-propelled** rockets could be, paving the way for space exploration.

V-2 (AGGREGAT 4)

This rocket stood at about 14 m (46 feet) tall - that's the same as three double-decker buses on top of each other! Developed in Germany, the V-2 was the world's first large-scale liquid-propelled rocket and the first rocket that could fly high enough to reach space.

R-7

The R-7 was a missile and **launch vehicle** developed in the 1950s. It was used to launch the first **satellite**, Sputnik 1, in 1957. Similar versions of the R-7 rocket were used to launch the first **cosmonauts** into space, including Yuri Gagarin, who became the first human to **orbit** the Earth.

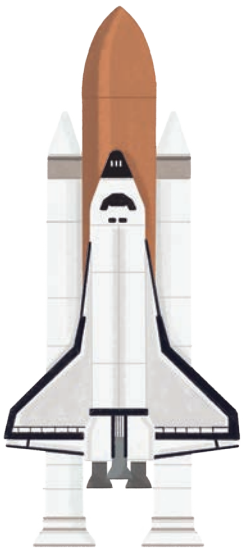
BUILDING ROCKETS: SCENE 4

RELEVANT INFORMATION

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

SATURN V

Saturn V was designed and used for all 10 US-**crewed Apollo missions**, from 1968 to 1972, including the famous Apollo 11 mission, which is when humans walked on the Moon for the first time. Over the course of its years in operation, it took 24 people to the Moon.



SPACE SHUTTLE

The space shuttle was the world's first **reusable spacecraft**. It launched like a rocket, but landed like a plane! It was first launched in 1981 and helped carry astronauts and **cargo** to and from Earth's orbit. Its longest mission lasted 17.5 days.

ATLAS V-541

This slim rocket was used as a launch vehicle for sending rovers, including Perseverance, to Mars. Standing 58 m (191 feet) tall, it's as tall as a 19-floor building. It has 4 solid rocket motors which increase engine **thrust**.

ONE SMALL STEP FOR MAN: SCENE 5

The material for this scene can be linked to curriculum topics, including:
Animals, including humans; Earth and space; living things and their habitats.

Journey to the surface of the Moon, seeing it in context of the first astronauts who walked there. Discuss the reasons astronauts wear space suits, using it as a way of linking in the differences between the Moon and Earth.

DISCUSSION PROMPTS

- **Why do you think the astronauts are wearing special suits and helmets?**
  Information overleaf

- **There is a planet pictured in the sky on the right-hand size of the scene. Do you know which planet this is?**
  Information overleaf

- **The Moon looks quite different from Earth, where we live. How many differences can you think of?**
  Encourage children to talk about features such as lack of plants and animals, emptiness, colour and texture of the ground, and so on.

ACTIVITY

Corresponding activity on page 8 of the activity pack: 'Adventurous Astronauts' is a true or false quiz. Children use what they have learnt from reading the main book, as well as their intuition, to fill in the answers.

ONE SMALL STEP FOR MAN: SCENE 5

RELEVANT INFORMATION

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

ASTRONAUT SPACE SUITS

Astronauts have different space suits for wearing inside and outside the **spacecraft**! These cleverly-designed suits help astronauts survive their trip to space. Outside space suits, like the ones in the scene, have some key features (some of which aren't visible), including:

- **Helmet** - the helmet gives the astronauts **oxygen** to breathe. It also has a gold **visor** which stops the astronauts' eyes from being damanged by the stronger sunlight. Some helmets have built-in **communication systems** so astronauts can speak to each other.

- **Gloves** - space can be freezing! Space gloves have little heaters inside to keep astronauts' fingers warm so that they can keep moving and doing their job.

- **Life support system** - worn like a backpack, this holds the oxygen, the fan that removes **carbon dioxide** (that the astronauts have breathed out), a machine that controls **temperature** within the suit, and electricity to keep the suit working.

- Layers of material - space suits can have up to 16 layers of material! This helps astronauts' bodies stay the right temperature.

Astronauts couldn't walk on the Moon without these suits, because:

- On the Moon, there is no **air** to breathe.
- On the Moon, temperatures can be extreme! It can get as hot as 121°C (250°F) and as cold as -246°C (-410°F).
- The Moon is exposed to harmful **radiation**. Space suits help to block some of this out.
- Moon and space dust can be very sharp and cause lots of harm.

VIEW FROM THE MOON

The planet pictured in the sky on the right-hand side of this scene is our planet, Earth.

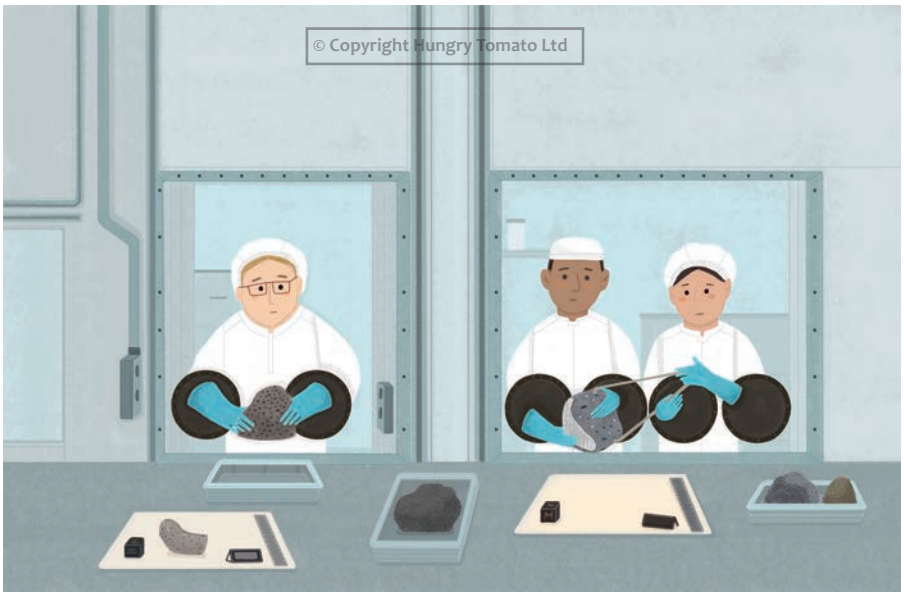
MOON LANDING

This scene shows the first time humans walked on the Moon. This happened during **NASA's Apollo 11 mission** in 1969. The astronauts involved were Neil Armstrong (Commander) and Buzz Aldrin (Pilot) who walked on the Moon, and Michael Collins (Pilot) who stayed on the command module above the Moon's surface.

EXAMINING MOON ROCKS: SCENE 6

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

Discover the special labs where scientists study Moon rocks, discuss the precautions they take to keep samples safe from contamination - using the scene as a prompt - and the reason they go to such trouble to look after samples.



DISCUSSION PROMPTS

- **The scientists are wearing lots of protective clothing in this scene. How many things can you spot?**
Encourage children to talk about features such as gloves, lab coats, and hats.

- **As well as wearing protective gear, the scientists are looking at the rocks through a glass screen. Why do you think this is?**
Information overleaf

ACTIVITY

Corresponding activity on page 9 of the activity pack: 'In the Lab' is a two-stage activity where children match-up the name of the scientific item with its description. They also have to identify which item is the odd one out.

EXAMINING MOON ROCKS: SCENE 6

RELEVANT INFORMATION

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

PROTECTING MOON ROCKS

As shown in the scene, scientists work hard to protect the Moon rocks they're looking at. They do this by wearing **protective clothing** such as clean gloves, hats, and lab coats, as well as by studying the rocks behind glass screens in special **labs**. The areas behind the glass screen are often **vacuum chambers** - sealed places with no air.

Scientists study Moon rocks like this to stop the **samples** from being **harmed** or **contaminated**. If samples were harmed or contaminated, it would affect what scientists could learn about the Moon. As so much time has passed since humans last went to the Moon - the last visit was in 1972 - scientists must make the most of the samples they have, as they are limited.

The samples collected during the Apollo 11 mission in 1969 are still being studied. This is because scientists today have stronger and more **advanced technology** than ever before, so they're still learning new things about the Moon and the solar system - even from samples that were collected more than 50 years ago!

WHAT IS THE MOON MADE OF?

Scientists have uncovered lots of things about the Moon by studying samples brought back to Earth by astronauts. Here's what makes up the Moon's surface:

- **Rocks** from the surface of the Moon were formed from cooled **lava**. Rocks aren't the only signs that the Moon once had **volcanoes** which erupted - scientists have found **craters** and land formations on the Moon's surface that show the remains of volcanoes! They think the Moon's volcanoes could have been active as recently as 50 million years ago - for space objects, that's very young!

- **Soil** on the Moon isn't like soil on Earth. Moon soil is made of rock and tiny pieces of glass so it's sharp and can cause harm to things it touches. From even short visits to the Moon, astronauts' space suits have become damaged because of the soil. Scientists think this harmful soil - which they call **'regolith'** - was created from **meteorites** that have flown into the Moon.

- Moon **dust** is the tiniest pieces of Moon soil.

WHY VISIT THE MOON: SCENE 7

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

Explore the many reasons that scientists think we should go back to the Moon, discussing how these tasks could be done safely and how they could impact our everyday lives here on Earth.

DISCUSSION PROMPTS

- **What do you think astronauts would find hard about mining material from the Moon?**
  Information overleaf

- **Helium-3 could be a new source of power. Can you think of any examples of places or things we get power from already?**
  Information overleaf

- **What do you think we could make out of materials from the Moon?**
  Information overleaf

ACTIVITY

Corresponding activity on page 10 of the activity pack: 'Back to the Moon' is a classic activity where children fill in the blanks in a series of sentences and facts about the Moon!

WHY VISIT THE MOON: SCENE 7

RELEVANT INFORMATION

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

BACK TO THE MOON

This scene shows a handful of the reasons some scientists want to go back to the Moon.

1. **Mining** opportunities (top image) - Moon rocks are full of ingredients like **rare metals** and **minerals** that could be very useful for us on Earth. Scientists even think we could mine water from the Moon and turn it into rocket fuel to be used by people living on the Moon who need to travel back to Earth or deeper into outer space.

There are some problems with mining the Moon, including:
- It's difficult and expensive to return large amounts of material back to Earth.
- Some people argue that no one has the right to make money from the Moon.
- If it was mined too much, it would become visible from Earth and ugly.
- The Moon holds lots of clues as to what the early universe was like. If it were mined, we could lose this evidence.

2. A new source of **power** (bottom, left-hand page) - The Moon has an element called helium-3 which could be used in **nuclear fusion** to make **electricity**. This could be a great alternative power source compared to current **nuclear power**, as it would produce no **nuclear waste** so it would be much less harmful.

Power can come from many places. Some power is **renewable** which means it comes from a source that doesn't run out and some is **non-renewable** which means it comes from a source that will eventually run out. Examples of power currently used on Earth includes:
- **Solar power** - created using the power of the Sun.
- **Wind power** - created using wind power.
- **Fossil fuel** - created using oil, coal, and natural gas.

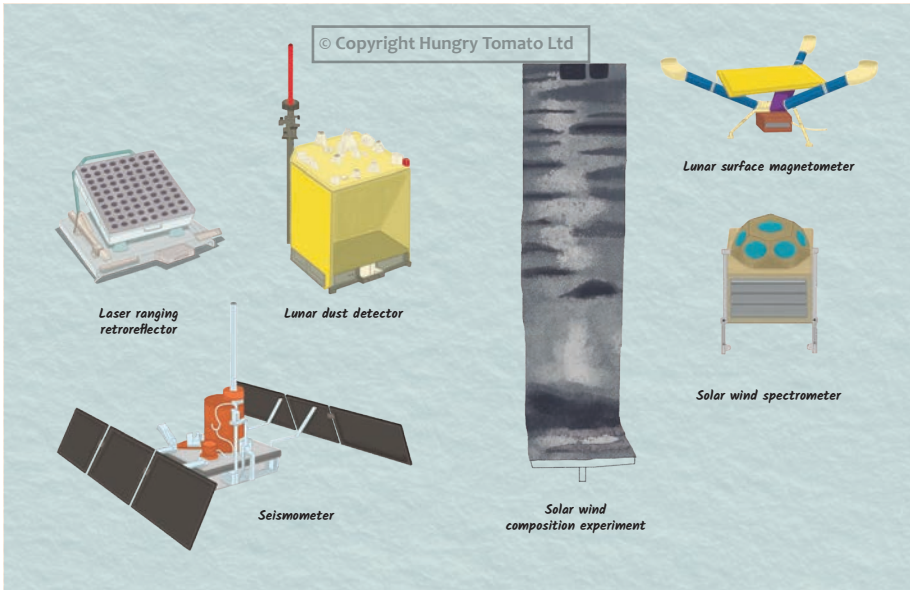
3. Materials for making items (bottom, right-hand page) - Rare metals from the Moon can be used to create lots of useful items, including the things pictured in the scene. Many of these rare metals are here on Earth, but they're very difficult or dangerous to get.

Other things that could be made using Moon materials include:
- Batteries
- Magnets
- Hard drives
- Vehicle engines

EXPERIMENTS ON THE MOON: SCENE 8

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

Explore some of the incredible experiments that astrobiologists and astronauts have conducted on the Moon so far. Discuss what the children would like to discover from a future Moon experiment.



DISCUSSION PROMPTS

- **Can you guess what any of these tools do?**
  Information overleaf

- **If you were a selenologist designing an experiment, what would you most want to find out about the Moon?**

- **How do you think running an experiment on the Moon would be different from running one on Earth?**
  Encourage children to talk about challenges such as working in lower gravity, wearing a space suit and gloves, and so on.

ACTIVITY

Corresponding activity on page 11 of the activity pack: 'Experiment Mix-Up' is a cut and stick activity where children match up the experiment with a description of its appearance and uses. A fun way to learn about different Moon experiments!

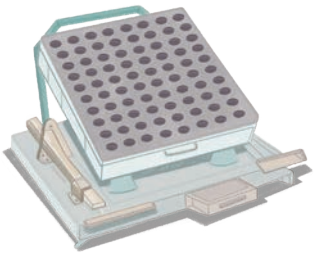
EXPERIMENTS ON THE MOON: SCENE 8

RELEVANT INFORMATION

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

AMAZING MOON EXPERIMENTS

Selenologists work with **engineers** and other clever scientists to develop amazing machines that can teach us lots about the Moon. Here are just some that were set up during the **Apollo missions**:

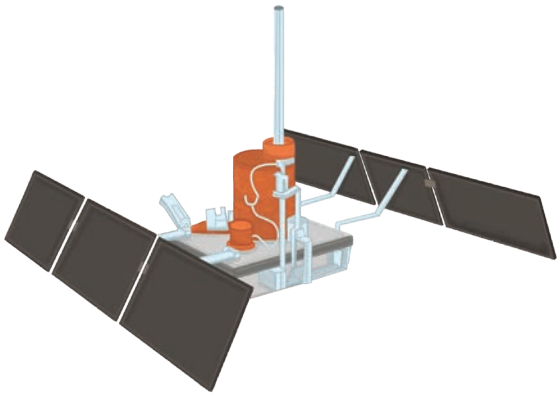


LASER RANGING RETROREFLECTOR

This shiny platform was left on the Moon on purpose! Scientists aim **laser beams** at it from Earth and use the reflection of the laser beams to monitor how fast the Moon is spinning, how far it is from Earth, and more. These tests have shown that the Moon is slowly moving away from Earth.

LUNAR DUST DETECTOR

This experiment was originally meant to measure dust build-up on the Moon's surface following spacecraft take-off and landing, and meteor strikes. But it was improved to also record **radiation**, and **temperature** data. This thing was TINY and sat on top of other experiments!



SEISMOMETER

This machine monitors **seismic activity** - movement - coming from under the surface of the Moon. We now know that the Moon has "moonquakes", just like Earth has earthquakes. It was left on the Moon to record information. It only worked for a short time, but it still gave scientists lots of information to work with.

SOLAR WIND COMPOSITION EXPERIMENT

This experiment was undertaken on an Apollo mission and brought back to Earth for examination. Particles in the air got trapped on the foil sheet. From that, scientists could work out the gases and other elements that make up **solar wind**.

EXPERIMENTS ON THE MOON: SCENE 8

RELEVANT INFORMATION

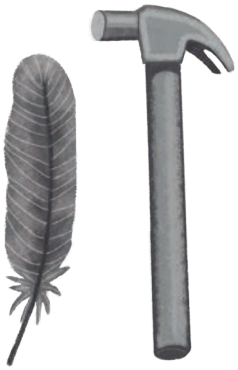
Keywords that you may want to pull out and explain have been put into bold.

LUNAR SURFACE MAGNETOMETER

This unusual-shaped machine tested the Moon's **magnetic field**, including working out how strong it is and how it reacts to other factors in outer space. The machine was left on the Moon to continue collecting data which it did for a few months before it stopped working.

SOLAR WIND SPECTROMETER

Two different solar wind spectrometers have been placed on the Moon. These machines measure the energy, direction of travel and other variations of the solar wind, including how it was affected by Earth's orbit as it passed the spot on the Moon.



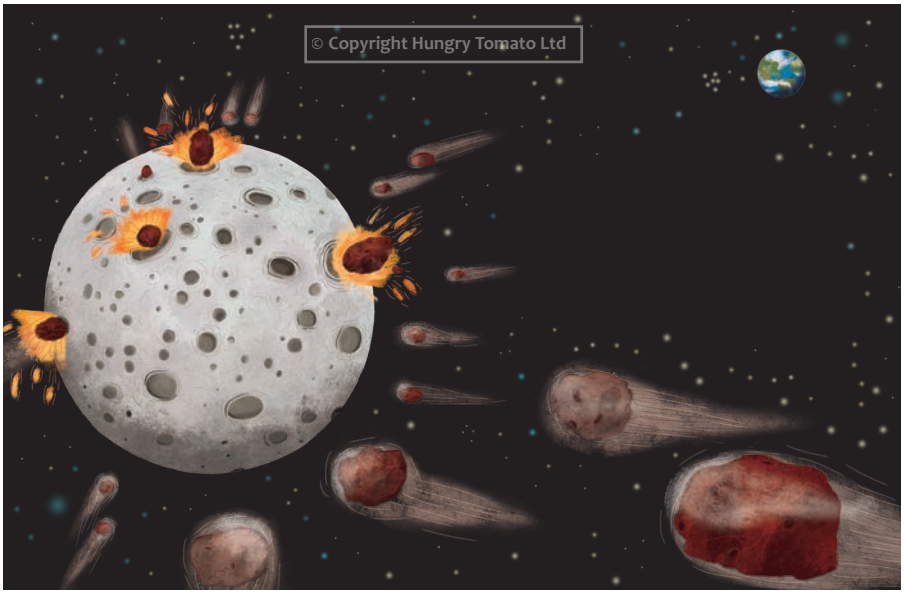
BONUS: FEATHER AND HAMMER EXPERIMENTS

This was an experiment that was done by astronauts while on the Moon. They dropped a feather and hammer at the same time to prove that in a **vacuum** all objects released together fall at the same rate regardless of **mass**. It's something that Galileo thought to be true hundreds of years ago in the 1600s and was finally confirmed in 1971.

THE ANCIENT MOON: SCENE 9

The material for this scene can be linked to curriculum topics, including:
Earth and space; everyday materials; rocks; states of matter.

Discover the power of outer space by looking back in time to the ancient Moon being bombarded by asteroids! Explore just how scientists know this happened and find out what makes asteroids different from other space rocks.



DISCUSSION PROMPTS

- **The solar system used to be much more dangerous than it is today. This scene shows something called the 'Late Heavy Bombardment'. Can you guess how long ago this happened?**
  Information overleaf

- **How do you think scientists know about the Late Heavy Bombardment?**
  Information overleaf

- **Can you spot Earth in the scene? Besides Earth, can you name any other planets in our solar system?**
  Information overleaf

ACTIVITY

Corresponding activity on page 12 of the activity pack: 'Word Smash' is an activity where children have to unscramble the letters to spell out space-themed words. In a linked activity, they have to see how many words they can create out of set letters.

THE ANCIENT MOON: SCENE 9

RELEVANT INFORMATION

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

ASTEROIDS EVERYWHERE! (THE LATE HEAVY BOMBARDMENT)

The Late Heavy Bombardment is a period in time that scientists have dated to around 4 billion years ago! During this time, there was a huge number of **asteroids** flying around the **solar system**, smashing into things. Scientists' understanding of this period comes from their studies on **Moon rocks** and **craters** which were impacted by the asteroid crashes.

The Moon is like a time capsule - because the Moon's surface doesn't move and isn't affected by plants, animals, weather and oceans like Earth is, scientists can use clues that are still on the surface of the Moon to work out what happened billions of years ago. Similar clues on the Earth have been long lost.

ASTEROIDS TODAY

Today, most asteroids in our solar system are found in a place scientists call the 'asteroid belt'. This is found between Mars and Jupiter. They **orbit** the Sun from this distance, just like the planets in the solar system do. Scientists think there are millions of asteroids there, some of which are small and some of which are huge!

But what are they and how are they different from other space rocks?

- Asteroids are space rocks left over from the early formation of our solar system. They orbit our Sun.

- **Comets** also orbit the Sun, but they are made of ice and dust. As they get closer to the Sun, comets start to melt. This can make comets look like they have a tail shooting out behind them!

- **Meteors** are small pieces of asteroids or comets that are usually the size of pebbles. They shoot through Earth's **atmosphere** so fast that they burn up and glow. This makes a streak of light in the sky, which is why they're sometimes called 'shooting stars'.

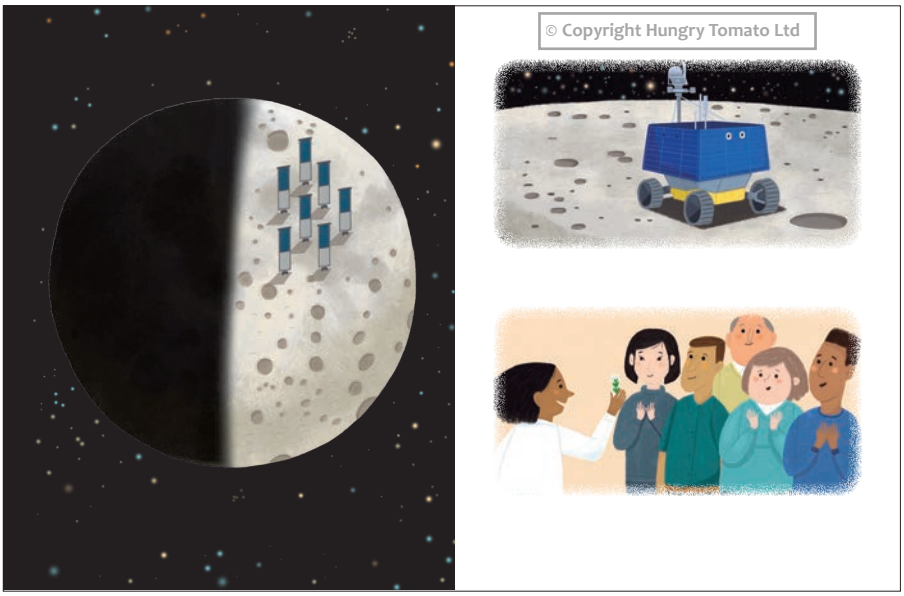
EARTH AND THE SOLAR SYSTEM

You can see Earth in the top right of the scene. There are eight planets in our solar system in total. These are recounted in their order from the Sun. They are:
Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

WHAT WE NEED TO LIVE ON THE MOON: SCENE 10

The material for this scene can be linked to curriculum topics, including:
Animals, including humans; Earth and space; living things and their habitats.

Explore some of the biggest challenges facing scientists who are trying to work out how to get humans to live and work on the Moon safely. Encourage children to think about the differences between living on the Moon and on Earth.



DISCUSSION PROMPTS

- **Can you name the things standing on the bright side of the Moon in the left scene? Do you know what they do?**
  Information overleaf

- **There are lots of challenges of living on the Moon. Can you think of any other examples of things that would be tricky there?**
  Information overleaf

- **What do you think would be the most different about living on the Moon compared to Earth?**

ACTIVITY

Corresponding activity on page 13 of the activity pack: 'Liftoff to the Moon' is a reflective writing task where children answer questions about their opinions on a number of space-related questions.

WHAT WE NEED TO LIVE ON THE MOON: SCENE 10

RELEVANT INFORMATION

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

SCIENCE IN THE SCENE

This scene shows some things that need to be put in place for us to live on the Moon.

1. **Solar panels** pictured on the bright side of the Moon (left-hand page). There are not yet solar panels on the Moon - this image is just to represent the need for humans to be able to **generate electricity** to power the **machines** needed to live on the Moon. Solar panels work by converting the power of the Sun into electricity.

2. Sourcing **water** on the Moon (top, right-hand page). The **rover** pictured is called **VIPER**. It's one of NASA's many creations that have been designed to map out the Moon and search for **water sources** that are the largest and easiest to access. It would be almost impossible to have enough water to sustain a whole Moon **colony** shipped from Earth, so this is a vital piece of **research**.

3. Growing **food** on the Moon (bottom, right-hand page). Plants don't naturally grow on the Moon, but scientists wanted to see if plants could be grown and kept alive in Moon soil. It would be difficult to ship enough food for a Moon colony from Earth so this research is really important. They have grown small plants in Moon soil in **controlled conditions** on Earth. They are not as strong as plants grown in Earth soil, but it's a promising start.

OTHER CHALLENGES OF LIVING ON THE MOON

Humans need to solve many more challenges before we can live on the Moon, including:

Extreme conditions - Unlike Earth, which has 24-hour days, the Moon's days last a really long time! It experiences 327.5 hours of **sunlight** followed by 327.5 hours of **darkness**. The sunlight and darkness on the Moon bring really extreme **temperatures**.

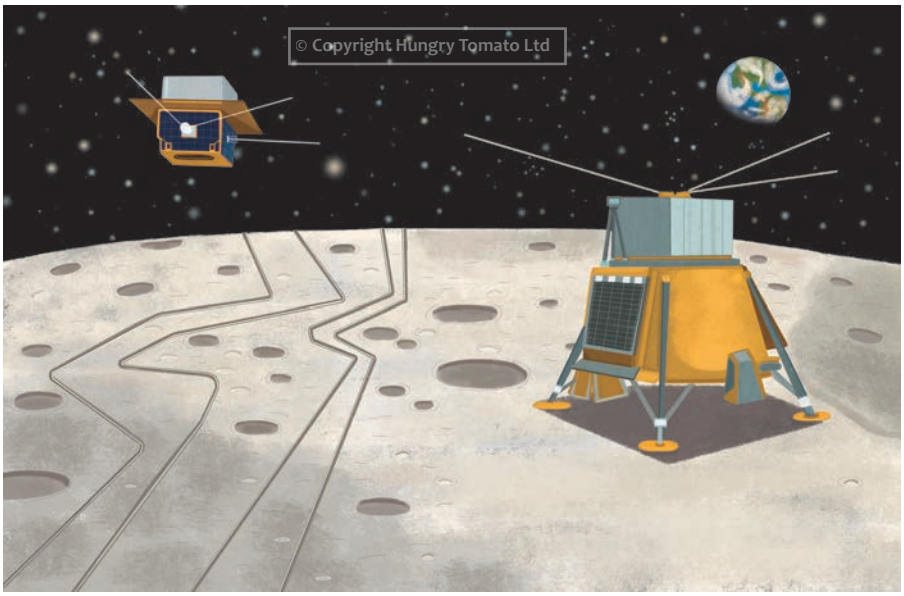
Building materials - because of the **lack of air**, the extreme temperatures, and the harmful **dust** on the Moon, we would need to live in special **shelters**. But transporting the materials to build a whole colony would be very difficult, time-consuming, and expensive. Could we use materials from the Moon to build our shelters? Scientists are looking into it.

Effect of living in space - from **astronauts** living in the **International Space Station (ISS)**, scientists know that living in low **gravity** can be harsh on the human body. Astronauts need a proper diet and exercise routine to keep their bodies healthy while in space.

FUTURE MOON EXPERIMENTS: SCENE 11

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

Discover some of the incredible telescopes and machines that scientists are designing to learn more about the Moon and to observe the early universe. This advanced technology could change the things we know about space!



DISCUSSION PROMPTS

- **How many telescopes can you count in the scene? Watch out – they might look different from what you expect!**
Information overleaf

- **Do you think it would be easy or hard for scientists to transport these kinds of telescopes to the Moon? Why do you think that?**
Information overleaf

ACTIVITY

Corresponding activity on page 14 of the activity pack: 'Words Floating in Space' is a classic word search activity, using lots of great space words to get children familiar with the language of selenology.

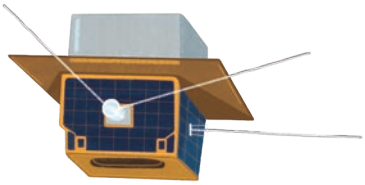
FUTURE MOON EXPERIMENTS: SCENE 11

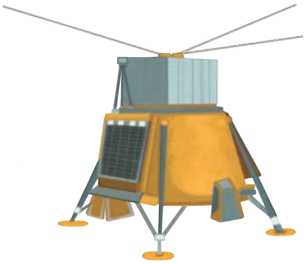
RELEVANT INFORMATION

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

TELESCOPES ON THE MOON

There are three different **telescopes** pictured in the scene. None of them look like the typical instruments that you might imagine when you hear the word "telescope". Here is a little information about each:





DAPPER

DAPPER stands for Dark Ages Polarimetry Pathfinder. It's a **radio** telescope that will float in the Moon's **orbit**, searching for radio signals from the early **universe**. DAPPER is being designed by the National Radio Astronomy Observatory (NRAO) and is expected to launch as part of NASA's **Artemis missions**.

FARVIEW OBSERVATORY

Also a radio telescope, the FarView Observatory is being designed as a large radio **array** that will cover a huge portion of the Moon's surface. Made up of thousands of **antennas**, this telescope is planned to be built on the far side of the Moon where there is less **interference** from Earth.

LUSEE-NIGHT

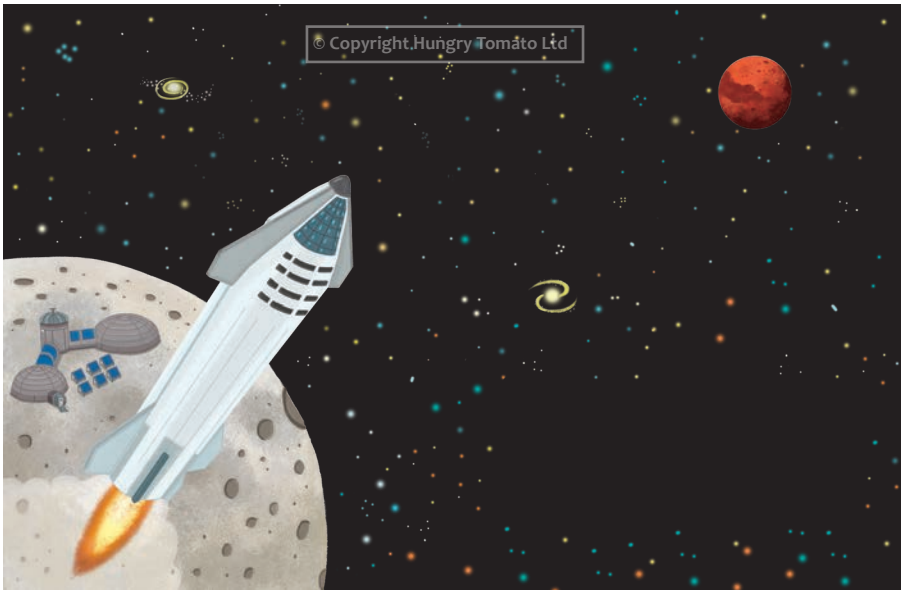
LuSEE stands for Lunar Surface Electromagnetics Experiment. Scientists from multiple **laboratories** have worked together to design it. A radio telescope, LuSEE-Night will study the Moon's radio environment and capture radio waves from the early universe.

Moon-based telescopes will need to be built on the Moon: it would be impossible to transport these big machines from Earth. That's why it's so important scientists find out what materials exist on the Moon. The telescopes shown in the scene are all radio telescopes, but scientists are also working on **optical telescopes**.

STEPPING STONE TO MARS: SCENE 12

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

Discover the Red Planet, Mars, including what makes it so special and why scientists think it's so important to explore. Discuss what children already know about Earth's red neighbour and introduce new facts to engage excitement about space.



DISCUSSION PROMPTS

- **Can you spot the planet Mars in this scene?**
Information overleaf

- **What do you know about Mars already?**
Encourage children to talk about things such as the fact that Mars is in our solar system, it comes after Earth, it's red, scientists are searching for alien life there, and so on. There is more information overleaf.

- **Humans haven't been to Mars yet - only scientists' robots have! Why do you think that is?**
Information overleaf

ACTIVITY

Corresponding activity on page 15 of the activity pack: 'Mission to Mars' is a classic line maze activity where children have to complete the maze to help the rocket reach Mars.

STEPPING STONE TO MARS: SCENE 12

RELEVANT INFORMATION

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

MARS

Mars is the large red planet that's shown in the top right-hand side of the scene.

Mars is the fourth **planet** from our Sun and is about half the size of Earth. It's often called 'the **Red Planet**' because it has lots of **iron** in its dirt which causes its surface to look red.

Mars is dry, dusty, and **barren** - there are no plants or animals. It can also get extremely cold: temperatures can fall as low as about -153°C (-225°F)! It's also home to the biggest **volcano** in our **solar system**! The volcano is called Olympus Mons and it's almost three times taller than Mount Everest.

So far, Mars is the only planet that scientists have sent **rovers** to explore. This makes it one of the most explored places in our solar system. But why? Despite seeming so unusual, of all the planets in our solar system, Mars is the most similar to Earth: both planets are **rocky**, have **seasonal weather**, and include **features** like volcanoes and **canyons**. Scientists think Mars may be the most likely place in the solar system to have signs of ancient alien life. The rovers haven't found any sign of aliens yet, but they have made some amazing discoveries about what Mars was like a long time ago.

EXPLORING OUTER SPACE

Scientists from around the world are busy working on plans to send humans into outer space. While **NASA** are famous for their plans to create a long-term presence of humans in space and for humans to explore deeper within the solar system, it's not just them - many other **space agencies** have similar goals.

Scientists have discovered so much more about the Moon since visiting it. Imagine how much more we could learn about Mars once people had been there too!

However, Mars would be a dangerous planet for humans to visit. There are lots of challenges that scientists need to overcome before humans can visit Mars, including:

- How humans would cope with the high levels of **radiation**.
- How humans would adjust to different levels of **gravity**.
- How to stay safe and healthy so far from Earth and during the 9-month long flight!

FUTURE MOON BASE: SCENE 13

The material for this scene can be linked to curriculum topics, including: Animals, including humans; Earth and space; living things and their habitats.

Explore what a future Moon base could look like with this final scene. Encourage children to point out the key features and useful machines depicted and discuss anything they think is missing that they would include in their own Moon colony.

DISCUSSION PROMPTS

- **What can you see in this Moon-based colony scene?**

Encourage children to talk about features such as the vehicles, astronauts and their suits, solar panels, plants, and so on.

- **There are three machines floating in the sky. What do you think they are and what do you think they do?**

Information overleaf

- **If you were designing this space colony, would you add anything else to it? Is there anything not shown that you would want to make sure is included?**

Encourage children to talk about bedrooms, kitchen, rockets to get back to Earth, and so on.

ACTIVITY

Corresponding activity on page 16 of the activity pack: 'Design Your Own Moon Base' is a creative drawing activity where children design their own space base on the Moon, using prompts for things to think about and include within their base.

FUTURE MOON BASE: SCENE 13

RELEVANT INFORMATION

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

SCIENCE IN THE SCENE

The three machines floating in the sky in this scene are **satellites**.

Humans have created many **artificial satellites** and launched them into Earth's **orbit**. We use these for different tasks such as helping with **navigation**, **communication**, and **weather forecasting**. It's likely that once a **colony** is established on the Moon, similar machines would be used there too.

Other key features within this scene include:

- Gym - astronauts need lots of exercise to make sure their bodies stay strong.
- Fresh food - astronauts need to eat lots of healthy food to fuel their bodies.
- Space suits - astronauts need to wear protective suits and helmets while outside in space (find more information on space suits on page 16).

BUILDING A MOON COLONY

Whilst many space agencies are planning to create a colony on the Moon, NASA's plan may be the most well known. The **Artemis missions** aim to get a long-term space base on the Moon by 2030. This will involve a colony on the Moon's **surface** and in its orbit.

Many new machines are being created for this series of missions, including new **spacecraft** like rockets and landers.

There will also be new ways of getting around the Moon! During the **Apollo missions**, astronauts used a **Lunar Roving Vehicle** (LRV) which is sometimes called a 'Moon buggy'. For the Artemis missions, there will be a new vehicle called a **Lunar Terrain Vehicle** (LTV). These vehicles may look similar - they are both open vehicles with four wheels, powered by electric - but the LTV will be much more advanced, for example:

- The LTV will be able travel roughly three times as far as the LRV and go twice as long without recharging.
- The LTV will be able to cope with the Moon's freezing nighttime temperatures so that it can be reused for at least 10 years.
- The LTV will be capable of driving up really steep slopes and uneven ground to allow astronauts to travel over more of the Moon's surface.

POST-READING QUESTIONS

Engage in discussion about the journey taken throughout the book and the facts that were uncovered, with the suggested questions below.

- **Were you surprised to learn that, one day soon, people may be able to live on the Moon?**
- **If you were given the chance, would you go and live on the Moon?**
- **Did anything in the book surprise you?**
- **What's the coolest thing you've learnt from this book?**

ACTIVITY

Corresponding activity on page 17 of the activity pack: 'Write Your Own Selenology Story' is a creative writing activity which encourages children to write a story about selenology, using three key prompt words.

THE BIG QUESTIONS ANSWERED

Explore the many diverse fields of science, discovering captivating stories and incredible discoveries with The Big Questions Answered, an exciting science series for inquisitive kids.

Find more information about
The Big Questions Answered and other
books in the series at:
www.thebigquestionsanswered.com

Published and Distributed in India by:

SCHOLASTIC


THE
BIG
QUESTIONS
ANSWERED