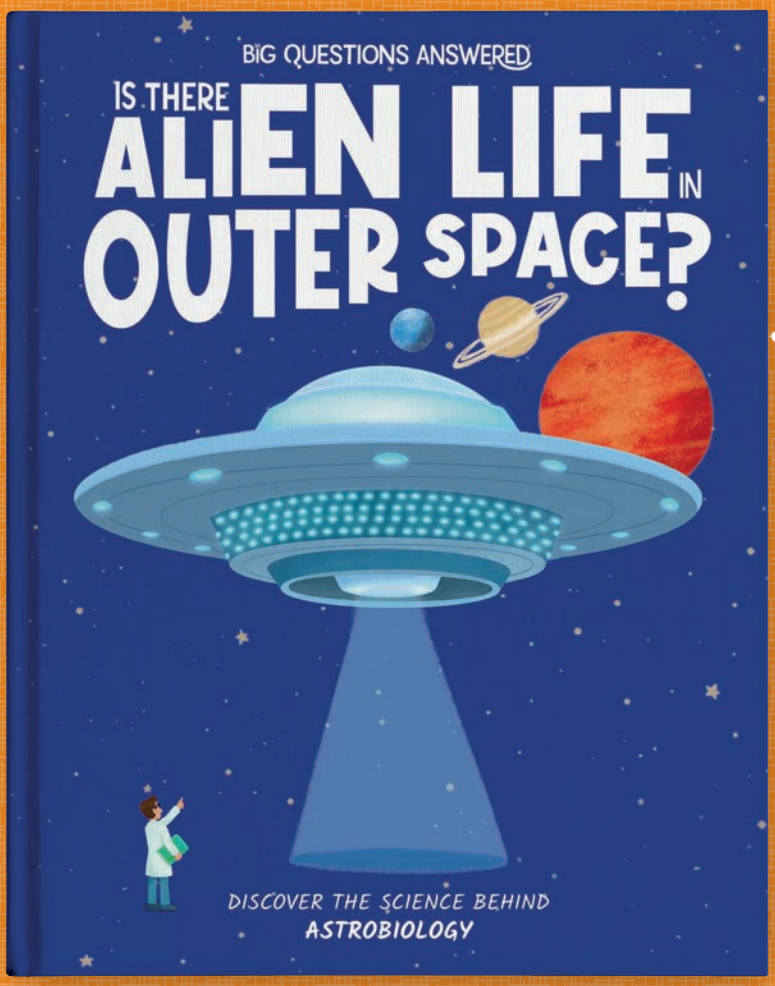
BIG QUESTIONS ANSWERED

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

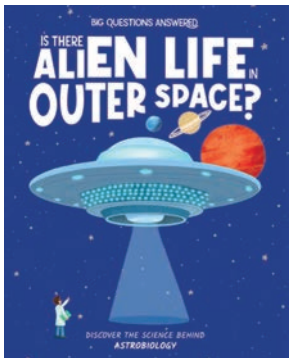
Inspire children's natural curiosity, improve literacy, and have fun learning about different sciences with The Big Questions Answered. Each book in the series is accompanied by a selection of fantastic, **FREE** downloadable resources.

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**

Is There Alien Life in Outer Space? book



Young Astrobiologists' Activity Pack

KEY CURRICULUM TOPICS

The resources related to *Is There Alien Life in Outer Space?* tie in with key curriculum topics including:

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

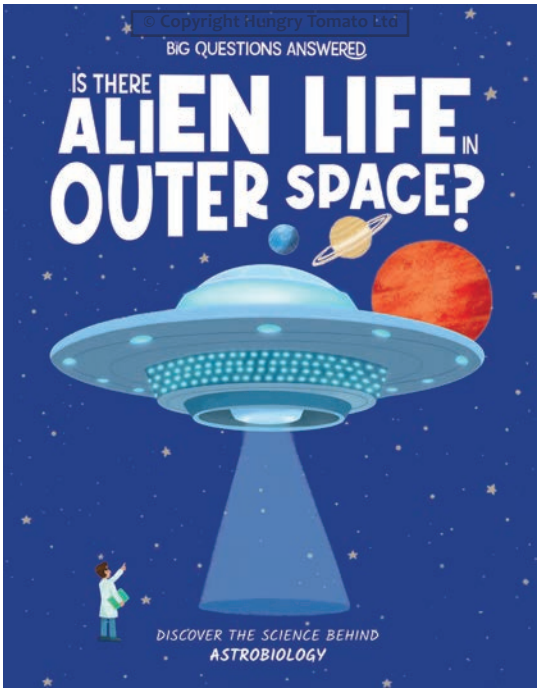
The most relevant topics are indicated throughout this guide.

IS THERE ALIEN LIFE IN OUTER SPACE?

This book explores the extraordinary world of astrobiology. As well as covering key facts about the ways that scientists are searching for alien life, the book explores the wider field of space science and living things. It looks at planets within and beyond our solar system and their unique features, the factors necessary for life on Earth, and the technology that allows scientists to learn more about outer space.

PRE-READING QUESTIONS

Engage in discussion about the general topic of astrobiology and the possibility of alien life, with the suggested questions below.



- Do you think aliens exist? Why or why not?
- If aliens existed, where do you think they would live?
- If aliens existed, what do you think they would look like?

OUR SOLAR SYSTEM: SCENE 1

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

Delve into the concept of outer space with this opening scene depicting the planets in our solar system. Engage in discussion about the different planets, how much is unknown, and the concept of alien life.

DISCUSSION PROMPTS

- **Can you name any of the planets in this scene? Do you know which one is missing?**
Information overleaf

- **What do you know about planets and outer space already?**
Encourage children to write down their answers. There are lots of facts in the main book as well as this resource booklet for them to read and learn.

- **What do you think it would be like to travel to another planet?**
Encourage children to use adjectives such as scary, exciting, fun, and so on.

ACTIVITY

Corresponding activity on page 3 of the activity pack: 'Planet Facts' is a mixture of research and creativity. Children choose a planet, research it, fill in the fact file and draw it. This activity can be printed multiple times to generate a fact booklet!

OUR SOLAR SYSTEM: SCENE 1

RELEVANT INFORMATION

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

OUR SOLAR SYSTEM

The **solar system** is made up of the **Sun** and all the **planets** and smaller objects that surround it. All the planets in the solar system have their own names, and we say them in the order that they appear in, starting with the one closest to the Sun:
Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

The planet that's missing from the picture in the first scene of the book is **Earth** - the planet that we live on!

The planets in our solar system are all very different from each other. For example, they vary in size, colour, temperature, and so on.

REMEMBERING THE PLANETS

People have come up with different ways to remember the order of the planets in our solar system. They often take the first letter of each planet's name and turn it into a funny phrase. The phrases change depending on the country you live in and the language you speak.

For example:

My	Very	Excited	Mother	Just	Served	Us	Nachos!
Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune

A MISSING PLANET?

Our solar system used to have a ninth planet which came after Neptune, called Pluto. In 2006, it was decided that Pluto was not big enough to be called a full planet. It is now considered a **dwarf planet** instead. There are four other dwarf planets in our solar system.

BEYOND THE SOLAR SYSTEM

There are many more planets in the **universe** than the eight in our solar system. Planets that are outside our solar system are called **exoplanets**. Scientists have discovered more than 5,000 exoplanets, but they think there are many, many more - we just haven't found them yet!

THE INVENTION OF TELESCOPES: SCENE 2

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

Delve into the world of astrobiology by discussing the differences before and after the invention of the telescope. Introduce how tools and technology change the way scientists work and understand everything around them.

DISCUSSION PROMPTS

- **Do you know what a telescope is and how it works?**
Information overleaf

- **Can you think of any other people who would find telescopes useful?**
Information overleaf

- **How do you think scientists studied outer space before the telescope was invented? What do you think they would have found difficult?**
Information overleaf

ACTIVITY

Corresponding activity on page 4 of the activity pack: 'Outer Space Mix-Up' is a task where children match up the image of the space object with its name. With handy hints, this fun task helps children understand what different space objects look like.

THE INVENTION OF TELESCOPES: SCENE 2

RELEVANT INFORMATION

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

WHAT IS A TELESCOPE?

A **telescope** is an **instrument** that allows people to see **distant** objects.

There are different kinds of telescopes, which help people study different things. The most famous kind are **light telescopes**. The telescope in this scene is a light telescope - it uses **lenses** or mirrors to collect light from objects and show what they look like.

It is also possible to have telescopes that collect other things, like **sound** or information about **heat** and **radiation**. A **radio telescope** is shown later in the main book (scene 11).

Telescopes are useful for **astronomers** (any scientists who study outer space). Light telescopes are especially useful as they show **planets** and **moons** in lots of detail. It's not just scientists that use telescopes - sailors use them to spot distant land or boats.

WHAT IS A MICROSCOPE?

You may think that telescopes sound similar to **microscopes**. It's true that they both help people see things close up. So, what's the difference?

- With telescopes, the real object is far away and the image shown is smaller than the object actually is.
- With microscopes, the real object is very close and the image shown is bigger than the object actually is.

TELESCOPES AND ASTRONOMY

The first telescope was **invented** in the early 1600s. It was expected to be used for seeing distant things on Earth. But **Galileo Galilei** (pictured in this scene in the main book) turned his telescope towards the sky and made many amazing discoveries including:

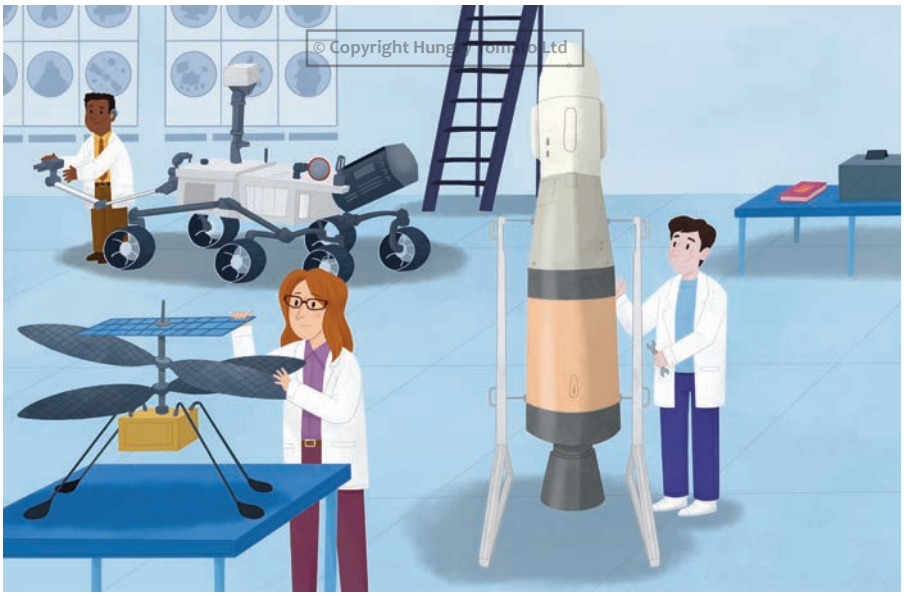
- The Moon is not a perfect **sphere** - it has **craters**, mountains, and other features.
- Earth is not the only planet with a moon - Jupiter has its own moons.
- The planets in our **solar system orbit** the Sun, not the Earth as was believed at the time! (This was not the first time this idea had been thought of, but Galileo's observations strengthened the **theory**.)

Telescopes completely changed **astronomy**. Before telescopes, scientists could only study planets and space objects with their eyes, which meant they couldn't see much at all!

MODERN-DAY ASTROBIOLOGY: SCENE 3

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

Jump ahead to the modern-day lab where astrobiologists are building space-exploring machines. Discuss the differences between this scene and the previous one set 400 years ago, and find out what scientists do differently today.



DISCUSSION PROMPTS

- **What is different about this scene compared to the one before it?**
Encourage children to point out things like the high-tech machines, the clothing, the setting for scientific research, and so on.

- **Can you guess what any of the machines in this scene do?**
Information overleaf

- **Do you think that astrobiologists have a fun job? Why or why not?**

- **Do you think that scientists have found any signs of alien life on Mars?**
Encourage children to write down their answers. The answer is revealed in the fourth scene of the main book, and they'll then be able to see if they were right!

ACTIVITY

Corresponding activity on page 5 of the activity pack: 'Spacecraft Adventure' is a drawing activity that encourages children to get creative and draw the images into an astrobiology-themed comic strip story.

MODERN-DAY ASTROBIOLOGY: SCENE 3

RELEVANT INFORMATION

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

ASTROBIOLOGY TODAY

The scientific research that goes on today is very different from **Galileo**'s time. Astrobiologists today have access to **advanced technology** and incredible things that scientists hundreds of years ago couldn't even dream of!

In this scene in the main book, we can see lots of interesting machines, including:

PERSEVERANCE ROVER

NASA's Mars Perseverance **Rover** (back left in scene) landed on **Mars** in early 2021. It's assisting with the search for signs of **ancient microbial life** by collecting soil and rock **samples** to return to Earth in the future. NASA hopes this will advance our understanding of how **habitable** Mars was in the past. Perseverance is still operating.

INGENUITY HELICOPTER

The Ingenuity Mars Helicopter (front left in scene) travelled to Mars with the Perseverance Rover. It became the first aircraft to achieve powered, controlled flight on another planet! Flying in Mars' thin **atmosphere** is a huge achievement that could help scientists design future flying machines capable of exploring other planets. Before its mission ended, Ingenuity examined Mars, choosing places for Perseverance to investigate and helping guide it there.

MARS ASCENT VEHICLE

The Mars Ascent Vehicle (right in scene) is a rocket that is expected to **launch** on its way to Mars in 2028. The plan is for it to work alongside other rovers, **landers**, and **spacecraft** to collect and then transport samples of material, like rock, from Mars back to Earth. This will allow scientists to do experiments they've never been able to do before.

TEAMWORK IN SCIENCE

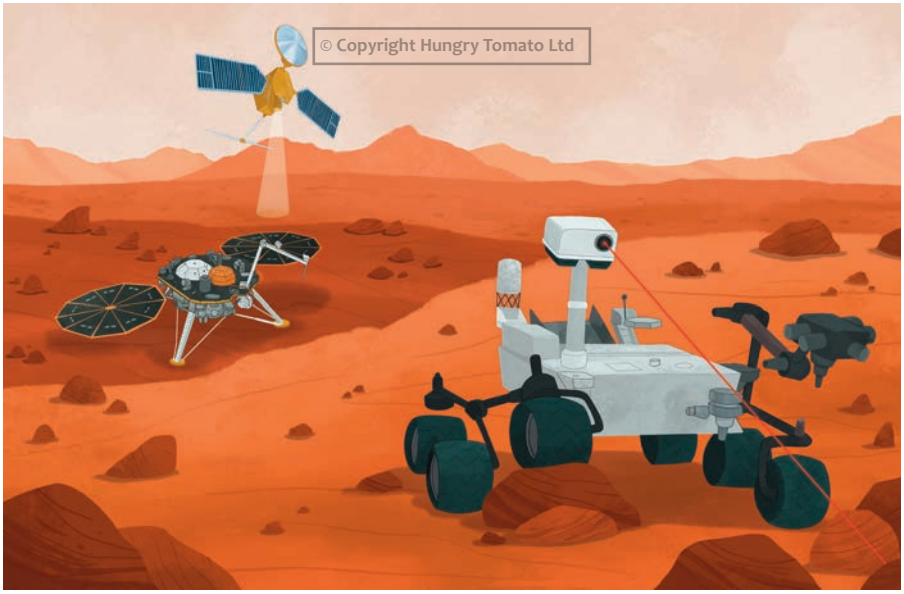
Working well as a team is important in all kinds of jobs, but it's especially important for astrobiologists who work closely with **engineers** and other clever people to design and create amazing machines that help the search for life in outer space.

From coming up with the idea of a machine, to building and testing it out, and eventually launching it into space and controlling it on its mission - astrobiology research projects are huge and couldn't happen without lots of different people working together.

EXPLORING MARS: SCENE 4

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

Discover the amazing machines and robots currently exploring the Red Planet, searching for signs of alien life. Engage in discussion about Mars, why it's the first planet being searched, and why humans have sent robots instead of themselves.



DISCUSSION PROMPTS

- **Why do you think scientists have sent robots to Mars?**
Information overleaf

- **How long do you think it took the robots to get to Mars?**
Information overleaf

- **Can you guess what any of the machines on this page are doing and how they work?**
Information overleaf

ACTIVITY

Corresponding activity on page 6 of the activity pack: 'Lost in Outer Space' is a classic line maze activity where children have to complete the maze to help the rocket reach Mars.

EXPLORING MARS: SCENE 4

RELEVANT INFORMATION

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

MARS

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 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.

EXPLORING MARS

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 Mars? 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 have **features** like volcanoes and **canyons**.

Mars exploration began in the mid-1960s when a **spacecraft** called Mariner 4 flew past the planet for the first time, taking the first ever close-up photos of another planet. It was in the mid-1970s that a spacecraft landed on Mars for the first time - Viking 1. Since then, more advanced machines have begun exploring Mars, including:

- Mars Reconnaissance Orbiter (top left in scene): studies **atmosphere**, **climate**, **terrain**, and uncovers the history of water on the planet.
- Insight Lander (bottom left in scene): monitors **marsquakes** (like earthquakes but on Mars) and studies the rocks under Mars' surface.
- Curiosity rover (right in scene): studies the makeup of rocks, including the **chemicals** and **minerals** present to search for the correct **conditions for life**. Early in its mission, Curiosity found **evidence** that suggests areas of Mars were once **habitable**.

HUMANS VS MACHINES

So far, only machines have visited Mars. Although many **space agencies**, like **NASA**, are planning to send humans to Mars in the future, there's a lot to figure out first, 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.

SURVIVING ON EARTH: SCENE 5

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

This scene is all about what most living things on Earth need to survive, and how this may relate to alien life. Engage in conversation about the differences between Earth and other worlds.

DISCUSSION PROMPTS

- **How many differences can you spot between Earth and the Moon?**

- **Besides the things mentioned in the scene, what couldn't you live without?**
Encourage children to talk about physical things such as clothes, shoes, a favourite book, as well as emotional things such as family and friends, and so on.

- **The main scene shows just some of the things that live and grow on Earth. What words can you use to describe the scene?**
Encourage children to use adjectives such as colourful, peaceful, happy, and so on. Write down the answers collectively - they will contrast with the following scene.

ACTIVITY

Corresponding activity on page 7 of the activity pack: 'A Trip into Outer Space' is a creative writing and drawing activity. Children imagine they're going on a trip into outer space and have to decide what 10 items they would take with them.

SURVIVING ON EARTH: SCENE 5

RELEVANT INFORMATION

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

LIFE ON EARTH

There are lots of different types of life on Earth, but they can be grouped into three main groups: humans, animals, and plants. Each of these things is suited to the **conditions** on Earth, and all need similar things to survive:

- **Water**: clean, drinkable freshwater. Only a few plants could survive in saltwater.
- **Energy**: energy from the Sun allows plants to grow which in turn provides food for humans and animals.
- **Nutrients**: humans and animals get nutrients from the food they eat. Plants get nutrients from the soil that they grow in.
- **Oxygen**: the invisible **gas** that we breathe. Even animals that live underwater need oxygen to breathe.

As well as these basic needs, most creatures also need **shelter**. All of these things are naturally found on Earth. From studying outer space, astrobiologists now understand that it's very **rare** to find these things on other planets.

ADAPTATIONS

Sometimes, living things need to change the way they do things to get used to living in a new place or new conditions. A great example of this is living things that have **adapted** to live in the desert, which has extreme temperatures and little water, for example:

- Camels grow long nostrils and eyelashes to keep out sand, save water by not sweating very much, and have large, flat feet to make it easier to walk on sand.
- Cacti have spikes instead of leaves to reduce water loss, and can have very long roots to reach water hidden deep underground.

Scientists have now found **bacteria** and **microbes** that can survive without oxygen - they are able to use a different gas instead! These are tiny **organisms**, and it's not clear whether larger **life-forms** would be able to do the same.

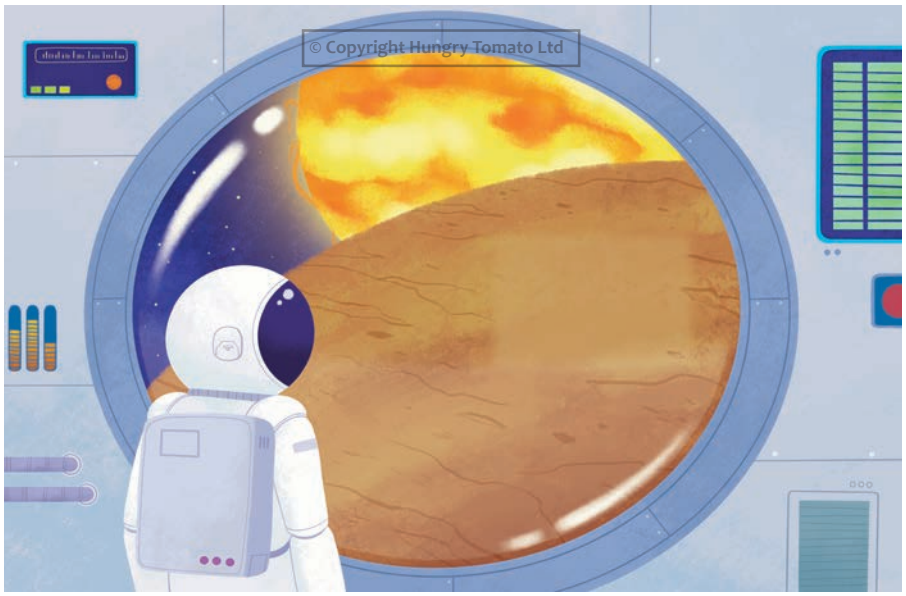
DIFFERENT TYPE OF NEEDS

As well as the most basic needs already mentioned, humans (and many animals) need a few more things, including shelter and safety. They also need love and help from friends and family. Human babies need looking after for much longer than other animals; they take months to walk, talk, feed themselves, and understand the world around them.

THE HABITABLE ZONE: SCENE 6

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

Following on from the previous scene, discover the reason our Earth is so perfect for life and living things, and marvel at how lucky we are to live on such a special planet by viewing an alternative reality.



DISCUSSION PROMPTS

- **The planet pictured in the scene gives an idea of what Earth would look like if it were closer to the Sun. What words can you use to describe it?**
Encourage children to use adjectives such as empty, lonely, boring, sad, and so on. Children could write these down and compare them with the adjectives used to describe the previous scene.

- **How do you think the astronaut in the scene would be feeling as they look at this planet?**
Give examples of emotions such as feeling shocked, scared, curious, and so on.

ACTIVITY

Corresponding activity on page 8 of the activity pack: 'Our Place in Space' is a classic activity where children fill in the blanks in a series of sentences and facts about Earth, the solar system, and outer space.

THE HABITABLE ZONE: SCENE 6

RELEVANT INFORMATION

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

THE HABITABLE ZONE

Earth is in the **habitable zone** of our **solar system**, but how do scientists work out where this is? The habitable zone is the distance from a **star** (see below) that could allow liquid water to exist on orbiting planets' surfaces. Liquid water is **essential** for life as we know it, so habitable zones help scientists narrow down the search for life in outer space.

Habitable zones are sometimes called 'Goldilocks zones' - like in the famous fairy tale, the conditions are not too hot nor too cold, but just right, for life.

The location of habitable zones varies across different star systems, depending on the size and type of star. The habitable zone in our solar system starts just beyond the orbit of Venus and reaches just beyond Mars.

STARS, SUNS, AND PLANETS

Scientists and non-scientists sometimes name things differently. In science, a star is a huge, glowing, hot ball of **gas**. Our Sun is a star.

When non-scientists look up at the night sky and say they're looking at the stars, they are actually looking at a mixture of stars and planets. Planets don't produce their own light - we can only see them if they're **reflecting** the light from a star.

UNINHABITABLE TRICKSTERS

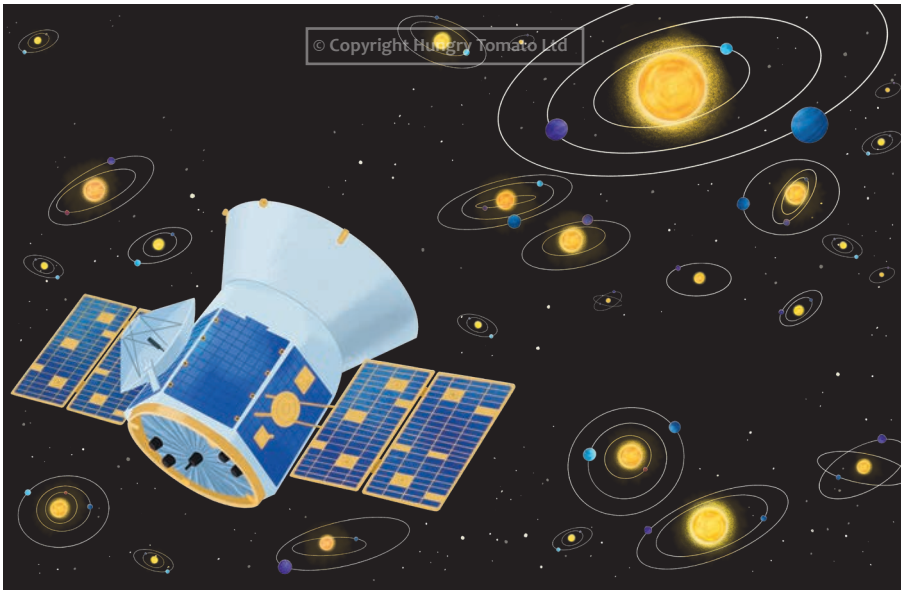
Don't be tricked by the habitable zone - just because a space object is in the habitable zone, it doesn't mean it's always habitable!

Being so close to Earth, the Moon is in the habitable zone of our solar system, but it's not a place humans could naturally live (without help from science).

THE SEARCH IS ON: SCENE 7

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

Explore a tiny patch of outer space, discussing the different types of worlds and space objects in the scene below. Discuss the power of modern-day telescopes and the things they've allowed astrobiologists to discover.



DISCUSSION PROMPTS

- **What do you think all the different coloured circles and rings represent in this scene?**
Information overleaf

- **How many planets do you think scientists have found in outer space?**
Encourage children to write down their answers. The answer is revealed in the eighth scene of the main book, and they'll then be able to see if they were right.

- **How far away do you think we can search in outer space?**
Information overleaf

ACTIVITY

Corresponding activity on page 9 of the activity pack: 'Words Lost in Outer Space' is a word search activity, using lots of great space words to get children familiar with the language of astrobiology.

THE SEARCH IS ON: SCENE 7

RELEVANT INFORMATION

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

SUPER TELESCOPES

To search for new planets, scientists need strong **telescopes**. Some are used from Earth, but the ones with the best chance of making discoveries are in outer space! The telescope in the scene is **'TESS'** which stands for 'Transiting Exoplanet Survey Satellite'. TESS has found thousands of **planets** since its launch in 2018. Other famous telescopes include:

- **Hubble space telescope** (launched 1990) – the first visual telescope to be launched into space. It has helped us understand how planets and **galaxies** form, found new **moons** and **black holes**, and shown images of the **universe** as it's never been seen before.
- **Solar and Heliospheric Observatory** (SOHO, launched 1995) - a huge space telescope that monitors the **Sun**, teaching us about its atmosphere, structure, and weather.
- **James Webb space telescope** (JWST, launched 2021) – possibly the most powerful telescope ever built, the JWST has given us information about how stars form, analysed the **chemical** makeup of **exoplanets**, and provided more detailed images than Hubble.

These are just a few examples of telescopes and their discoveries.

HOW FAR CAN WE SEE?

The James Webb space telescope has discovered the most distant galaxy to date. JADES-GS-z13-0 is approximately 33 billion **light-years** away from Earth.

SIZE OF THE UNIVERSE

No one knows just how big the universe is. Scientists have calculated the size of the **'observable universe'** to be about 92 billion light-years across. However, they do not know how much more universe might be beyond what's observable!

STARS AND PLANETS

In the scene, TESS is making observations from space, but what exactly can we see?

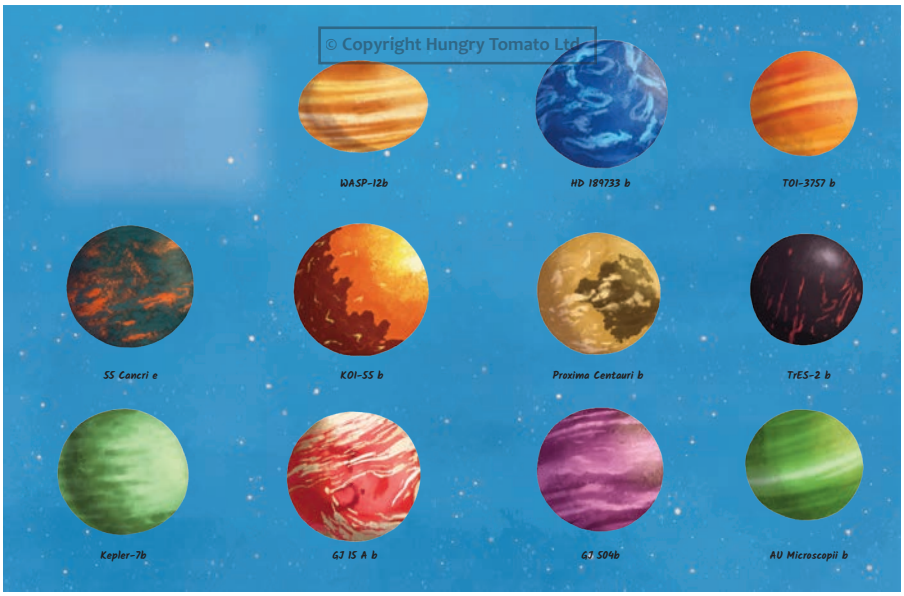
- Planets – round, **celestial bodies** that **orbit** a star. In the scene, these are the small, colourful spheres. The thin circles show the path they follow when orbiting the star.
- Stars – giant, hot balls of **gas** that **emit** light. Our Sun is a star. In the scene, these are the bigger, brighter yellow spheres.
- **Planetary systems** – the groups of planets, their orbits, and the star are called 'planetary systems'. Our solar system is a planetary system.

INCREDIBLE EXOPLANETS: SCENE 8

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

Uncover some weird and wonderful exoplanets that scientists have discovered. Explore the clever ways scientists find exoplanets, and why they give them such strange names.

Note: The planets in the scene are not to scale with each other.



DISCUSSION PROMPTS

- **Which exoplanet in this scene do you think looks the best to live on? Why?**

- **Exoplanets are so far away that they're really hard to spot! How do you think scientists find them?**
  Information overleaf

- **Why do you think scientists have given exoplanets these strange names?**
  Information overleaf

ACTIVITY

Corresponding activity on page 10 of the activity pack: 'Diary Entry' is a creative writing activity which encourages children to imagine they discovered a new exoplanet and describe it in a diary entry.

INCREDIBLE EXOPLANETS: SCENE 8

RELEVANT INFORMATION

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

FINDING EXOPLANETS

Scientists have been finding **exoplanets** since the 1980s. As **telescopes** get stronger and scientists' understanding of **stars** and **planets** increases, more exoplanets are being discovered. They have found that most exoplanets **orbit** a star, but some are free-floating!

Scientists use a mixture of clever ways to find exoplanets, most of which rely on strong space telescopes, including:

- **Direct imaging** – physically spotting exoplanets.
- Watching for changes in starlight - regular dark or bright spots passing in front of a star could be a sign of an exoplanet orbiting.
- Watching for wobbly stars – small movements to a star's position suggest an exoplanet could be orbiting, its **gravity** affecting the star.

NAMING EXOPLANETS

Scientists give exoplanets names which show how and where they were discovered. This means their names are very different from the planets in our **solar system**, which were named centuries ago after the Roman gods.

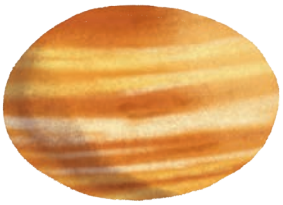
For example, HD 189733 b (pictured in the scene):

- The first part of the name is the telescope or survey that found it - 'HD' stands for 'Henry Draper Catalogue', which is a big list of stars.
- '189733' shows the star's place in the list. This means it was the 189,733rd star added to the list.
- 'b' tells us the order in which the planet was found. The first planet to be found is always 'b'. The following planets would be named c, d, e, and so on. The star that the exoplanet orbits is usually 'A'.

INCREDIBLE EXOPLANETS: SCENE 8 CONT.

EXAMPLES OF EXOPLANETS

Scientists have found so many **exoplanets** with weird and wonderful features. This scene shows just a small selection of them, including:



WASP-12B

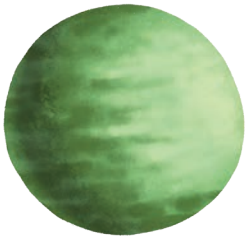
This planet **orbits** so close to its star that it has been pulled into a strange egg-like shape. Scientists think that it will eventually be pulled into its star and be destroyed!

55 CANCRI E

55 Cancri e is thought to be covered in an ocean of lava! Scientists classify it as a '**Super-Earth**'. This term doesn't mean the planet is similar to Earth; it refers to its size - bigger than Earth but smaller than Neptune.

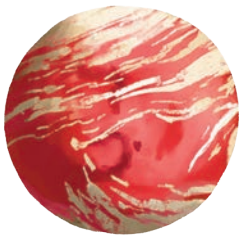
KOI-55 B

Also called Kepler-70b, this planet is extreme! It's one of the hottest planets discovered, with estimated temperatures of 6,800°C (12,000°F). It was once much bigger, but after spending time inside its own sun – something that destroys most planets – it got smaller!



KEPLER-7B

This green exoplanet was one of the first to have its clouds mapped – a complicated task that used information from the **Kepler space telescope** and the **Spitzer space telescope**.



GJ 15 A B

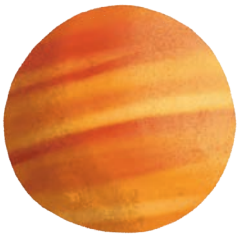
Another Super-Earth, GJ 15 A b is one of Earth's closest neighbours, being only 11 **light-years** away. But that doesn't mean they're close: scientists estimate that it would take a jet plane moving at 600 mph (966 km/h) 13 million years to get there!

HD 189733 B

This blue planet may look beautiful, and a bit like Earth, but the truth is it's very scary! Scientists think that HD 189733 b experiences extremely fast winds and rain made of glass.

INCREDIBLE EXOPLANETS: SCENE 8 CONT.

EXAMPLES OF EXOPLANETS

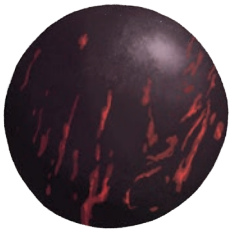


TOI-3757 B

TOI-3757 b is around 580-590 light-years away from Earth. Located very close to its star, this **gas giant** has the lowest **density** of any planet found before. It's thought to have a similar density to a marshmallow!

PROXIMA CENTAURI B

Discovered in 2016, this exoplanet is one of the most similar-to-Earth planets discovered. It's thought to be rocky, almost the same size as Earth, and located in its star's **habitable zone.** It's only 4 light-years away.



TrES-2 B

TrES-2 b is the darkest planet ever discovered. It **absorbs** almost all the light that hits it! It's considered a '**Hot Jupiter**'. 'Hot Jupiters' are gas giants that are located very close to their sun and have an orbit time of less than 10 days. TrES-2 b's orbit only takes about 2.5 days.

GJ 504B

This hot exoplanet glows pink! Because it's so far from its sun, it takes GJ 504b the same as 127,750 Earth days to orbit its sun. This means that on GJ 504b one year is the same as 350 years on Earth!

AU MICROSCOPPI B

Discovered by TESS in 2020, this exoplanet is in one of the youngest **star systems** ever found! As the planet is so close to its young, active star, it's constantly hit with **solar flares**, wind, and harmful X-ray light. Scientists will be keeping an eye on this exoplanet to see how it copes long-term being so close to the star.

IMAGINING ALIEN LIFE: SCENE 9

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

Explore a range of aliens, all based on scientists' ideas of how living things might adapt to outer space conditions. Compare and contrast their features with animals that live on Earth today, encouraging discussion about methods for survival.

DISCUSSION PROMPTS

- **These pictures of aliens all look very different from each other! How do you think their different features might help them survive if they did exist?**
  Information overleaf

- **Do these pictures of aliens remind you of any animals that live on Earth today? Why do they remind you of these animals?**
  Encourage children to talk about features such as neck shape and length, features like wings and antennae, and so on.

- **If these aliens existed, which would you most like to meet? Which would you least like to meet? Why did you pick those aliens?**

ACTIVITY

Corresponding activity on page 11 of the activity pack: 'Create Your Own Alien' is a series of creative drawing activities where children create their own aliens! They are given prompts for ideas of the body parts to include.

IMAGINING ALIEN LIFE: SCENE 9

RELEVANT INFORMATION

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

BODY PARTS

All animals are **unique**, but many have similar parts that make up their bodies. For example, head, mouth, and eyes. Despite this, animals on Earth can look very different from each other. For example, giraffes and horses both have necks, but they don't look alike at all! It makes sense that different aliens would look different too, if they existed.

Animals' **body parts** and **behaviour** can change over time to allow them to live more easily in a certain place or in a certain way. Scientists call this "**adapting**". We know living things on Earth adapt, so it's possible that aliens, if they existed, would do the same to cope with changes and different locations on their own planet.

ALIEN ADAPTATIONS?

Scientists have lots of **theories** about what aliens would look like, and a lot of it depends on where they live. Some of their ideas include:

- **Advanced technology**: if alien **civilisations** had been around for longer than us, their technology may be much more advanced than ours.
- **Different ways to breathe**: creatures that live on planets with different **gases** to Earth may have different **lungs** or body parts to help them breathe.
- **Big wings**: to cope with **low-density atmospheres**, creatures may need huge wings.
- **Big eyes**: to cope with dark **environments** with little light, creatures may need much bigger and more sensitive eyes than living things on Earth.
- Lots of **limbs**: to increase **agility** and help them climb over different **terrains**.
- **Weird-shaped bodies**: it's possible that living with a different strength of **gravity** would affect the shape that living things' bodies grow into.

METHODS OF SURVIVAL

Earth can be quite a dangerous place to live; only the smartest plants and animals survive. Some clever **survival techniques** for life on Earth include:

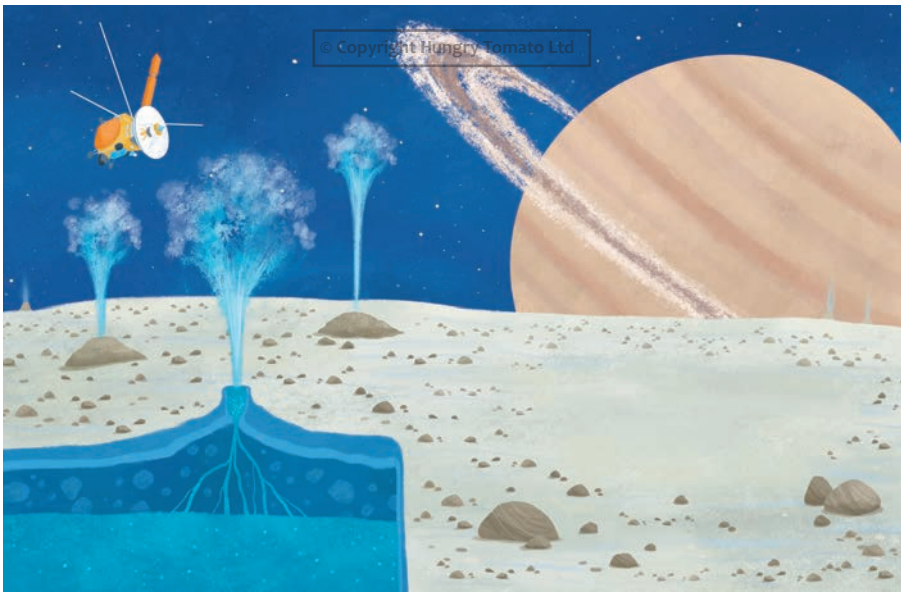
- **Camouflage** - animals that can change the colour of their skin to fit in with their surroundings are more successful at hiding from **predators** or sneaking up on **prey**!
- **Teeth and claws** - animals with sharp, strong body parts can fight off attacking animals.
- **Venom** - creating a venom that harms living things is a clever survival technique.

Would aliens use these techniques too, or would they have completely new ones?

STRANGE NEW MOONS: SCENE 10

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

Discover Enceladus, an intriguing moon in our solar system that may prove significant in scientists' search for life in outer space. This is a good opportunity to discuss the differences between moons and planets, and learn more about Saturn.



DISCUSSION PROMPTS

- **The planet in the background is in our solar system. Can you name it?**
Information overleaf

- **Do you know the difference between a moon and a planet?**
Information overleaf

- **From looking at the picture, what do you think it's like on Enceladus?**
Encourage children to use adjectives such as cold, quiet, lonely, and so on.

- **Do you think scientists will find any life there? Why or why not?**
Encourage children to talk about things that are thought to be needed for life such as temperature, food and water, shelter, and compare them with the visuals of the scene.

ACTIVITY

Corresponding activity on page 13 of the activity pack: 'Design Your Own Space Base' is creative drawing activity where children design their own space base, using prompts for things to think about and include within their space colony.

STRANGE NEW MOONS: SCENE 10

RELEVANT INFORMATION

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

A RINGED PLANET

This scene, viewed from Enceladus, shows Saturn – a ringed **planet** in our solar system that this **moon orbits**. Saturn's rings are made up of chunks of rock, ice, and dust. It's thought that these originally came from **comets**, **asteroids**, and pieces of moons that were pulled apart by the planet's **gravity**!

In total, Saturn has 146 moons - more than any other planet in our solar system!

MOONS AND PLANETS

From afar, you may think that moons and planets look similar. So, what's the difference? Moons are **natural satellites** that orbit a planet, whereas planets are **celestial bodies** that orbit a star. To be considered a planet, planets must also be **spherical** in shape and be big enough to have cleared any objects and **debris** around them (through **gravity**).

EXPLORING ENCELADUS

Enceladus is the brightest world in our solar system! Although it can't produce its own light, its icy surface makes it very reflective. This interesting moon has been very important for astrobiology.

Although its ocean is under the surface, because it shoots water out through **geyser**-like jets, that water can be collected and tested, without needing to land on the surface, dig, or drill! NASA's **spacecraft**, **Cassini** (pictured in scene), flew through the water jets and detected **gases** that suggest the moon may have the ingredients for life.

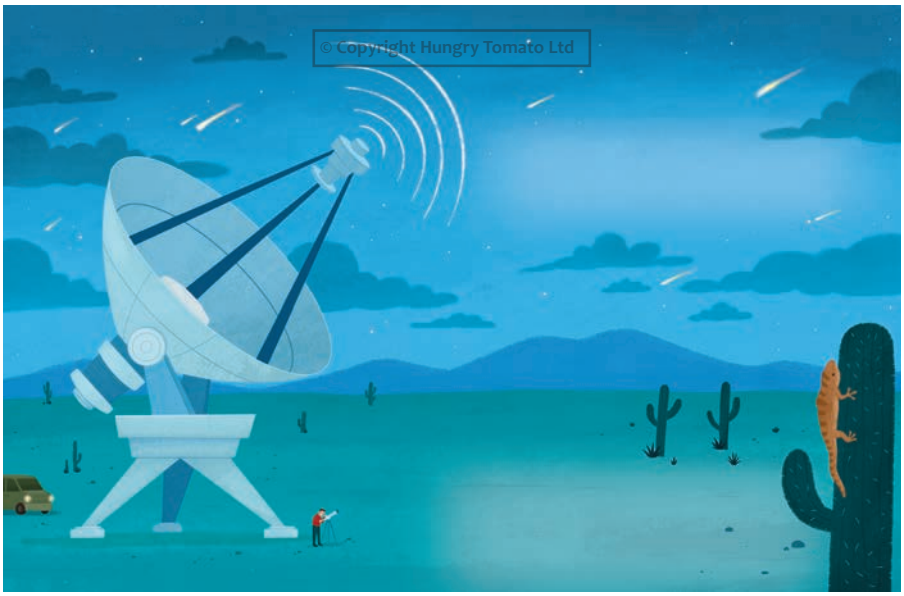
BEYOND ENCELADUS

In addition to Enceladus, Titan, Saturn's largest moon, is another place scientists are interested to learn more about. It's the only other place in our solar system to have rain, lakes, rivers, and cycles of liquid (although these are made of something other than water). NASA is currently planning to send a rotorcraft lander to Titan in the next few years to explore it further.

LISTENING FOR LIFE: SCENE 11

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

Discover the machines that interpret radio waves from outer space and how they're helping astrobiologists. Engage in discussion about different communication methods and how to converse with people (and things) that are different from you.



DISCUSSION PROMPTS

- **How far away do you think radio telescopes can receive messages?**
  Information overleaf

- **If aliens existed, what kind of noises do you think they would make? Do you think they would speak languages, like humans do?**

- **If you were to create a message to send into outer space for aliens, what would you do? Why did you make this decision?**
  Encourage children to consider different modes of communication, for example, writing, speech, pictures, videos, and so on. Encourage them to plan out their message. This is an opportunity for them to think about how to communicate with others that may not understand.

ACTIVITY

Corresponding activity on page 14 of the activity pack: 'A Message from Space!' is a code-breaking activity where children have to align symbols and letters to decipher a message from aliens and work out what they're saying.

LISTENING FOR LIFE: SCENE 11

RELEVANT INFORMATION

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

RADIO TELESCOPES

Radio telescopes can pick up **signals** from deep in outer space by collecting **radio waves**. They convert these into readable information or images, which helps scientists understand the structure and movement of things. Because of this, radio telescopes teach us about the universe as well as help with the search for signs of intelligent life.

The telescope pictured in the scene is based on **SETI**'s Very Large Array, a big collection of radio **antennas** in the USA, but there are many similar places set up around the world.

DISTANT MESSAGES

How far a radio telescope can pick up signals from depends on the strength of the signal and the sensitivity of the **receiver**. In 2023, the Giant Metrewave Radio Telescope in India picked up a radio signal that is estimated to have originated almost 9 billion **light-years** away. That broke the record for the longest travelled signal received by a radio telescope!

Scientists haven't picked up signs of alien life, but they have received signals which have uncovered new **phenomena**, improving knowledge of outer space. Thanks to radio telescopes, we know about pulsars – fast-spinning leftovers from **supernova** explosions!

SENDING MESSAGES

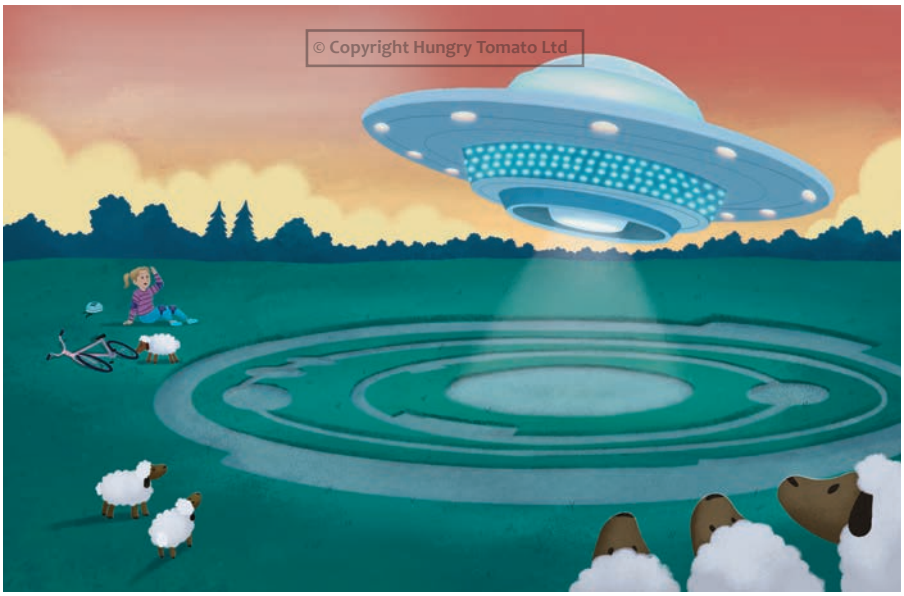
Some radio telescopes can send messages as well as receive them. The strongest signal sent into space was sent in 1974 by the Arecibo Radio Telescope in Puerto Rico. The message contained information about numbers and scientific elements, and images of humans, our solar system, and the radio telescope itself. It was all sent in code.

We have also sent spacecraft into outer space carrying physical messages. The 'Golden Record', aboard Voyager 1 and 2 contained music, sounds, and images.

STORIES OF UFOS: SCENE 12

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

This scene introduces the idea that some people believe they have seen UFOs or aliens. There is currently no scientific evidence to support these stories. This is an opportunity to discuss children's opinions on the matter.



DISCUSSION PROMPTS

- **How do you think the person in the scene would be feeling as they look at this spaceship?**

Give examples of emotions such as feeling shocked, scared, curious, and so on.

- **Do you think aliens have visited Earth? Why or why not?**

ACTIVITY

Corresponding activity on page 15 of the activity pack: 'Undercover UFO' is a spot the difference activity where children are given multiple similar scenes containing a UFO and they have to try and notice what is different about each one.

STORIES OF UFOS: SCENE 12

RELEVANT INFORMATION

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

UNUSUAL OCCURRENCES

Over the years there have been many stories from people who think they have seen **UFO**s and strange **creatures**. Most of the time, these situations can be explained by science or reason. Here's some famous examples:

CROP CIRCLES

The story: In the 1970s, simple **crop circles** began to appear in southern England, UK. They would be made at night, and over time grew to be large and intricate patterns. Some people thought that, due to the shapes and fact that the crops were bent but not broken, they must have been made by **extraterrestrial** visitors.

The science: In early 1990, two men admitted to having created more than 200 crop circles using ropes and boards. As the mystery of crop circles gained media attention, the men had enjoyed making their designs more complex to try and confuse the experts looking into the mystery.

OUMUAMUA

The story: In 2017, a strange object was seen flying away from the Sun. This confused scientists as usually objects of the same size would be swept into the Sun by **gravity**. Some people claimed it was an alien **spaceship**.

The science: **NASA** confirmed that, although it was an unusual shape and size to any seen before, Oumuamua was a **comet** – a rocky object, about 400 m (a quarter of a mile) long. It was the first known **interstellar** object to pass through our **solar system** and was travelling so fast that the Sun's gravity didn't have the chance to affect its movement. It has since zoomed out of the solar system.

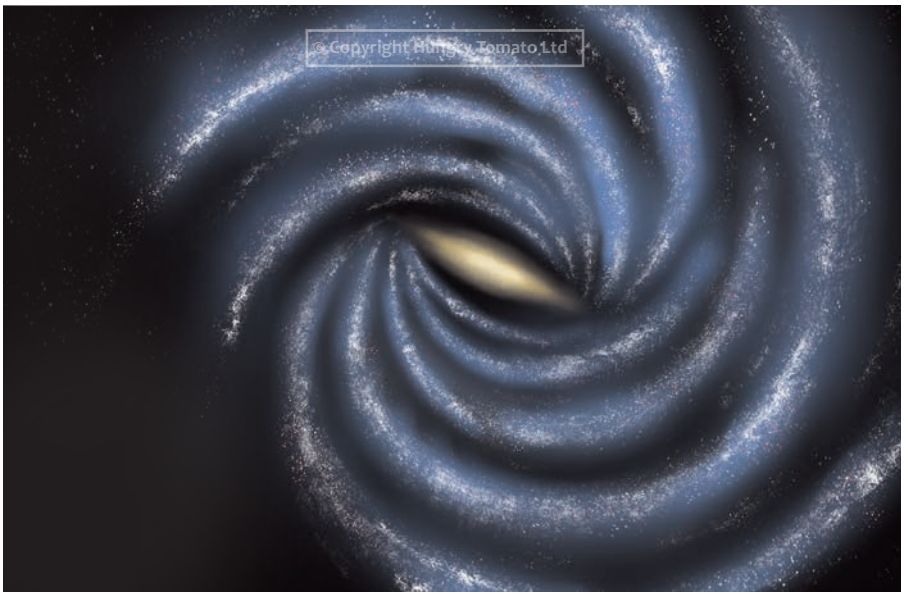
A NEW TERM

Whilst many people use the term 'UFO' to talk about 'unidentified flying objects', some official organisations like the **Pentagon** and NASA use **'UAP'**. This stands for 'unidentified anomalous **phenomena**' which can refer to any unexplained thing anywhere, whether that be in the air, in space, underwater, and so on.

THE MILKY WAY: SCENE 13

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

View the Milky Way, discussing its surprising shape, and try to identify the location of our own solar system. Discuss the impressive size of our galaxy, and compare it with the size of the universe overall to show how big outer space really is.



DISCUSSION PROMPTS

- **Can you guess where our solar system is located in the image of the Milky Way (the scene shows the Milky Way)?**
  Information overleaf

- **If you were an astrobiologist, what else would you want to find out about outer space?**

ACTIVITY

Corresponding activity on page 16 of the activity pack: 'Into the Unknown' is a reflective writing task where children answer questions about their opinions on a number of space-related questions.

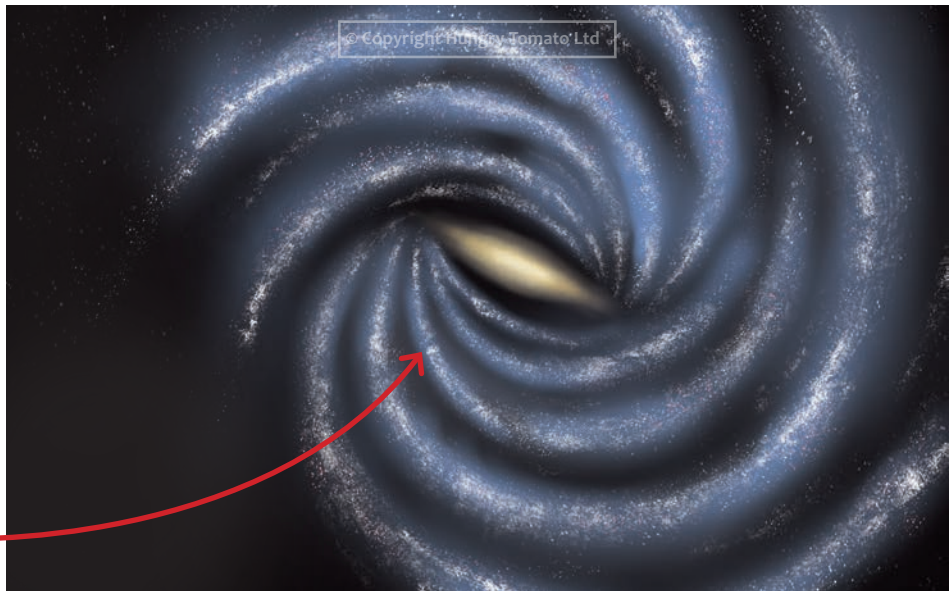
THE MILKY WAY: SCENE 13

RELEVANT INFORMATION

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

THE MILKY WAY

Our solar system is in a **galaxy** called the Milky Way. The Milky Way has billions of stars, all held together in a spiral shape by **gravity**. Our **solar system** takes up just a tiny space within the Milky Way. Our approximate location has been pointed out by the red arrow.



Scientists estimate that the Milky Way is more than 100,000 **light-years** across, which is massive! But scientists have discovered other galaxies that are much bigger. For example, Andromeda (which is close-by to the Milky Way) is 220,000 light-years across. And there may be others that are millions of light-years across!

When you put these into perspective, though, these are all tiny compared to the overall size of the **universe**, which scientists estimate to be around 92 billion light-years across.

GALAXY SHAPES

Galaxies can come in different shapes. Most are spiral-shaped, like the Milky Way, or elliptical. Some are irregular; these tend to be the older galaxies that formed when the universe was still very young.

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 scientists haven't found any aliens in outer space?**
- **Do you think scientists will ever find aliens in outer space? Why or why not?**
- **Did anything else 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 Astrobiology Story' is a creative writing activity which encourages children to write a story about astrobiology, 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