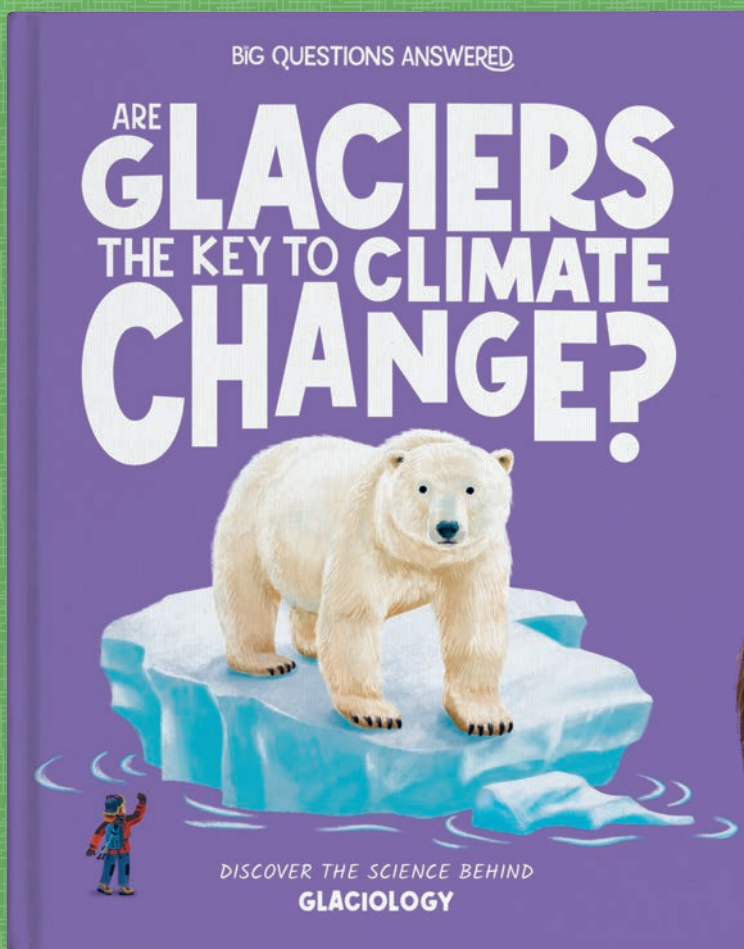


THE BIG QUESTIONS ANSWERED

TEACHERS' & PARENTS' RESOURCES

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



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INTRODUCTION

NOTES FOR TEACHERS, HOME EDUCATORS AND PARENTS

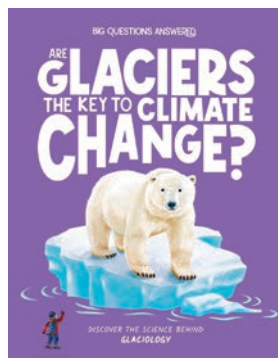
Inspire children's natural curiosity, improve literacy, and have fun learning about different sciences with The Big Questions Answered. Each book in the series is accompanied by a selection of fantastic, **FREE** downloadable resources.

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.

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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

Are Glaciers the Key to Climate Change? book



Young Glaciologists' Activity Pack

KEY CURRICULUM TOPICS

The resources related to *'Are Glaciers the Key to Climate Change?'* tie in with key curriculum topics including:

- Animals, including humans
- Climate change
- Earth and space
- Energy
- History
- Living things and their habitats
- Materials and their properties
- Rocks
- States of matter
- Working scientifically

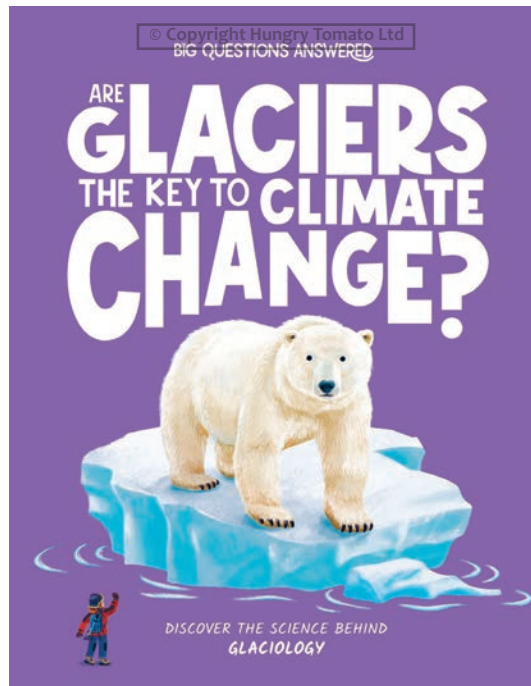
The most relevant topics are indicated throughout this guide.

ARE GLACIERS THE KEY TO CLIMATE CHANGE?

This book explores the extraordinary world of glaciology. As well as covering key facts about glaciers, how climate change works, and the link between the two, the book explores the concept of ice ages, different plants and animals that have lived on Earth, and the way our whole natural world is connected.

PRE-READING QUESTIONS

Engage in discussion about the general topic of glaciology with the suggested questions below.

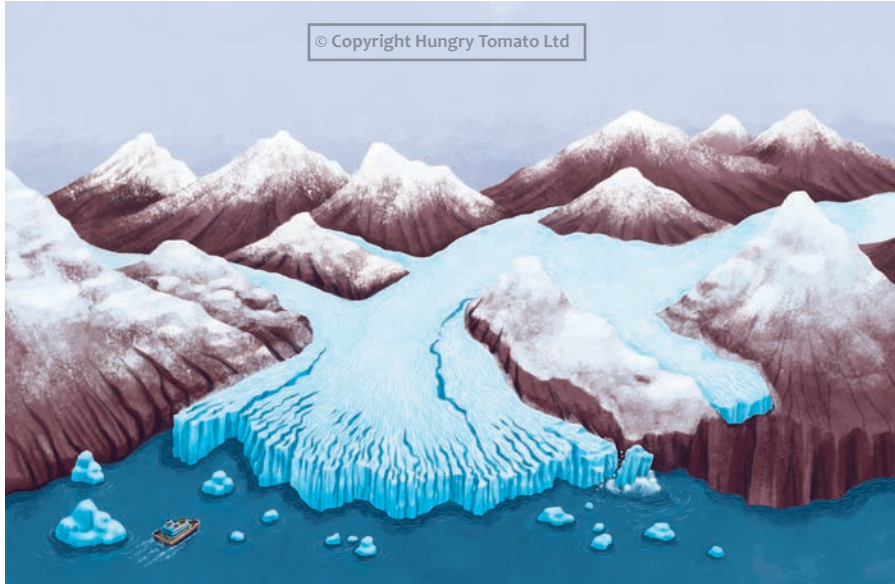


- What do you know about glaciers already?
- Do you know any facts about climate change already?
- How do you think glaciers and climate change are linked?

GLACIERS ON THE MOVE: SCENE 1

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

Introduce the freezing world of glaciers and the topics in this book by discussing what glaciers are made of, where they can be found, which animals make their homes in these regions, and the reason that glaciers are always on the move.



DISCUSSION PROMPTS

- What is glacier ice made of?
Information overleaf
- Where in the world can you find glaciers?
Information overleaf
- Can you name any animals that live on or near glaciers?
Information overleaf
- What do you think makes glaciers move?
Information overleaf

ACTIVITY

Corresponding activity on page 3 of the activity pack: 'Diary Entry' is a creative writing activity which encourages children to imagine they discovered a new glacier and observed its movements, and describe it in a diary entry.

GLACIERS ON THE MOVE: SCENE 1

RELEVANT INFORMATION

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

WHAT GLACIERS ARE MADE OF

Glaciers are formed from layers of **snow**. Over a long period of time, as the snow piles up, more and more weight pushes down on the layers deeper down. This **pressure** causes the snow to **compact** and turn into solid **ice**.

Today, glacier ice holds about three-quarters of all the **fresh water** in the world!

WHERE IN THE WORLD?

Glaciers are found in the very coldest parts of our planet. They are commonly found towards the North and South poles as these places get less sunlight than anywhere else on Earth and so stay very cold. Most of Earth's glaciers today are found in Antarctica.

But the poles aren't the only places glaciers can be found. Every **continent** except Australia has glaciers! Glaciers can form in **mountains** and places of high **altitude**, where snow falls faster than it melts. For example, in the Himalayan mountains in Asia and in the Andes mountains of South America.

GLACIER HABITATS

Very few animals are able to permanently live on glaciers as there are so few **nutrients**, no plants, and very harsh temperatures. However, many animals live near glaciers and use them for **hunting grounds**.

Some of the most famous animals that live near or travel across glaciers include reindeer, bison, mountain goats, polar bears, penguins, seals, and lynx. These animals have **adapted** to survive in these cold and harsh conditions.

ALWAYS ON THE MOVE

Glaciers are always moving, which is why they are sometimes called 'rivers of ice'. They are so heavy that **gravity** is always pulling them downhill.

Some glaciers move incredibly slowly – only a few centimetres (a few inches) a year, whereas others may move several metres (several feet) per day. The fastest glacier recorded was the Jakobshavn Isbrae in Greenland, which was noted to move around 40 metres per day (130 feet)!

DRILLING INTO ICE: SCENE 2

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

Introduce some early glaciologists with this scene set in the past. Discuss the way these scientists collected samples from glaciers to study them, and how this differs from the way modern glaciologists work.



DISCUSSION PROMPTS

- How thick do you think glaciers normally are?

Information overleaf

- When do you think this scene is set?

Encourage children to think about the drill that's being used, the clothes that the people are wearing, and so on. There is also information overleaf.

- Do you think this drill would have been difficult to use? Why or why not?

ACTIVITY

Corresponding activity on page 4 of the activity pack: 'Sneaky Scientists' is a spot the difference activity where children have to spot 10 differences between two versions of this scene.

DRILLING INTO ICE: SCENE 2

RELEVANT INFORMATION

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

HOW THICK ARE GLACIERS?

Glaciers can vary in **thickness**, but they can be more than 1 km (0.6 miles) thick. That means that they are taller than the tallest building in the world!

Scientists have a few different ways of measuring how thick a glacier is, including:

- **Drilling** ice – this can be difficult to do and time-consuming.
- **Sound waves** – to do this, scientists set off small explosions. When the sound waves reach the bottom of the ice, they bounce back. By timing how long this takes, scientists can work out depth.
- **Radar** – this works in the same way as sound waves but is based on sending **radio waves** into the glacier instead. Ice and rock reflect radio waves differently, which allows scientists to work out how far the bottom is.

SETTING THE SCENE

This scene is based on an **expedition** to the **Alps** by scientists in the 1840s. It was led by Louis Agassiz and is thought to have been the first expedition to measure glacier thickness. Agassiz's work was also important for our understanding of how glaciers move and how, in past ice ages, glaciers once covered much of Europe.

In the scene, we see Agassiz and his team using a tall, triangular-framed **drill** to try to cut down into the ice of the glacier Unteraargletscher. It took many people to use this drill, making it very different from modern-day drills, which are much more powerful.

Some modern-day glacier drills rely on hot water to help them cut through the ice. They are also **electric-powered** and don't rely on physical human power to work.

CLUES HIDDEN IN ICE CORES: SCENE 3

The material for this scene can be linked to curriculum topics, including: history; states of matter; working scientifically.

Discover the impressive ice cores that glaciologists extract to learn all sorts about glaciers from the materials that have been trapped inside. Discuss how long glaciers can exist for on the surface of the Earth, as well as how ice freezes.



DISCUSSION PROMPTS

- How far back in time do you think scientists can look using glaciers?
Information overleaf
- How do you think scientists work out how old glacier ice is?
Information overleaf
- How old do you think the oldest ice ever discovered was?
Information overleaf
- At what temperature does water freeze into ice?
Information overleaf

ACTIVITY

Corresponding activity on page 5 of the activity pack: 'A Message in the Ice' is a code-breaking activity where children have to align symbols and letters to decipher a message that's been hidden for years inside glacier ice.

CLUES HIDDEN IN ICE CORES: SCENE 3

RELEVANT INFORMATION

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

STUDYING ICE CORES

Scientists can learn about things that happened thousands of years ago by studying **ice cores**. They are only limited by the ice itself! The oldest ice is usually at the bottom of the glacier. As glaciers can be extremely thick, it can be hard to drill that deep. Also, often glacier ice at the bottom of the glacier can melt or get scraped off as the main chunk of ice moves across land, meaning that the oldest ice gets lost and scientists can't study it!

Once they have extracted an ice core, scientists need to know how to work out its age. There are a few ways they can do this:

- **Counting the layers** – layers of ice can vary slightly in colour. By counting the layers, scientists count back in time. But it's rare for the layers to be clear enough to do this.
- **Radiometric dating** – studying the material, like dust, trapped in the ice to see how much it has **decayed**. Scientists know how quickly dust normally decays, so this comparison helps them estimate the age of that section of ice.

ANCIENT GLACIERS

Scientists think that there have been glaciers on Earth for billions of years. The oldest **ice age** we know about was just over 2 billion years ago, and was called the **Huronian glaciation**. We haven't found any ice left over from this event – scientists have learnt about it due to evidence left behind in **rocks**.

The oldest glacier ice ever discovered and studied was dated to be 6 million years old! It was found in Antarctica in 2024.

IT'S FREEZING!

Water freezes into **ice** at 0°C (32°F). This is sometimes called the “freezing point” or “freezing temperature”. But ice can get even colder than that!

Working on glaciers is difficult because of the extremely low temperatures. Scientists working in these conditions wear sensible clothing, like thick coats and gloves, and **thermal** underclothes to keep them warm. It can be dangerous for the human body to get too cold, so these clothes help keep scientists safe on icy **expeditions**.

ICY ANIMALS: SCENE 4

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

Discover how amazing ice is at preserving things with this scene that represents some of the animals that have been found in underground ice! Discuss these creatures, their features, and their similarities with animals that live today.



DISCUSSION PROMPTS

- Do you know what the animals in the scene are? Do they remind you of any animals that live on Earth today?

Information overleaf

- When do you think these animals lived?

Information overleaf

- What do you think these animals used their tusks for?

Information overleaf

ACTIVITY

Corresponding activity on page 60 of the activity pack: 'Draw Your Own Icy Discovery' is a creative drawing activity where children imagine they have found something amazing hidden in underground ice, and draw a scene to show off their discovery.

ICY ANIMALS: SCENE 4

RELEVANT INFORMATION

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

WOOLLY MAMMOTHS

The animals trapped in the ice in this scene are **woolly mammoths**. These animals roamed Earth for thousands of years, before becoming extinct around 4,000 years ago. They were well suited to living in cold places, thanks to their thick fur and a thick layer of fat under their skin. This also meant they coped well during **ice ages**.

Mammoths have a similar body shape to elephants that live on Earth today, with chunky bodies, and long **tusks** and noses. Woolly mammoths are just one type of mammoth.

Usually, scientists would only be able to study the **fossil bones** of animals that died as long ago as the mammoths. But because some mammoths have been preserved in ice, their flesh, skin, fur, and **DNA** have all been kept in such good condition that scientists have been able to study them! By performing **genetics studies** on mammoths found in underground ice, scientists have discovered that woolly mammoths and modern Asian elephants are more closely related to each other than either is to the African elephant!

The ice that mammoths have been found in isn't usually clear ice, instead, it's permanently frozen mud that's deep underground! Scientists call it '**permafrost**'. Woolly mammoths also aren't the only animals to have been found like this – woolly rhinos, cave lions, and ancient bison have also been discovered in permafrost!

TERRIFIC TUSKS

Scientists think mammoths used their long tusks to dig under the snow for food like grass and shrubs. They may have also been used to fight off attacking animals and to attract a **mate**. These are similar to the ways that elephants living on Earth today use their tusks.

Scientists have used the remains of tusks to learn about mammoths too. By studying tusks, scientists can work out where a mammoth lived at different times in its life! This also tells us how often and how far these animals used to travel, which helps us better understand how they lived and interacted with the world around them.

BACK IN TIME: SCENE 5

The material for this scene can be linked to curriculum topics, including: animals, including humans; climate change; living things and their habitats.

Jump back in time to see woolly mammoths as they would have looked in their habitat when they were alive! Discuss the other animals and plants that lived at the same time, leading into a conversation about the different diets that animals have.



DISCUSSION PROMPTS

- Besides the mammoths, can you name the other animals in this scene?
Information overleaf
- What do you think the animals in this scene ate?
Information overleaf
- What's happening to the volcano in the background of this scene? Why does this happen?
Information overleaf

ACTIVITY

Corresponding activity on page 7 of the activity pack: 'Prehistoric Mix-Up' is a task where children match the photograph of a prehistoric animal with its name and description. This activity shows the diversity of animals that used to live on Earth.

BACK IN TIME: SCENE 5

RELEVANT INFORMATION

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

ANIMALS IN THE SCENE

There are several ancient animals in this scene which have since become **extinct**.

- **Woolly mammoths** – find more information about them on page 12 of this booklet.
- **Sabre-toothed cats** – these were fierce, meat-eating **big cats**, similar in size to lions today. They were famous for their huge teeth which made them excellent **hunters**.
- **Teratorns** – these were a group of **birds of prey**. They had massive **wingspans** which are thought to have measured up to 3.5 metres (12 feet) across.

ANIMAL DIETS

Just like us, animals don't all eat the same things. They all have different **diets**.

- **Carnivores** hunt and eat other animals. They often have sharp **teeth**, **jaws**, and **claws** for catching and eating **prey**. Sabre-toothed cats and teratorns were carnivores.
- **Herbivores** only eat plants. They often have features that help them find and eat plants, including **long necks**, **flat teeth**, and special **digestive systems**. Woolly mammoths were herbivores.
- **Omnivores** eat meat AND plants! Modern-day examples include baboons and bears.
- **Piscivores** mostly eat fish. Modern-day examples include otters and sea lions.

VOLCANIC ERUPTIONS

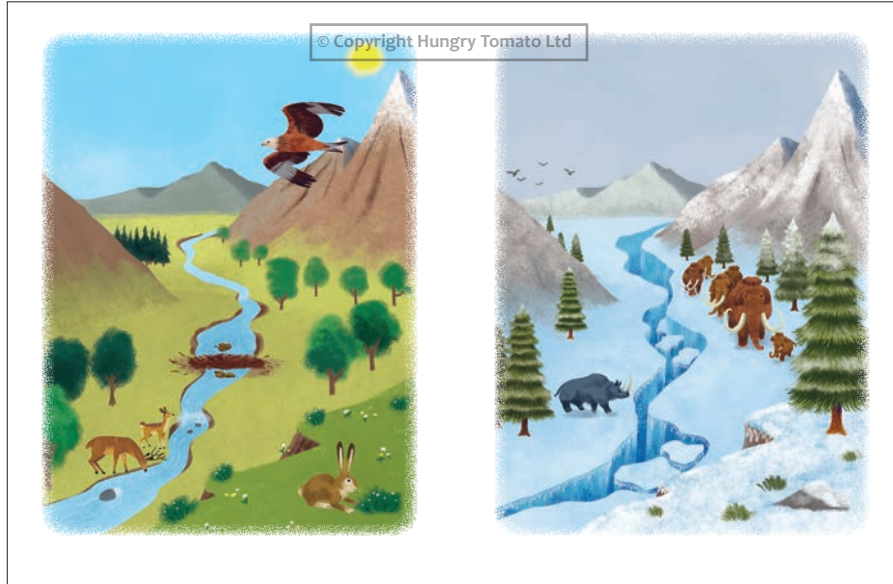
Volcanoes are openings on a planet's surface, where hot material from deep underground can rise to the surface and escape. When this material, which includes **ash**, **lava**, **rocks**, and **gas**, escapes, we call it an **eruption**. This is what is happening in the scene.

Volcanic eruptions can be triggered by movements under Earth's surface and a build-up of **pressure**. They are studied by scientists called **volcanologists**. These scientists think volcanoes have been erupting on Earth for at least 4 billion years! They're working to better predict eruptions, which can be deadly. Predicting eruptions sooner means, evacuating people faster from danger zones, and protecting more lives.

ICE AGE - THEN AND NOW: SCENE 6

The material for this scene can be linked to curriculum topics, including: animals, including humans; climate change; history; living things and their habitats.

Explore how Earth goes through periods of ice ages and warm climates with this scene which contrasts the two different conditions. Discuss how different life is in each one, from the weather to the animals that live there.



DISCUSSION PROMPTS

- When was the last ice age and when will the next one be?
Information overleaf
- Which of these two scenes would you rather live in? Why?
- Why do you think these ice age animals are no longer around?
Information overleaf
- How many of the modern-day animals can you name?
Information overleaf

ACTIVITY

Corresponding activity on page 8 of the activity pack: 'Incredible Ice Ages' is a classic activity where children fill in the blanks in a series of sentences and facts about ice ages, ancient Earth, and clever scientists.

ICE AGE - THEN AND NOW: SCENE 6

RELEVANT INFORMATION

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

ICE AGES

The last major **ice age** ended around 11,500 years ago.

How long the current **warm period** will last depends on a few factors, including the **tilt** of the Earth and the shape of Earth's **orbit** around the Sun. Scientists think that **global warming**, increased by human activity, may also have an effect. Some scientists estimate that the next major ice age won't happen for another 100,000 years.

ICE AGE ANIMALS

As well as **woolly mammoths**, this ice age scene features a **woolly rhino**. The woolly rhino is another animal that coped well in the ice age, but no longer walks the Earth, having become **extinct** several thousand years ago.

Woolly rhinos were related to some of the rhino **species** that still live on Earth today, but they had a thick covering of fur to keep them warm.

WHY ANIMALS BECOME EXTINCT

Animals become **extinct** when they die out and no more of that **species** exists anymore. The same thing can happen to plants. We can learn about living things that have become extinct from their remains and **fossils**. But it's not just a problem of the past – many of the things that live on Earth today are at risk of extinction.

Extinction can happen for many reasons, including **habitat** loss, loss of **food sources**, **hunting** (by humans), **disease**, and **climate change**.

MODERN-DAY ANIMALS IN THE SCENE

There are millions of animal species living in the world today. This scene only features a few examples:

- Red kite (bird)
- Hare
- Deer
- Beaver

DISCOVERING CLIMATE CHANGE: SCENE 7

The material for this scene can be linked to curriculum topics, including: climate change; living things and their habitats; rocks; working scientifically.

Learn about several ways scientists understand past climate conditions by studying different things in nature, from trees and pollen to rocks! Discuss how different types of scientists often have to work together to succeed.



DISCUSSION PROMPTS

- What else do you think scientists can learn from tree rings?
Information overleaf
- Do you know what pollen is?
Information overleaf
- How old do you think planet Earth is?
Information overleaf
- How do you think scientists work out how old rocks are?
Information overleaf

ACTIVITY

Corresponding activity on page 9 of the activity pack: 'Hidden Evidence' is a classic word search activity, using lots of great words related to climate change and the ways scientists study it, to get children familiar with the language of this process.

DISCOVERING CLIMATE CHANGE: SCENE 7

RELEVANT INFORMATION

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

TREE RINGS

Every year, many trees grow another **ring** of wood inside their **trunks**. By looking at the colour and number of rings inside the trunk, scientists can work out a tree's age.

The rings also tell scientists what the **weather** and **climate** was like in each year of the past: light-coloured rings show wood that grew in spring or early summer, and dark-coloured rings show wood that grew in late summer or autumn. The rings grow wider in warm, wet years, and thinner in cold, dry years.

POLLEN AND PLANTS

Fossils are the remains of things that lived millions of years ago. For animals, it's mostly hard parts, like bones and teeth, which become **fossilised**. But lots of parts of plants can become fossilised, from roots and leaves to the **pollen** they use to make young plants!

Each plant produces distinct pollen, allowing scientists to learn which plant it belonged to. Knowing the conditions different plants thrive in allows scientists to understand what the climate was like when these plants grew. For example, high levels of grass pollen suggest a dry, cool climate, while oak tree pollen suggests a warmer, wetter climate.

ROCKS AND ANCIENT EARTH

Our planet is made of rock which has built up in layers over time. **Sedimentary rocks** like sandstone are formed from sand and silt; **igneous rocks** like basalt are formed from **lava**. By studying rock formations, the depth of their layers and what they're made of, scientists can learn what the climate was like in a place many years ago.

By studying rocks, scientists estimate Earth to be around 4.5 billion years old! They work out a rock's age through **radiometric dating** – studying the material that makes up the rock to see how much it has **decayed**. Scientists know how quickly these materials normally take to decay, so this comparison helps them estimate the age of that rock.

ALL TYPES OF SCIENTISTS

Lots of different scientists are interested in learning the history of Earth and how climate conditions have changed over time, not just glaciologists! Scientists often have to work together to get a full picture of the past.

HUMANS AND GLOBAL WARMING: SCENE 8

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

Discover the difference between climate change and global warming, and learn about the impact human activity has had on these processes. Discuss clean alternatives to fossil fuels that are better for the environment.



DISCUSSION PROMPTS

- What do you know already about climate change and global warming?

Information overleaf

- Do you think fast global warming is good or bad? Why?

- Scientists and leaders around the world are looking for different ways to make power that is better for the environment. Can you think of any?

Encourage children to name clean energy sources such as solar power, wind power, geothermal power, and so on.

ACTIVITY

Corresponding activity on page 10 of the activity pack: 'Changing World' is a crossword activity where children use clues to name some of the possible effects of climate change. They can then fill in the crossword with the answers.

HUMANS AND GLOBAL WARMING: SCENE 8

RELEVANT INFORMATION

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

CLIMATE CHANGE AND GLOBAL WARMING

Weather changes day to day. **Climate** is the pattern of weather conditions over a long period of time.

Rocks, fossils, and glaciers have shown that Earth's climate changes naturally over time as it is affected by factors such as the **Sun, volcanic eruptions, and Earth's orbit**. However, scientists have noticed that the climate has been changing much quicker than normal over the last few hundreds years, a change which has been linked with humans burning **fossil fuels**.

When burnt, fossil fuels release **gases** into the atmosphere which trap heat and make the climate hotter around the world. This process works like the air inside a greenhouse, which is why these gases are often called '**greenhouse gases**'. One example of a greenhouse gas is **carbon dioxide**.

Our natural world has clever ways of reducing the amount of carbon in the atmosphere. For example, trees take in carbon dioxide from the air, which they use to grow, and release **oxygen**, which humans and animals need to breathe. This helps to keep our air clean. However, due to human activity, carbon dioxide levels are currently building up quicker than nature can remove them.

CLEAN POWER SOURCES

Many people are starting to use **clean energy** sources which, unlike fossil fuels, aren't harmful to the **environment**. These include:

- **Solar power** – energy produced using heat from the Sun.
- **Wind power** – energy produced from the power of the wind.
- **Water power** – energy produced by the fast flow of water sources and wave power.

Lots of these sources of energy are also called '**renewable**' as they come from sources that will not run out. In contrast, fossil fuels are '**non-renewable**' as they will eventually run out. This is because fossil fuels come from naturally occurring materials like coal and oil, which will eventually run out.

INVESTIGATING GLACIOLOGISTS: SCENE 9

The material for this scene can be linked to curriculum topics, including: climate change; working scientifically.

Explore the role of glaciologists today with this busy expedition scene that shows scientists conducting lots of tests. Discuss the tools and equipment that glaciologists use, as well as the clothing they need to wear to stay safe on glaciers.



DISCUSSION PROMPTS

- What do you think the glaciologists in the scene are doing? What do you think their tools do?

Information overleaf

- What pieces of clothing can you see the glaciologists wearing? How do you think these clothes help them work on glaciers?

Encourage children to point out clothing such as sunglasses, gloves, and so on, and identify how they link with the scientists' environment. There's also information overleaf.

- If you were a glaciologist, what's the first thing you would want to learn about glaciers?

- Would you ever want to visit a glacier? Why or why not?

ACTIVITY

Corresponding activity on page 11 of the activity pack: 'Glaciologists' Toolkit' is a cut and stick activity where children match up the name of the tool with its description. A fun way to show how glaciologists work!

INVESTIGATING GLACIOLOGISTS: SCENE 9

RELEVANT INFORMATION

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

MODERN-DAY GLACIOLOGISTS

Glaciologists study glaciers for many different reasons, but many of them **monitor** the same glaciers over a long period of time to see how their shape and size is changing. This shows them how glaciers may be affected by factors such as **climate change**. Their work includes going on **expeditions** to glaciers and spending time in a lab, studying data.

The glaciologists in this scene are shown carrying out some of these expedition tasks, including photographing the glacier, making observations about features such as **crevasses** and **moulins**, and measuring the depths of cracks and holes, and **meltwater**.

GLACIOLOGISTS' TOOLS AND CLOTHING

The tools the glaciologists in the scene are using include cameras, notebooks, and rulers and measuring devices. These are just some of the tools that glaciologists use.

The items of clothing glaciologists wear are just as important as the tools they use. Staying warm is key, so scientists on expeditions wear thick coats and gloves, hats and scarves, **thermal** underclothes, and sensible boots. When walking on ice, scientists attach **crampons** to their boots – spikes which help the boot grip into the ice and stop the person falling over.

STAYING SAFE ON THE ICE

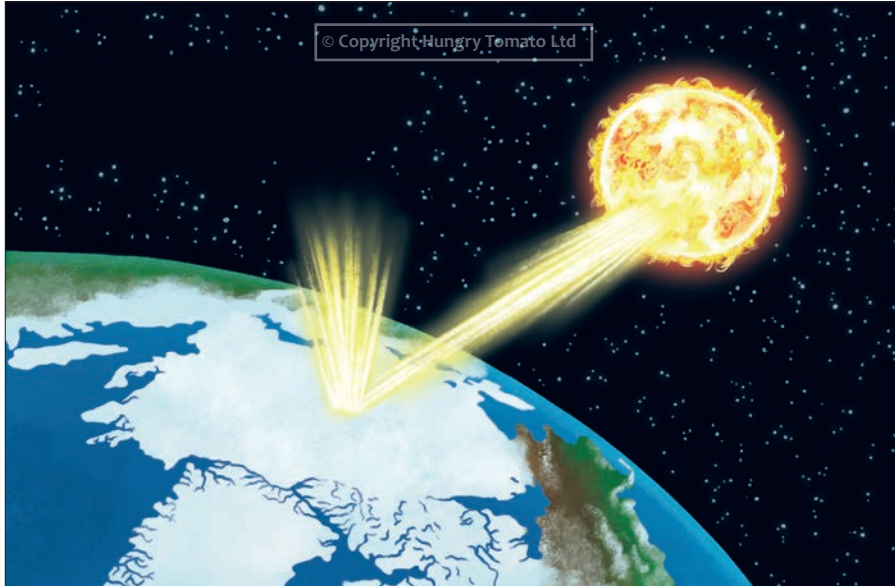
Glaciers are dangerous places to work – they are slippery, and there are lots of huge, deep cracks and holes which can be deadly. Glaciologists must ensure they always go as part of a team. Often, team members wear **safety harnesses** and tie themselves to each other on long pieces of rope. This is so if one person falls, the others can pull them up.

Glaciers are often in places with limited phone signal. Scientists take a **satellite communication device** with them so that they can get in touch with emergency services if needed. These devices use **GPS signals**.

STAYING COOL: SCENE 10

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

View Earth and its glacial ice from a completely different perspective with this space-based scene! Explore the power of the Sun and how it interacts with Earth's ice, as well as the effect that global warming has on this process.



DISCUSSION PROMPTS

- How much of the Earth is covered in ice?
Information overleaf
- How fast is Earth's ice melting?
Information overleaf
- How far away is the Sun from Earth?
Information overleaf

ACTIVITY

Corresponding activity on page 12 of the activity pack: 'Unearthing Icy Secrets' 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.

STAYING COOL: SCENE 10

RELEVANT INFORMATION

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

ICE ON EARTH

Ice covers about 10% of Earth's surface, most of which is in the **Antarctic ice sheet**. This hasn't always been the case – scientists estimate that during the height of the last **ice age**, ice covered just over 30% of Earth's surface!

Today, a lot of the world's ice is disappearing quickly. Scientists think the Arctic is warming twice as fast as anywhere else on the planet. They estimate that the **sea ice** there is reducing by more than 10% every 10 years.

Scientists have found evidence that the main reason **glaciers** and sea ice are melting so quickly is because of **climate change** linked to human activity.

THE SUN & THE SOLAR SYSTEM

The Sun is at the centre of our **solar system** and is what all the planets and smaller objects near us spin around. The process of planets and space objects moving around a larger object in space is called '**orbiting**'.

The planets in our solar system all have their own names, and are named in the order that they appear, starting with the one closest to the Sun: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. These planets are all very different from each other, varying in size, colour, temperature, and other features.

Earth and the Sun are about 93 million miles (149 million km) far apart from each other!

The Sun is incredibly hot and powerful and is the reason that we have light and heat. It's also the reason that living things are able to grow, and stay alive and healthy. Without it, life wouldn't exist on Earth.

STORMY SEAS: SCENE 11

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

Explore the effect of melting glaciers on the world and human life with this scene which focuses on sea level rise and increasing extreme weather events. Discuss how melting glaciers affect people all around the world, not just those who live nearby.



DISCUSSION PROMPTS

- Can you think of any other things that might be affected by glaciers melting?
Information overleaf
- Besides storms and hurricanes, can you think of any other types of extreme weather events?
Information overleaf
- Have you ever experienced an extreme weather event?

ACTIVITY

Corresponding activity on page 13 of the activity pack: 'Wave Jumble' is an activity where children have to unscramble the letters to spell out storm-related words. In a linked activity, they have to see how many words they can create out of set letters.

STORMY SEAS: SCENE 11

RELEVANT INFORMATION

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

MELTING GLACIERS

Glaciers are found in different places, but when they melt they can affect the whole world! Because glaciers are found on land, when they melt and run into the ocean, they cause ocean levels across the world to rise. This means they can affect lots of people!

As well as causing **flooding** of coastal areas, and **extreme weather events**, melting glaciers can cause:

- Coastal areas, like cliffs, to be worn away.
- An interruption to the supply of **freshwater** in places that rely on glacial rivers.
- The release of **greenhouse gases** previously trapped inside ice.
- More challenges for **farming** and **fishing** industries.
- Loss of **habitats** for animals, and loss of places to live for humans.

These are just a few of the things that melting glaciers can affect.

EXTREME WEATHER EVENTS

Storms and **hurricanes** are just two examples of extreme weather events. Other examples include:

- **Heatwaves**
- **Droughts**
- **Flooding**
- **Tornadoes**
- **Cyclones**
- **Blizzards**
- **Forest fires**

Because of **climate change**, extreme weather events are becoming more common. Scientists who study the weather and extreme weather events with the aim of **forecasting** future weather are called '**meteorologists**'.

UNHAPPY HABITATS: SCENE 12

The material for this scene can be linked to curriculum topics, including: animals, including humans; climate change; living things and their habitats.

Explore the effect of melting glaciers on animals and their habitats with this scene which focuses on sea ice melting. Discuss the animals that live in these habitats and how they may be affected by melting ice.



DISCUSSION PROMPTS

- What type of animal can you see in the scene?

Information overleaf

- Where do these animals live?

Information overleaf

- Can you think of any other animals that live on and around glaciers or sea ice that could also be affected by them melting?

Information overleaf

ACTIVITY

Corresponding activity on page 14 of the activity pack: 'Lost in the Snow' is a classic line maze activity where children have to complete the maze to help the baby polar bear find its way back to its parent.

UNHAPPY HABITATS: SCENE 12

RELEVANT INFORMATION

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

POLAR BEARS

The animals in the scene are polar bears. They are the largest **species** of bear and land **carnivore**. They live mostly on **sea ice** in the Arctic, which they rely on for **hunting**, **resting**, **mating**, and making **dens**.

They are strong swimmers, which makes them fierce **predators** who are able to hunt on land and in water. They spend half of their time hunting for food like seals and fish, but will eat almost anything if they are hungry enough! They have a thick layer of **blubber** and **fur** which helps to keep them warm.

ANIMALS AND THEIR ICY HABITATS

Polar bears aren't the only animals to live on and around **glaciers** and **sea ice**. Other animals that live in these icy places include:

- Penguins
- Seals
- Walruses
- Reindeer

Animals that live under and around glaciers and sea ice include:

- Narwhals
- Beluga whales
- Orcas
- Antarctic krill

ENDANGERED ANIMALS

Like many animals, polar bears are **vulnerable** to **extinction** in the wild.

Wildlife agencies categorise animals to compare their risk of extinction. This helps them work out which need the most help with **conservation**. These categories include:

- Vulnerable
- **Endangered**
- Critically endangered
- **Extinct** in the wild
- Extinct

THE POWER OF GLACIERS: SCENE 13

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

Explore how glaciers impact, and form an important part, of our natural world with this scene depicting penguins in Antarctica. Discuss why we should protect glaciers, for ourselves and the animals that rely on them, as well as the simple ways we can all help.



DISCUSSION PROMPTS

- What type of animal can you see in the scene?
Information overleaf
- Why do you think some of these animals are yellow and black, and others are grey and white?
Information overleaf
- Do you think we should protect glaciers and the animals that live on or near them? Why or why not?
- How do you think we can protect glaciers and the animals that live on or near them?
Information overleaf

ACTIVITY

Corresponding activity on page 15 of the activity pack: 'Polar Perspective' is a reflective writing task where children answer questions about their opinions on a number of glacier-related questions.

THE POWER OF GLACIERS: SCENE 13

RELEVANT INFORMATION

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

PENGUINS

The animals in the scene are emperor penguins. These are the tallest and heaviest of all penguin **species**. They live on **sea ice** in Antarctica, and spend a lot of their time swimming in the ocean around it, where they **hunt** for food. They have lots of layers of thick feathers which help to keep them warm. They also huddle together for warmth. The yellow and black penguins are adults, and the little grey and white ones are babies.

There are many different penguin species – 18 in total! Some of them don't live in icy **climates**, but in hot climates like the Galapagos Islands off the coast of South America, and South Africa.

LAYING EGGS

Penguins are **birds**, although they can't fly. Like all other birds and many **reptiles** and **amphibians**, penguins lay eggs which their babies hatch out of. Because they live in such cold places, emperor penguins keep their eggs safe and warm by placing them on top of their feet and under a thick fold of skin until the babies are ready to hatch.

Not all animals have babies in the same way. **Mammals** are **warm-blooded** animals that give birth to **live young** rather than eggs. They also feed their babies with milk that their bodies produce. Examples of mammals include dogs, cows, tigers, and humans.

PROTECTING GLACIERS & ANIMALS

We can all help to protect **glaciers** and the animals that live on or near them by doing things that help the **environment**. These include:

- Using less water.
- Turning lights and **appliances** off when not in use.
- **Reusing** and **recycling** items.
- Walking, cycling, or using public transport instead of cars.
- Planting more trees and plants.
- Talking about **climate change** to encourage other people to help.

If we all made a few of these changes, it could make a big difference. We only have one planet, it's important we all do our bit to look after it!

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 glaciers help us learn about climate change?
- Did anything else in the book surprise you?
- What's the coolest thing you've learnt from this book?

ACTIVITY

Corresponding activity on page 16 of the activity pack: 'Write Your Own Glaciology Story' is a creative writing activity which encourages children to write a story about glaciology, using three key prompt words.

DISCLAIMER:

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

THE BIG QUESTIONS ANSWERED

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