

ILLUSTRATED ENCYCLOPEDIA



EARTH



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EARTH

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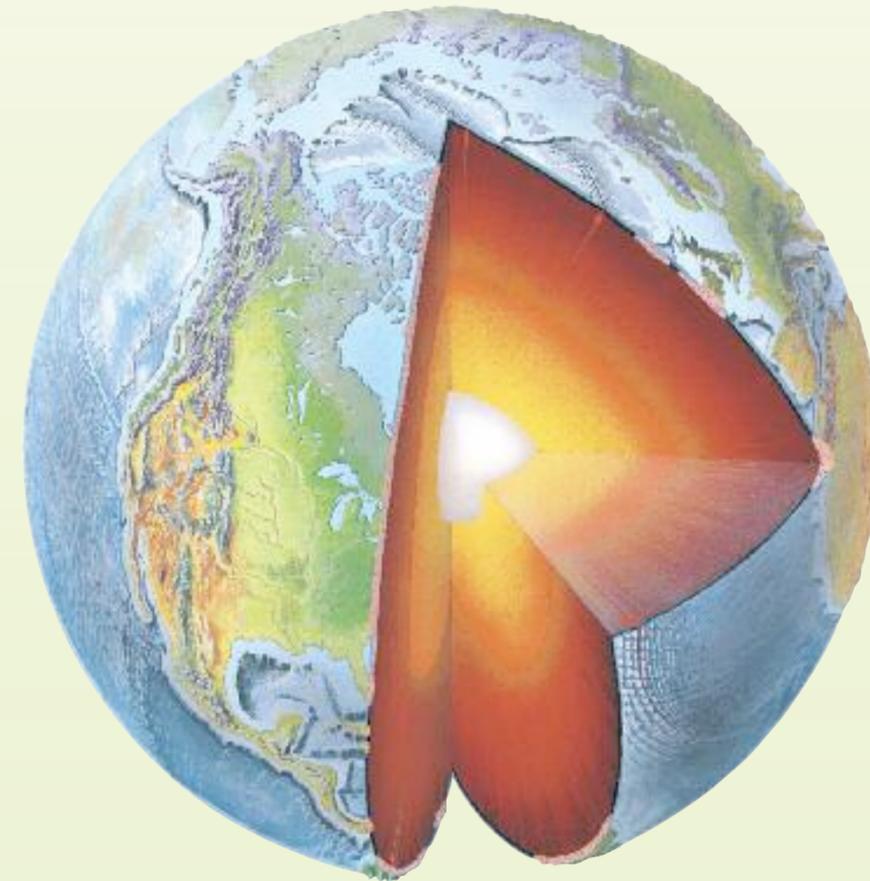
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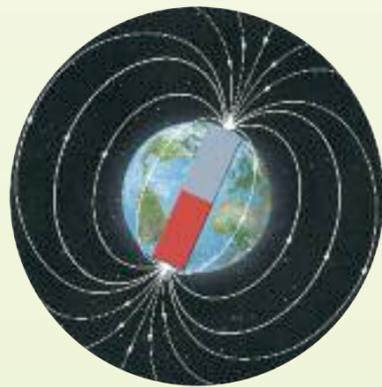
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ABOUT THIS BOOK

Each double page contains a brief introduction, explaining the general subject, followed by key words arranged in alphabetical order. To look up a specific word, turn to the index at the back of this book: this will tell you which page to go to. If you want to learn more about a subject, take a look at the factfile, or follow the arrows to read related entries.



INTRODUCTION
This explains the general subject and provides some basic knowledge.

ARROWS
These arrows show you where to look up other words mentioned in the entry. For example, (→ 26) tells you to go forward to page 26 and (← 6) tells you to turn back to page 6.

PAGE NUMBER
Page numbers are easy to find at the side of the page.

DESERTS

A desert is a dry area that receives less than 25 centimetres of rain per year. Most people think of deserts as vast sandy regions, but only 20 per cent of the world's deserts are sandy. The rest are bare rock, or covered with gravel. When rain does fall in occasional storms, there is no soil to soak it up so it quickly dries up. Some deserts are hot all year round and some are always cold. In many deserts, strong winds blast sand at the rocks, carving out amazing shapes.

Arid Very dry. Arid regions, such as deserts, have too little water to support plant life.

Barchan A crescent-shaped sand dune that slowly shifts along with the wind.

Butte A desert hill with very steep sides and a flat top. A butte is made up of hard rock that does not easily wear away. It is like a mesa but smaller.

Hamada A flat, rocky area of desert, with little or no sand covering.

Mesa A desert mountain with a flat top and very steep sides. Mesas are formed when layers of soft rock are worn away by wind and water, revealing a block of harder rock. Mesas take their name, the Spanish word for "tabletop", from their distinctive, flat-topped appearance.

Desert pavement A hard, thin desert surface of densely packed pebbles and rocks. Desert pavements form when sand and small rocks are blown away, leaving behind heavier lumps of rock.

Erg A flat, sandy area of desert.

MAP OF DESERT FEATURES

Natural arch A rock formation in the Valley of Fire park in America (above). The park is named after its distinctive bright red sandstone. Monument Valley in America (below) has many flat-topped buttes and mesas.

Hoodoo A strangely shaped column of rock. Hoodoos are made up of layers of soft and hard rock, which the wind and sand erodes at different rates, producing bizarre shapes and colours, and sometimes a stripy appearance.

Hot desert An area with less than 25 cm of snow or rainfall a year, and with an average temperature of over 20°C. Hot deserts are cold at night because they do not have any cloud cover to trap heat.

Mesa A desert mountain with a flat top and very steep sides. Mesas are formed when layers of soft rock are worn away by wind and water, revealing a block of harder rock. Mesas take their name, the Spanish word for "tabletop", from their distinctive, flat-topped appearance.

Natural arch A rock that is shaped like an arch. Natural arches form when the wind forces open a crack in a rock face.

Oasis A lush area of water and trees in the middle of a desert. An oasis forms where an underground river comes to the surface at a spring.

Plateau A flat, raised area of land. Plateaus form when the movement of tectonic plates (→ 10) pushes up whole sections of flat rock. Buttes and mesas are both types of plateau.

Playa A flat, dried-up lake, sometimes called a salina. During a rare rainstorm, a playa may briefly fill up with rainwater.

The Olgas In western Australia, one of the result of extreme daily heating and cooling. These cause rock layers to flake away, leaving smooth, rounded blocks.

Rain shadow An area of land that receives little rain because it lies on the far side of a mountain range to the prevailing winds. Winds blow moist air over the mountains, where moisture condenses in the cold and falls as rain or snow. By the time wind reaches the far side of the mountains, it has lost most of its moisture.

Salt flat A layer of salt crystals that forms in a dried-out lake. During a brief rainstorm, salts in the rocks of the desert dissolve in the warm rainwater. A pool of water may collect in an area of low ground. When it dries out, a layer of salt is left behind. After each rainfall the layer of salt becomes thicker.

Sand dune A heap, or bank, of sand that has been shaped by the wind. Sand dunes form where sand, blown by the wind, is stopped by an obstacle, such as a boulder, a plant or a change in the shape of the land.

Wadi A steep-sided gorge. It is formed when fast-flowing water from rare rainstorms wears away desert rocks.

Wind erosion The gradual wearing away of the land caused by the wind. Wind erosion gradually blows away soil and sand. Strong winds may hurl sand against rocky surfaces, where it acts like sandpaper, wearing away the rock.

Zeugens A mushroom-shaped rock in the desert. It is formed by wind erosion. Most of the sand carried by the wind is found about a metre above the ground. Zeugens form when wind-blown sand blasts away the base of a boulder, leaving a narrow, top-heavy rock formation. Zeugens are sometimes called rock pedestals.

FACTFILE

- Deserts and arid regions cover one-eighth of the world's land area.
- The largest hot desert in the world is the Sahara in Africa, which is over 9 million square km.
- Antarctica is the largest desert in the world. It covers over 13 million square km. It receives very little snow each year—the equivalent of just 5 cm of rain.
- The continent with the largest proportion of desert—about one half its area—is Australia.
- The driest desert is the Atacama in Chile, South America, with an average of less than 1 mm of rain per year.
- "Hot" deserts can be bitterly cold at night. The Takla Makan Desert in China can be a scorching 40°C by day yet plunge to temperatures of -40°C at night.

KEY WORDS AND ENTRIES
Key words are arranged alphabetically across each double page. Each entry provides a short explanation of what the key word means.

BOLD WORDS
These highlight useful words that do not have their own entry.

FACTFILE
The factfile provides extra information on the subject. Facts are presented in easy to read bullet points.

THE ORIGIN OF EARTH

Planet Earth is one of eight planets orbiting the Sun. The Sun is one of billions of stars in the Milky Way Galaxy, itself one of billions of galaxies in the Universe. The Universe came into existence 13.7 billion years ago. It was not until about 4500 million years ago that the Sun and its family of planets, including Earth, were formed. No one can say for sure how the Earth was formed, but many scientists agree on a likely sequence of events, as illustrated here.

1 The Solar System started out as a cloud of gas and dust drifting in space.

2 Something—perhaps a series of shock waves emitted from an exploding star nearby—caused the cloud to clump together. A huge, swirling disc was set in motion.

3 Matter fell towards the centre and became hotter and denser than the edge of the disc. The core of intense energy was the beginnings of our Sun.

4 Fragments of dust spinning around the Sun began to clump together, becoming at first small bands of rocks, then larger boulders, before growing into chunks several kilometres across, known as planetesimals.

6 Heavy particles of iron and other metals sank to form the cores of the planets.

5 The planetesimals started to collide with each other, building up to become the four rocky inner planets, Mercury, Venus, Earth and Mars.

10 Eventually the surface cooled. Gases, trapped beneath the newly solidified surface, burst through the crust in volcanoes. They collected to form an atmosphere. Water vapour rose to form huge clouds.

7 The Moon may have formed when a large object collided with the newly-formed Earth.

8 The impact “splashed” vast amounts of debris into space, surrounding the Earth. These particles came together to form the Moon.

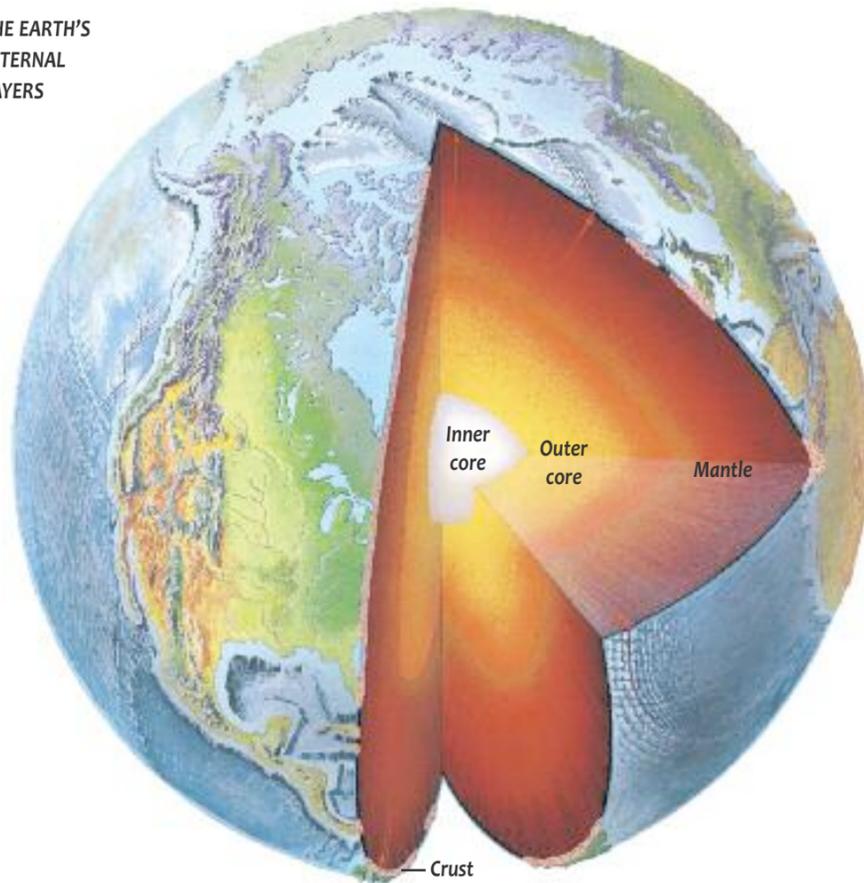
9 In its early days, the Earth was a barren planet. Unprotected by an atmosphere it was continually bombarded by meteorites. The Earth’s surface temperature rose until the planet became a global sea of molten rock.

11 Once the planet’s surface had cooled, water began to collect in low basins. These filled up to form the first oceans.

PLANET EARTH

THE EARTH'S INTERNAL LAYERS

The Earth is a spinning ball of rock and metal. It is one of eight planets that orbit, or circle, our nearest star, the Sun. Its surface is made up of oceans and landmasses called continents. A layer of air called the atmosphere (▶28) surrounds the whole planet. The Earth's outer layer, the crust, is a thin, rocky shell. Beneath the crust lies the mantle, a thick layer made of hot, dense rock. At the very centre of the Earth is its core, a ball of metal, liquid on the outside, solid on the inside.

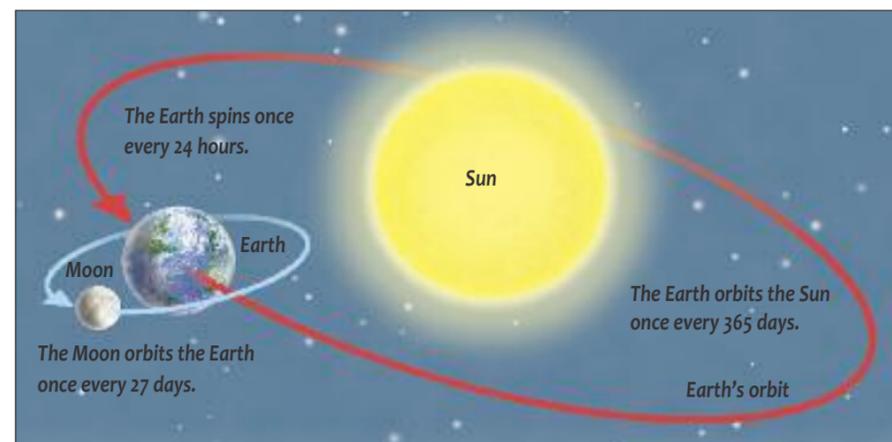


Asthenosphere A soft layer in the Earth's upper mantle. It lies just beneath the lithosphere. It is partly molten and allows the lithosphere to slide about over it.

Aurora The display of coloured lights seen in the night skies close to the Earth's magnetic poles. It occurs when high-energy particles from the Sun are trapped by the Earth's magnetic field.

Axis An imaginary straight line that runs North to South through the centre of the Earth. The Earth rotates, or spins, on its axis.

The orbits of the Earth and Moon



Continent One of the seven large landmasses on the Earth. They also include the continental shelf (▶22), an area that extends beyond the seashore.

Convection current The movement of heat through liquids and gases. Heated from below, a liquid or gas will expand, become less dense, and rise. Away from the source of heat, it will cool down and sink. Convection currents in the Earth's mantle are responsible for continental drift (▶10).

Core The innermost part of the Earth, mostly made of iron with a little nickel. It is divided into the outer and inner core.

Crust The thin, rocky outer layer of the Earth. There are two main types of crust: continental crust and oceanic crust. Continental crust is between 35 and 70 km thick. Oceanic crust is only 5 to 10 km thick.

Inner core The very innermost part of the Earth. The inner core is a solid ball of the metal iron, about 2500 km in diameter. It is under so much pressure that it is solid even at temperatures of 5430°C.

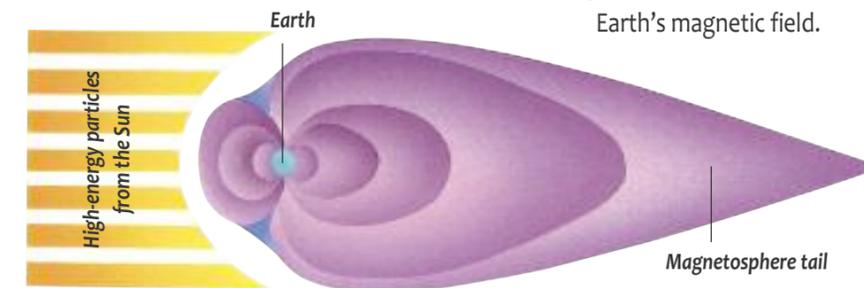
Lithosphere A layer of the Earth made up of its crust, plus a thin layer of the upper mantle. It is split into large pieces called lithospheric, or tectonic, plates (▶11). These slide about on top of the asthenosphere.

Lower mantle The inner layer of the Earth's mantle. It is about 2300 km thick. The pressure exerted by the layers above prevents the rock from melting.

Magnetic field The region surrounding a magnet, an object which has two poles and a force of attraction between them. The Earth has its own magnetic field, which stretches into space and protects it from the Sun's high-energy particles.

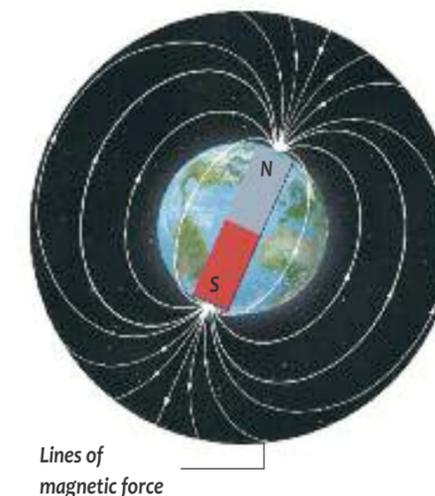
Magnetic poles The two points at either end of a magnet, where its force is at its strongest. The Earth's magnetic poles are located close to the geographical north and south poles. These are the two points where the Earth's axis meets the surface of the Earth.

THE MAGNETOSPHERE



Magnetosphere The region around the Earth in which its magnetic field exerts a force. The magnetosphere stretches thousands of kilometres into space and protects us from the Sun's high-energy particles, known as the solar wind. The solar wind "blows" the magnetosphere into a teardrop shape.

THE EARTH'S MAGNETIC FIELD



Mantle The rocky layer of the Earth that lies between the crust and the core. It is made up of the upper and lower mantle.

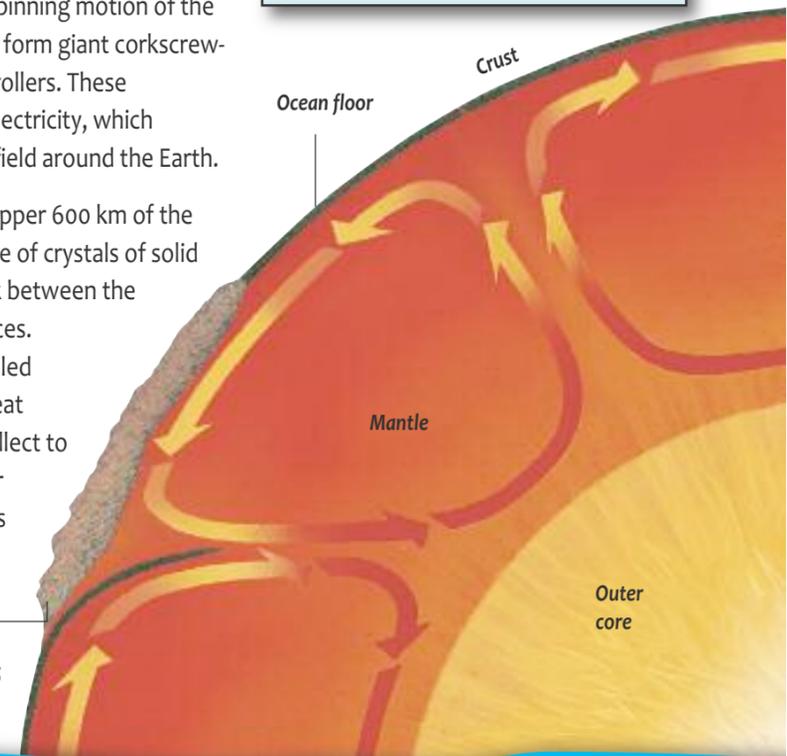
Moho (Mohorovičić discontinuity) The boundary between the Earth's crust and mantle. It is recognized because of the way it affects the movement of seismic waves travelling through the Earth (▶11).

Outer core The outer layer of the Earth's core. It is 2200 km thick and made up mostly of molten iron. Temperatures here rise to more than 4000°C. The liquid outer core spins around the solid inner core as the Earth rotates. This movement, known as rollers, is probably the cause of the Earth's magnetic field.

Rollers The twisting movement of liquid iron inside the Earth's outer core. Convection currents in the core cause liquid metal to swirl around. The currents are twisted by the spinning motion of the Earth's rotation and form giant corkscrew-like patterns called rollers. These movements make electricity, which creates a magnetic field around the Earth.

Upper mantle The upper 600 km of the Earth's mantle, made of crystals of solid rock with liquid rock between the crystals in some places. The molten rock, called magma, is under great pressure and can collect to burst out of holes or cracks in the crust as volcanoes (▶12).

CONVECTION CURRENTS IN THE EARTH



The aurora borealis, or Northern Lights, light up the skies of the Northern hemisphere (▶28).

FACTFILE

Diameter: 12,756 km
Day: 23 hours 56 minutes
Average distance from the Sun: 149.7 million km
Surface temperature: -70°C to +55°C
Atmosphere: nitrogen, oxygen, water vapour

- ★ The Earth is about 4.5 billion years old.
- ★ The Earth is not a true sphere, but is a slightly squashed shape called an oblate spheroid. The distance around the Earth's equator is slightly greater than the distance around the Earth from pole to pole. This is caused by the spinning motion of the Earth pushing its mass out around the equator.
- ★ The deepest anyone has ever drilled down into the Earth is 15 km.

EARTH MOVEMENTS

The Earth's outer layer, the lithosphere, is divided into enormous irregular slabs, called tectonic plates. These fit together like a ball-shaped jigsaw. The plates "float" on top of the liquid asthenosphere (8). Convection currents (8) in the mantle push the plates and makes them move. In some places, the plates push against each other and crumple, forming mountains. In other places, they pull away from one another and molten rock wells up between them. Sometimes plates lock together for a time, then suddenly jolt apart, causing earthquakes.

Aftershock A small earthquake that immediately follows a larger one. Aftershocks occur as rocks in the Earth's crust re-adjust after the main shock.

Continental drift The movement of the continents (8) around the globe. The continents are attached to the tectonic plates, and are carried by their movements.

Convergent boundary A boundary between two tectonic plates that are pushing against each other. If one of the plates is oceanic, its edge may be forced down under a heavier continental plate. If both plates are continental, they will collide and crumple up into mountains.

Divergent boundary A boundary between tectonic plates that are moving away from each other. Molten rock wells up to fill the gap between the plates. Most divergent boundaries are between oceanic plates and are called mid-oceanic ridges (23).

Earthquake A shaking or trembling of the ground, caused by the sudden movement of rocks in the Earth's crust. Most earthquakes happen along the edges of tectonic plates, when plates collide or slide past each other. The two plates lock together before the pressure becomes too much and the rocks suddenly snap apart.

Epicentre The point on the Earth's surface directly above the focus of an earthquake.

Fault A crack in the Earth's crust, along which there is movement of one side relative to the other. Faults form when rocks are stretched or bent and crack along weak points.



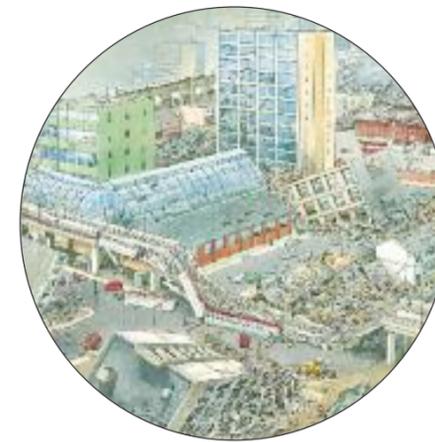
These two maps of the Earth show how its surface is divided up into tectonic plates.

Focus The point beneath the Earth's surface where rocks break or shift, triggering an earthquake.

Fold A bend in the rocks of the Earth's crust. Folds occur when intense pressure is exerted on rocks by movements in the crust. Folds vary in size from small wrinkles to large mountains.

Mercalli Scale A scale used to measure the amount of damage caused by an earthquake. The scale ranges from 1, an earthquake so small it can barely be felt, to 12, an earthquake that causes total devastation and changes the landscape.

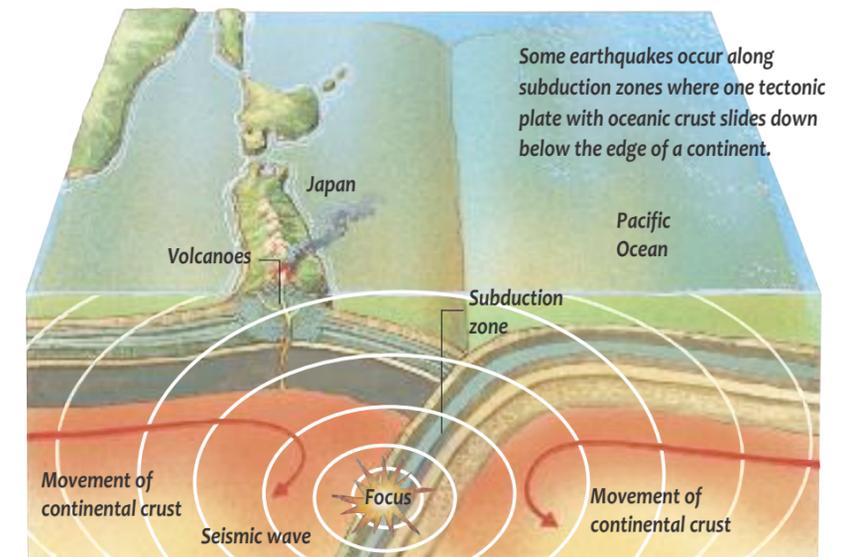
Richter Scale A scale used to measure the strength, or magnitude, of an earthquake. Earthquakes with a magnitude of less than 2 cannot be felt. Earthquakes with a magnitude of 7 or more can cause huge amounts of damage and loss of life.



A damaged city after a strong earthquake

Rift A place where the Earth's crust is being pulled apart by the movement of tectonic plates. Rifting causes rocks at the Earth's surface to crack, creating faults. A block of land may slip down between faults to form a rift valley (15).

Seismic waves Waves of pressure that move through the Earth. They are caused by earthquakes. **Primary waves** travel through all layers of the Earth, squeezing and stretching rock. **Secondary waves** shake rock from side to side. They are slower than primary waves and cannot travel through the Earth's liquid outer core (9).



Some earthquakes occur along subduction zones where one tectonic plate with oceanic crust slides down below the edge of a continent.

Seismometer An instrument used to measure the strength of an earthquake.

Subduction The process by which one tectonic plate slides beneath another. The place where this occurs is called a **subduction zone**. A thinner, denser oceanic plate will slide beneath a continental plate when the two collide.

Tectonic plates The large slabs into which the Earth's surface is divided. They are sometimes called **lithospheric plates**. Each plate consists of a piece of the Earth's crust, plus a portion of upper mantle, which together form the lithosphere (8).

Transform fault A boundary between tectonic plates that are sliding past each other. **The San Andreas Fault**, which stretches 750 miles along the west coast of North America, is an example of a transform fault.

A tsunami rears up as it enters shallow water.



Tsunami A massive wave caused by an earthquake deep under the seabed. In the open ocean, tsunami waves are barely noticeable, but as they near the shore they grow much bigger—up to 30 m high. The wall of water surges ashore with an unstoppable force, quickly flooding coastal areas.

FACTFILE

★ There are about 500,000 earthquakes every year. About 100,000 of these can be felt without detection equipment. Every few years a massive earthquake results in great loss of life.

★ Major earthquakes only cause large loss of life in towns and cities. The sudden violent shaking of the ground may collapse buildings and bridges, and burst pipes. Broken cables can lead to fires. In some places affected by earthquakes, houses are now built to resist shaking.

★ The strongest earthquake ever recorded was the Great Chilean Earthquake of 22nd May 1960. It had a magnitude of 9.5 on the Richter Scale.



VOLCANOES

A volcano is an opening, or vent, in the Earth's crust through which magma, molten rock, erupts. The word volcano is usually used to describe a cone-shaped mountain with a central vent and a crater at the summit, but this is not always the case. Many volcanoes have gently spreading slopes. Others are simply cracks in the ocean bed. Most volcanoes are situated along the edges of the giant plates that make up the Earth's surface. More than half of the world's active volcanoes above sea level encircle the Pacific Ocean to form the so-called "Ring of Fire".

Aa Lava that carries lumps of solid rock called **clinker**.

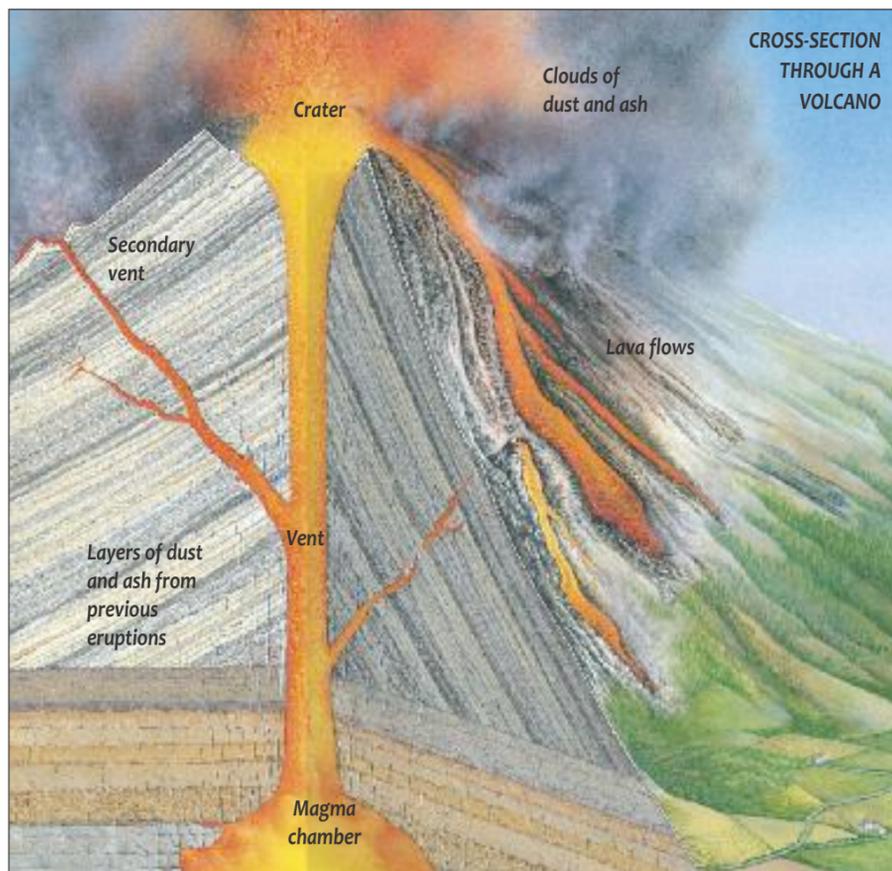
Ash Lava that has been blown to powder by the force of an eruption. Ash clouds can reach up to 40 km into the sky.

Caldera A large, deep hole formed when a volcano collapses in on itself after a violent eruption.

Crater A circular, funnel-shaped opening at the summit of a volcano.

Dormant volcano A volcano that has stopped erupting, but which may burst into life again in the future. Mount St. Helens in the USA was a dormant volcano that came back to life spectacularly in 1980.

Fast-moving, runny lava flows are characteristic of volcanoes that erupt frequently and comparatively gently.



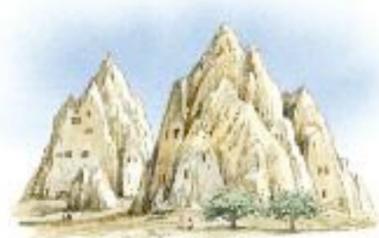
Eruption As pressure in the magma beneath the Earth's crust builds up, it forces its way up through cracks and erupts at the surface as lava. If the magma is quite runny, the gas contained in it can escape easily. The lava oozes out of the opening and flows down the sides of the volcano. If the magma is thick and sticky, the gas cannot escape, but builds up until it explodes. Huge clouds of gases and ash fly high up into the air.

Extinct volcano A volcano that has not erupted for tens of thousands of years.

Fissure A large crack or opening in the Earth's crust. Lava may emerge through a fissure without an explosive eruption. Undersea volcanoes are fissures in the seabed.

Geyser A natural fountain of hot water or steam that periodically ejects from an opening in the Earth's crust. Geysers erupt when underground water comes into close contact with hot, volcanic rocks.

Hot spot A weakness in the Earth's crust where magma is liable to force its way through. Over time, solidified lava builds up and may eventually break the surface of the ocean. The Hawaiian Islands, for example, are the summits of volcanoes rising from the floor of the Pacific Ocean.



Rock churches carved out of soft, volcanic rock in Cappadocia in southern Turkey.

Lava Magma that has erupted at the Earth's surface through volcanoes. It may flow as hot, molten rock for a while, but then quickly cools and solidifies. Lavas vary from thick to runny, according to the amount of gas contained within them and the type of silicates they are made of.

Magma chamber An underground pool of magma. Over time, pressure in the chamber builds up, forcing magma to push through cracks in the Earth's crust. Many volcanoes are situated above a magma chamber.

Magma Hot, molten rock beneath the Earth's surface. Magma is formed in the Earth's mantle. It is composed mostly of silicates, with gases contained in bubbles.

Pahoehoe Very runny lava that flows beneath a hardening, rocky crust. On cooling, it has a smooth, billowy texture and rope-like appearance.



A geyser erupts

Pillow lava Runny lava that erupts under the sea and hardens into round, pillow-shaped lumps of rock.

Pumice A volcanic glass "froth" formed from cooling, gassy lava. It contains numerous bubbles.

Pyroclastic flow The extremely hot mixture of volcanic rock and gases that sweeps down a volcano's slopes at more than 300 km/h, destroying everything in its path. The residents of Pompeii were wiped out by a pyroclastic flow when Mt Vesuvius erupted in AD 79.

A close-up of ash shows that it is made of pieces of pumice.

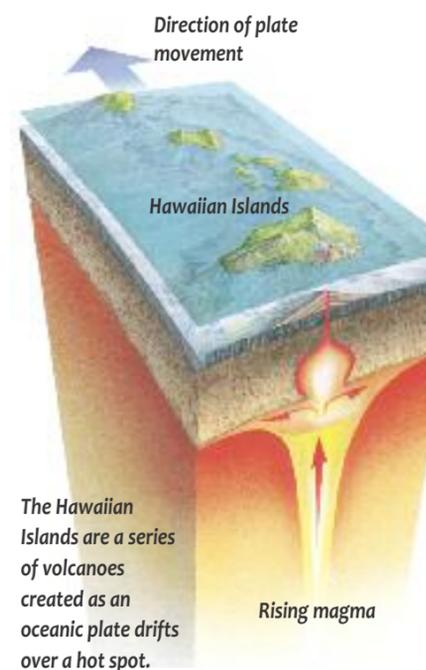


Undersea volcanoes on the mid-ocean ridge

Ring of Fire An area surrounding the Pacific Ocean where large numbers of earthquakes and volcanic eruptions occur. There are about 452 volcanoes in the Ring of Fire.

Shield volcano A large volcano with gently sloping sides. Shield volcanoes build up over time from repeated lava flows. They erupt thin, runny lava.

Silicates Types of mineral (17) that contain silicon and oxygen. Silicates make up more than 90% of the rocks in the Earth's crust. Thin, runny magmas consist of different types of silicates to those that make up thick, viscous magmas.



The Hawaiian Islands are a series of volcanoes created as an oceanic plate drifts over a hot spot.

Stratovolcano A tall, steep, cone-shaped volcano. Stratovolcanoes are formed from layers of volcanic lava, built up by multiple eruptions over hundreds of thousands of years. They erupt ash, pumice and thick, viscous lava. Stratovolcanoes are the most common type of volcano.

Tuff A type of rock made of volcanic ash welded together. It was used by the Romans to make many buildings and bridges, and by the natives of Easter Island to make their famous statues.

FACTFILE

- ★ The eruption in Tambora, Indonesia in 1815 killed about 92,000 people. The huge volume of ash in the atmosphere cooled the world climate for more than a year. It was called "the year without a summer".
- ★ The world "volcano" comes from the Italian island of Vulcano. Centuries ago, people believed that it was the chimney of the forge of Vulcan, the Roman god of life.
- ★ There are at least 1500 active volcanoes above sea level around the world. Indonesia has the most: 86 have erupted in its history.
- ★ One in 10 people live within "danger range" of a volcano.
- ★ Volcanic ash forms very fertile soil, so plants grow quickly after an eruption.
- ★ More than 80% of the Earth's surface is volcanic in origin. The ocean floor was formed entirely by lava from volcanic eruptions.
- ★ In 1943 a Mexican farmer watched an eruption in his field. He came back the next morning to find a volcanic cone 10 m high. It erupted repeatedly: after one year, the cone had grown to 336 m.

Vent An opening in the Earth's surface through which lava and gases seep out.

Viscosity A measure of the fluidity of magma and lava (and other liquids). Thick lava is more viscous than thin, runny lava.

MOUNTAINS & GLACIERS

A mountain is a high peak of land. A glacier is a moving mass of ice that is formed when layers of snow pile up and compress. The ice then starts to move under its own weight. Some glaciers snake down mountain valleys, while others are so huge and thick they almost totally cover the land.

Arête A narrow ridge between glacial valleys. It is formed when two glaciers carve out adjacent valleys.

Bergschrund A deep gap formed when a glacier pulls away from the solid, immobile wall of ice behind it.

Cirque A semicircular basin in a mountainside, from which compacted areas of snow spill out to form a glacier.

Crevasse A deep crack in a glacier. It is formed when ice splits as it moves over uneven rocks or turns a corner.

Dome mountain A mountain that is formed by molten rock pushing the rock above it into a large lump.

Drumlin A smooth, tear-shaped hill, formed when glaciers move over soft clay or gravel that has been deposited there by previous glaciers.

The peaks of the Rockies, a mountain range in North America (below)



Esker A narrow, winding ridge of gravel, deposited by meltwater streams running beneath a glacier.

Fjord A deep U-shaped valley that has been gouged out by a glacier and “drowned” by rising sea levels. There are many fjords on the coast of Norway and New Zealand.

Fold mountain A mountain that is formed when tectonic plates collide, squeezing layers of rock up into wrinkles.

Glacial erosion The gradual wearing down of the land by the movement of glaciers. Rocks and pebbles carried on the bottom and sides of a glacier scrape along the ground, acting like sandpaper.

Hanging valley A small glacial valley that joins a larger valley. The base of the smaller valley is much higher up than that of the main valley and so “hangs” over its side. Hanging valleys are formed by small, tributary glaciers flowing into larger glaciers.

Horst A block of land that is pushed upwards between two faults so that it is higher than the land around it. Horsts are sometimes called **block mountains**.

A fjord winds through the mountains of Norway.

Ice cap A large glacier that envelops an area of land. The tops of mountains may breach the surface of the ice.

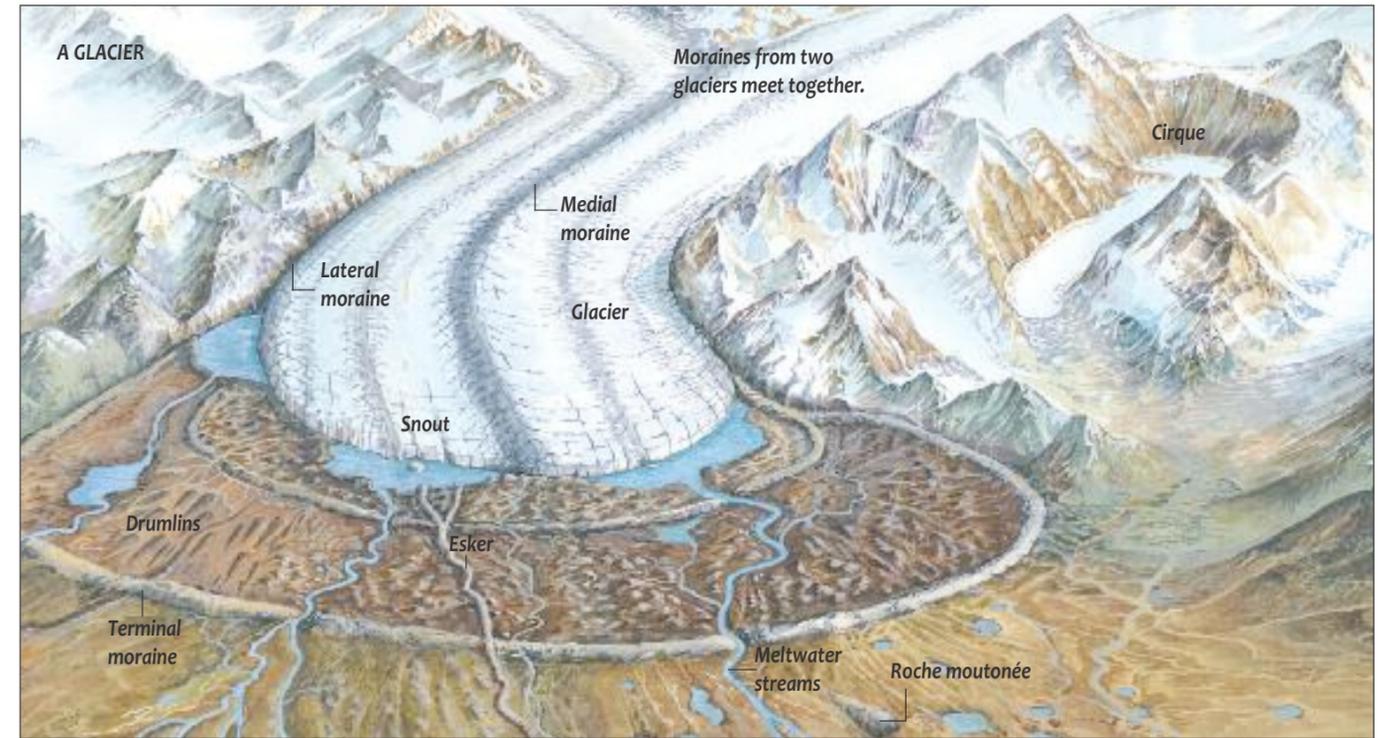
Ice sheet An ice cap that covers whole continents for a long period of time. Today the only ice sheets are in Greenland and Antarctica.

An iceberg



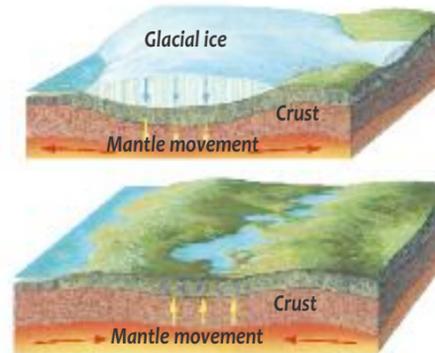
Ice shelf A large sheet of ice that extends out from the land to float on the sea.

Iceberg A large lump of ice floating in the sea. About 90% of it lies underwater. Arctic icebergs break away from glaciers. Antarctic icebergs break away from ice shelves and are often flat-topped.



Moraine The soil and rock carried and deposited by glaciers. **Lateral moraine** is the debris carried at the sides of a glacier. When two glaciers join, their lateral moraines form a **medial moraine** in the middle of the combined glacier. A **terminal moraine** is the ridge deposited at the end, or snout, of a glacier when it melts.

POST-GLACIAL REBOUND



Meltwater stream The water that comes from a melted glacier. Glacial meltwater may run under the glacier to form lakes in front of its snout.

Moulin A vertical hole through a glacier, carved out by meltwater trickling down through cracks in the surface of the ice.

Nunatak A mountain summit that pokes through the top of a glacier or ice cap.

Post-glacial rebound The rising up of land that has previously been pressed down by the weight of ice. For example, much of Scandinavia, which was covered by glaciers almost 20,000 years ago, is still rising by about 1 cm per year.

Randkluft A deep crack formed where a glacier pulls away from the wall of rock behind it.

Rift valley A valley with steep slopes on either side. Rift valleys (also known as **grabens**) are created when a strip of land slips down between two faults.

Roche moutonnée A smooth, tear-shaped mound of bedrock formed by glacial erosion.

Serac A large block of glacial ice that forms between two crevasses. Seracs are often unstable, and prone to collapsing. For this reason, they pose a great risk to mountaineers.

Snout The lowest point, or end, of a glacier, sometimes called its **terminus**.

Summit The highest point of a hill or mountain.

Tributary glacier A small glacier that leads into a larger one.

Valley A low area of land between mountains or hills. **Glacial valleys** are carved out by glacial erosion. **River valleys** are shaped by river erosion.

FACTFILE

★ Ice covers about 15 million square km, nearly one-tenth of the Earth's land surface.

★ The largest glacier in the world is Antarctica's Lambert Glacier, which is usually more than 500 km long.

★ The word iceberg comes from the German word *eisberg*, which means “ice mountain”.

★ The highest mountain in the world is Mt Everest on the Tibet-Nepal border. Its summit is 8848 m above sea level. Everest is part of the Himalayan range of mountains.

★ The highest mountain in the Solar System is Olympus Mons, on the planet Mars.

ROCKS

Rock is the hard substance that makes up the Earth's crust. Rocks lie beneath both the soil and the depths of the ocean. They are made up of a solid mixture of minerals, consisting of different chemical substances. There are many different kinds of rocks, but they can all be divided into three main groups. These are: igneous rocks, sedimentary rocks and metamorphic rocks.

Basalt A dark grey igneous rock. The entire ocean crust and much of the Earth's solid surface is made of basalt.

Batholith A large mass of igneous rock formed when an upwelling of magma spreads through rocks underground, but never reaches the surface. It may be revealed later when erosion wears away the rocks above it.

Bedrock The solid rock that lies beneath the soil.

Crystal A substance with a regular arrangement of atoms (the basic building blocks of matter). Crystals form when molten rock cools and solidifies. The more slowly the rock cools, the larger the crystals will be. If the rock cools too quickly the crystals may not have time to form.

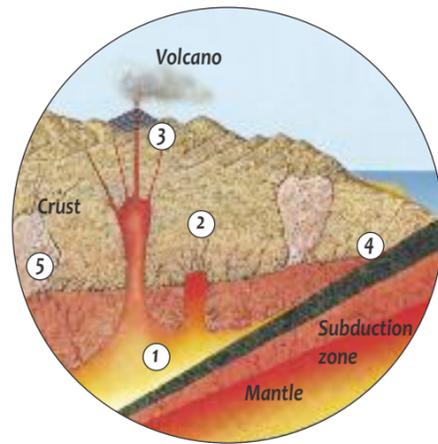
Dyke A sheet of rock formed by magma rising vertically through the Earth's crust and cutting across surrounding rock strata.

Erosion The transportation by water, wind or ice of rock fragments that have been broken down by weathering.

Gemstone A type of mineral that is valuable because it is rare and beautiful. **Diamonds, rubies and topaz** are all types of gemstone.

Granite A hard, pink-grey igneous rock, made up of large, clearly-visible crystals.

Igneous rock A type of rock formed when magma (♣13) rises to the Earth's surface and solidifies. Intrusive igneous rock, such as granite, is formed when magma solidifies beneath the ground. Extrusive igneous rock, such as basalt, is formed when it solidifies above the ground.



Certain conditions can make ordinary rocks change into gemstones. Diamonds form in the Earth's mantle (1). Rubies and sapphires occur in some metamorphic rocks (2). Amethyst forms in cooling volcanic rock (3). Jade (4) is produced in subduction zones (♣11), while topaz is found in granite (5).

Laccolith A dome of igneous rock that lies between layers of sedimentary rock. It is formed when magma pushes between the sedimentary rock strata.

Limestone A type of sedimentary rock, often made up of the remains of tiny sea creatures that lived millions of years ago. It is made up of calcium carbonate, which dissolves easily in water.

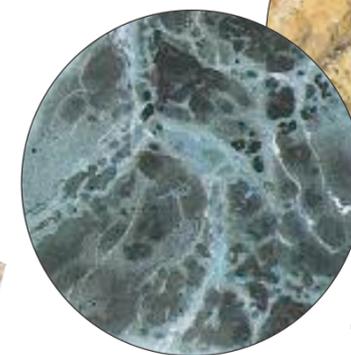
Marble A type of metamorphic rock formed when limestone is heated to high temperatures. Marble has a smooth structure and can be almost any colour from pink, to blue, to black.



The Giant's Causeway (above) is the result of lava cooling very slowly into large crystal shapes.

Metamorphic rock A rock that has changed due to intense heat and pressure underground. Sedimentary rocks, igneous rocks and other metamorphic rocks may all undergo this change. When a rock is changed in this way, its minerals recrystallize into different shapes.

Marble



Mineral A naturally occurring solid chemical substance. Rocks are made up of various different types of minerals, such as quartz, feldspar and mica.

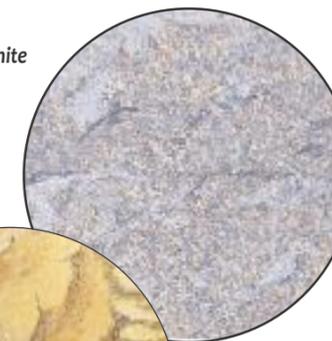
Moh's scale A scale used to measure how hard a mineral is, where 1 is the softest and 10 is the hardest.

Obsidian A dark, glassy rock formed when lava cools down so quickly that its minerals do not have time to crystallize.

Ore A rock that contains a metal.

Rock cycle The process by which rocks change from one type to another. Rocks on the surface of the Earth are constantly worn away by wind and rain. The fragments of rock left behind may be pressed together to make sedimentary rock or may be baked and compressed to form metamorphic rock. Alternatively, the molten rock may rise, cool and solidify to form igneous rock.

Granite



Limestone



Sandstone A sedimentary rock made up of grains of sand compressed and cemented together.

Sedimentary rock A type of rock that is formed by compressing rock fragments over millions of years. These fragments, such as sand, gravel and mud, are formed when other rock types are worn away by wind and rain. They settle in layers in lakes, rivers and seas. As the layers build up, the particles are compressed and cemented into sedimentary rock.

Sill A flat sheet of igneous rock formed as magma pushes through the Earth's crust and squeezes between older horizontal layers of rock.

FACTFILE

★ The oldest rocks on the Earth are about 3800 million years old.

★ Feldspar is the most commonly occurring mineral on the Earth.

★ Diamond is the hardest natural substance found on the Earth. It is a type of gemstone that is usually clear and colourless. Diamond forms when carbon, the element that makes up coal, is squeezed in the Earth's mantle.

★ The study of rocks is called petrology. It comes from the Greek words *petra*, meaning rock, and *logos*, meaning knowledge.



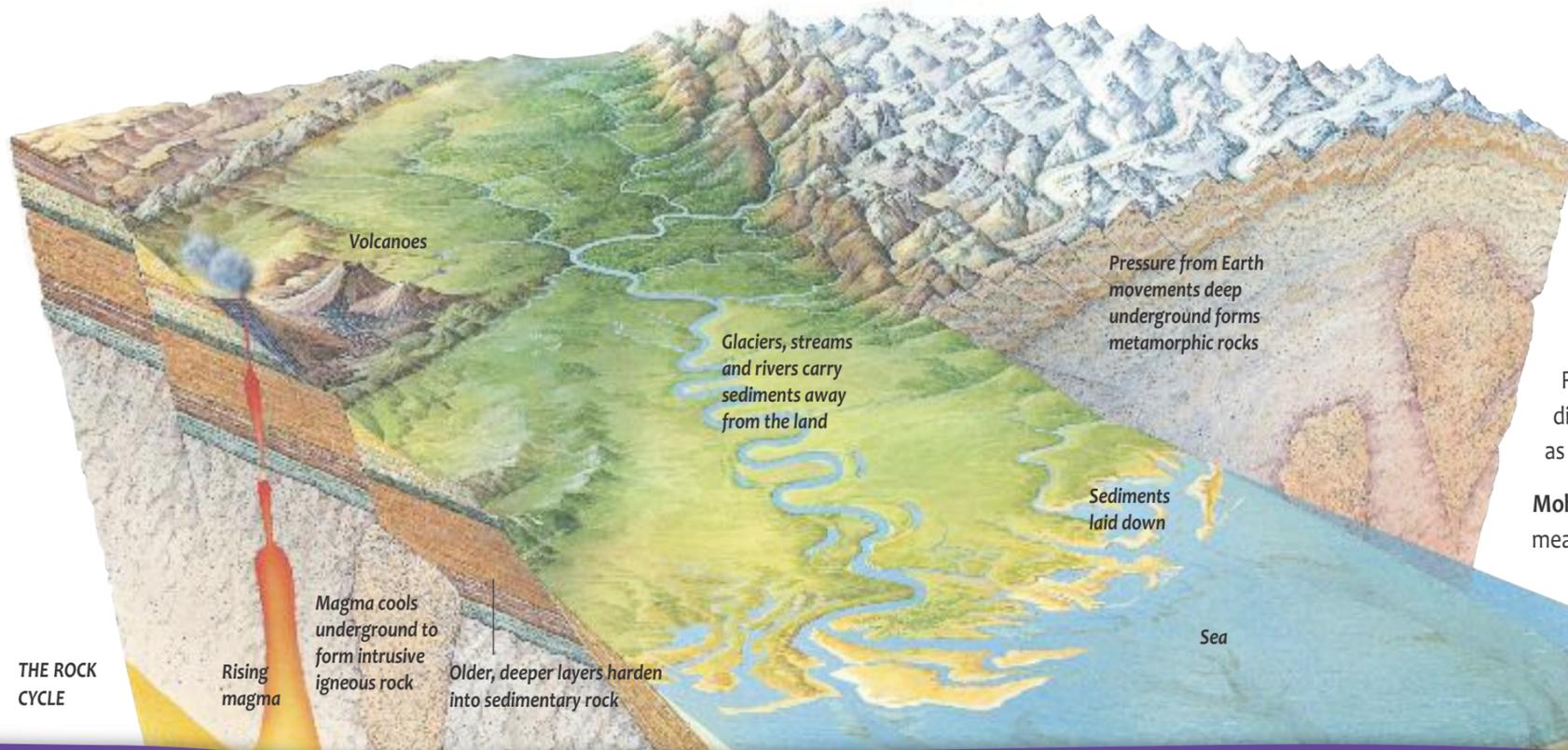
Diamond ring

Slate A dark grey metamorphic rock. The crystals that make it up are very flat, so slate easily splits into thin slabs. This makes it a useful material for tiling roofs.

Stratum A layer of rock. When a cliff face is exposed by erosion or faulting, different strata can often be seen in the rocks.

Weathering The breaking down of rocks due to the weather. Water seeps into tiny cracks in the ground and dissolves away the rock. In cold weather, ice forms in the cracks and expands, splitting off pieces of rock. Tree roots can make the rock break apart even faster.

Quartz (below) is a mineral made of silica found in rocks.



THE ROCK CYCLE

Rising magma

Magma cools underground to form intrusive igneous rock

Older, deeper layers harden into sedimentary rock

Glaciers, streams and rivers carry sediments away from the land

Sediments laid down

Sea

Pressure from Earth movements deep underground forms metamorphic rocks

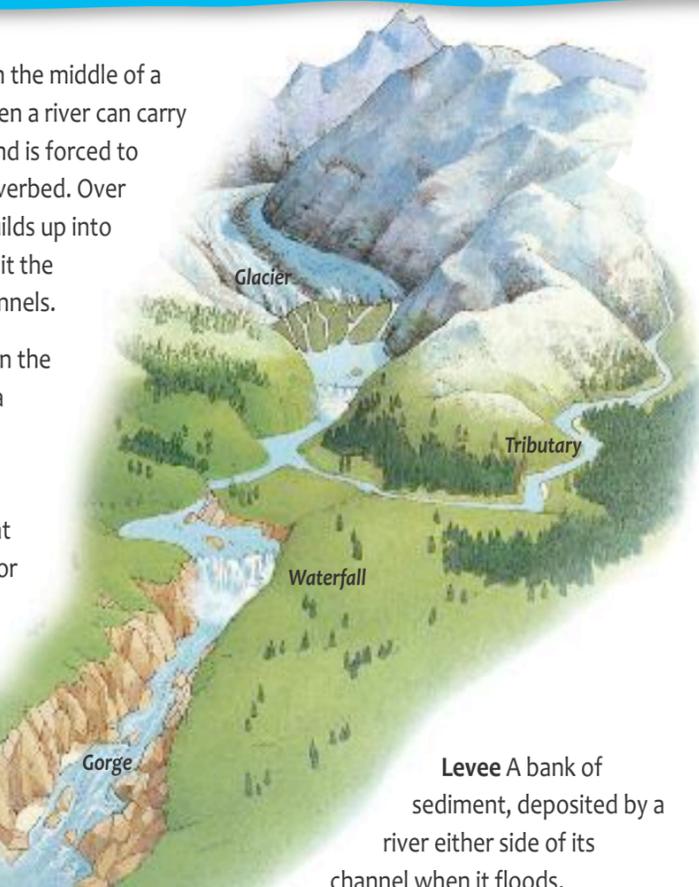
RIVERS & CAVES

A river is a natural channel of water that runs downhill. It starts as a spring, as melted water from a glacier (14), or as rainwater collecting on sodden ground. Near its source, river is a fast-flowing stream. Lower down it slows and widens as other streams join it. The river eventually flows into a lake or sea. A cave is an underground hole in the rock. Most caves are formed when streams or rivers, flowing below ground, hollows out soluble rocks, such as limestone.

Braid A small island in the middle of a river. Braids form when a river can carry no more sediment, and is forced to dump some on the riverbed. Over time the sediment builds up into braids. These may split the river into smaller channels.

Channel The groove in the ground along which a river flows.

Column A tall, thin formation of rock that joins the roof and floor of a cave. Columns are formed when a stalactite and stalagmite meet.



Levee A bank of sediment, deposited by a river either side of its channel when it floods.

Limestone cave A type of cave made in limestone rocks by a chemical process. Rainwater naturally contains tiny amounts of acid. When rain trickles into cracks in the rock it reacts with the rock made of soluble calcium carbonate to dissolve them away. Over thousands of years small cracks are widened into large caves.

Meander A curve or bend in a river. Meanders form when a river erodes sediments from one side of a bend and deposits them on the other side. This occurs because the water on the outside of the bend flows more quickly than the water on the inside. Over time this action increases the size of the bend.

Mouth The point where a river flows into a sea or lake.

Ox-bow lake A curved lake that was once part of a meander. It is formed when a river cuts through the land between two meanders in order to shorten its course. The old meander is cut off by sediments and becomes an ox-bow lake.

Confluence The point where two rivers meet.

Delta An area of land sometimes formed at the mouth of a river. Deltas develop when a river loses its speed and deposits its sediments. These form braids and divide the river into several channels.

Gorge A deep, steep-sided valley, sometimes called a canyon. Gorges may be cut into the ground by a river or may form when a cave roof collapses.

Lake A large, still, pool of water. Many lakes are filled by rivers. Some are filled by rain, or melted glaciers.



The Grand Canyon: the Colorado River once flowed across level ground (1), but as the land rose (2) it was forced to cut a deeper and deeper valley in order to maintain its course (3).

Plunge pool The deep pool at the base of a waterfall. It is carved out by the force of the falling water.

Rapids A fast-flowing, turbulent stretch of river. Rapids occur where the river is shallow and the riverbed slopes steeply.

River erosion The gradual wearing down of the land by a river. Rocks, sand and soil, carried away by the force of running water, scrape against the sides of the river, acting like sandpaper.

INSIDE A CAVE



Sediment Particles of soil, sand and mud that are moved from one point to another by water, wind or ice. Fast-flowing rivers can transport heavier sediment, such as gravel and rocks.

Source The point where a river begins, often high in the mountains or hills.

Spring A point where water gushes up from underground.

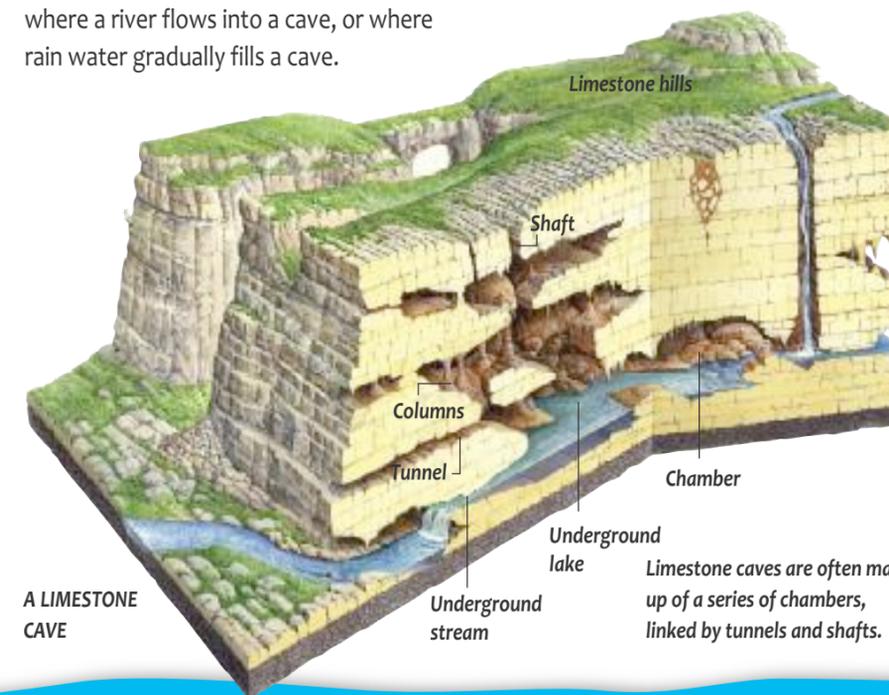
Stalactite An icicle-like formation of rock that hangs down from the ceiling of a cave. As water drips from the ceiling of a cave, the minerals dissolved in it harden very gradually into this shape.

Stalagmite A pointed column of rock that points upwards from the floor of a cave. It is formed from the drips falling from stalactites above it.

Stream A small, shallow flow of water.

Tributary A small river that flows into a larger river.

Underground lake A large pool of water beneath the Earth's surface. It forms where a river flows into a cave, or where rain water gradually fills a cave.



A LIMESTONE CAVE



Angel Falls

FACTFILE

★ The longest river in the world is the River Nile which runs through north Africa. It is 6695 km long from source to mouth.

★ The world delta comes from the Greek letter delta, Δ, which is the same shape as the River Nile delta.

★ Stalactites and stalagmites can reach 30 m in length.

★ The world's longest cave system is Mammoth Cave in Kentucky, America. It has 591 km of passageways on five separate levels.

★ The highest waterfall in the world is Angel Falls in Venezuela, South America. It is 979 m high.

Waterfall A cascade of water that occurs where a riverbed changes from hard to soft rock. The river wears away the softer rock more quickly, so a "lip" of hard rock forms on the riverbed, gradually becoming a cliff over which the river waters plunge.

Limestone caves are often made up of a series of chambers, linked by tunnels and shafts.

DESERTS

A desert is a dry area that receives less than 25 centimetres of rain per year. Most people think of deserts as vast sandy regions, but only 20 per cent of the world's deserts are sandy. The rest are bare rock, or covered with gravel. When rain does fall in occasional storms, there is no soil to soak it up so it quickly dries up. Some deserts are hot all year round and some are always cold. In many deserts, strong winds blast sand at the rocks, carving out amazing shapes.

Arid Very dry. Arid regions, such as deserts, have too little water to support plant life.

Barchan A crescent-shaped sand dune that slowly shifts along with the wind.

Butte A desert hill with very steep sides and a flat top. A butte is made up of hard rock that does not easily wear away. It is like a mesa but smaller.



Natural arch

Cold desert An area with less than 25 cm of snow or rainfall a year, and with an average temperature of less than 10°C. For example, Antarctica is a cold desert, as it receives very little snow.

Desert pavement A hard, thin desert surface of densely packed pebbles and rocks. Desert pavements form when sand and small rocks are blown away, leaving behind heavier lumps of rock.

Erg A flat, sandy area of desert.

Hamada A flat, rocky area of desert, with little or no sand covering.

Hoodoo A strangely shaped column of rock. Hoodoos are made up of layers of soft and hard rock, which the wind and sand erodes at different rates, producing bizarre shapes and colours, and sometimes a stripy appearance.

Hot desert An area with less than 25 cm of snow or rainfall a year, and with an average temperature of over 20°C. Hot deserts are cold at night because they do not have any cloud cover to trap heat.

Mesa A desert mountain with a flat top and very steep sides. Mesas are formed when layers of soft rock are worn away by wind and water, revealing a block of harder rock. Mesas take their name, the Spanish word for “tabletop”, from their distinctive, flat-topped appearance.

Natural arch A rock that is shaped like an arch. Natural arches form when the wind forces open a crack in a rock face.

Oasis A lush area of water and trees in the middle of a desert. An oasis forms where an underground river comes to the surface at a spring.

Plateau A flat, raised area of land. Plateaus form when the movement of tectonic plates (10) pushes up whole sections of flat rock. Buttes and mesas are both types of plateau.

Playa A flat, dried-up lake, sometimes called a **salina**. During a rare rainstorm, the playa may briefly fill up with rainwater.



The Olgas, in western Australia, are the result of extreme daily heating and cooling. These cause rock layers to flake away, leaving smooth, rounded blocks.

Rain shadow An area of land that receives little rain because it lies on the far side of a mountain range to the prevailing winds. Winds blow moist air over the mountains, where moisture condenses in the cold and falls as rain or snow. By the time wind reaches the far side of the mountains, it has lost most of its moisture.

Salt flat A layer of salt crystals that forms in a dried-out lake. During a brief rainstorm, salts in the rocks of the desert dissolve in the warm rainwater. A pool of water may collect in an area of low ground. When it dries out, a layer of salt is left behind. After each rainfall the layer of salt becomes thicker.

Sand Tiny pieces of rock. Sand is formed when larger rocks are worn down by wind and rain.

Sand dune A heap, or bank, of sand that has been shaped by the wind. Sand dunes form where sand, blown by the wind, is stopped by an obstacle, such as a boulder, a plant or a change in the shape of the shape of the land.

Wadi A steep-sided gorge. It is formed when fast-flowing water from rare rainstorms wears away desert rocks.

Wind erosion The gradual wearing away of the land caused by the wind. Wind erosion gradually blows away soil and sand. Strong winds may hurl sand against rocky surfaces, where it acts like sandpaper, wearing away the rock.



A rock formation in the Valley of Fire park in America (above). The park is named after its distinctive bright red sandstone. Monument Valley in America (below) has many flat-topped buttes and mesas.

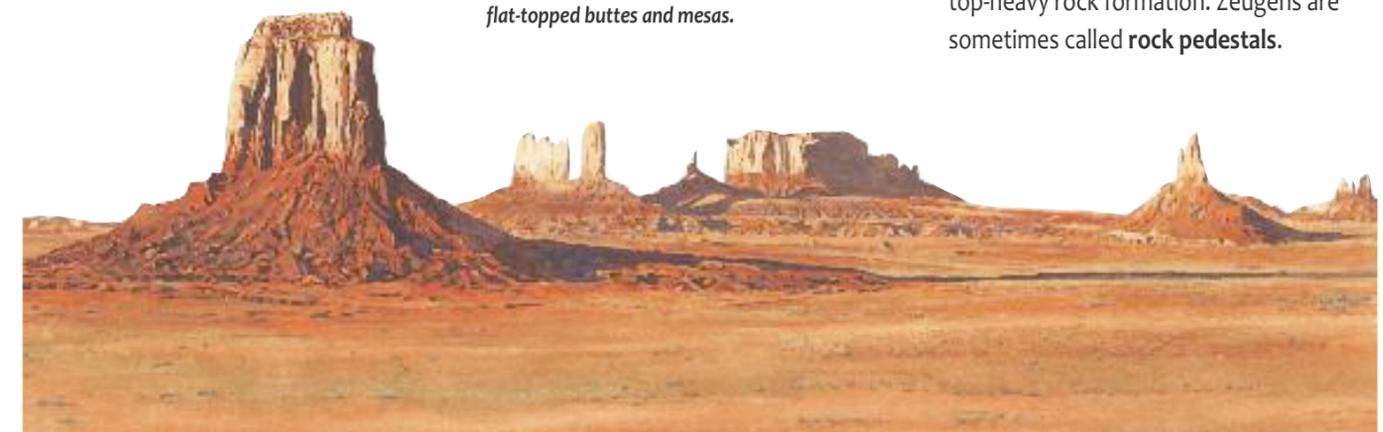
FACTFILE

- ★ Deserts and arid regions cover one-eighth of the world's land area.
- ★ The largest hot desert in the world is the Sahara in Africa, which is over 5000 km wide and covers 9 million square km.
- ★ Antarctica is the largest desert in the world. It covers over 13 million square km. It receives very little snow each year—the equivalent of just 5 cm of rain.
- ★ The continent with the largest proportion of desert—about one half its area—is Australia.
- ★ The driest desert is the Atacama in Chile, South America, with an average of less than 1 mm of rain per year.
- ★ “Hot” deserts can be bitterly cold at night. The Takla Makan Desert in China can be a scorching 40°C by day yet plunge to temperatures of -40°C at night.

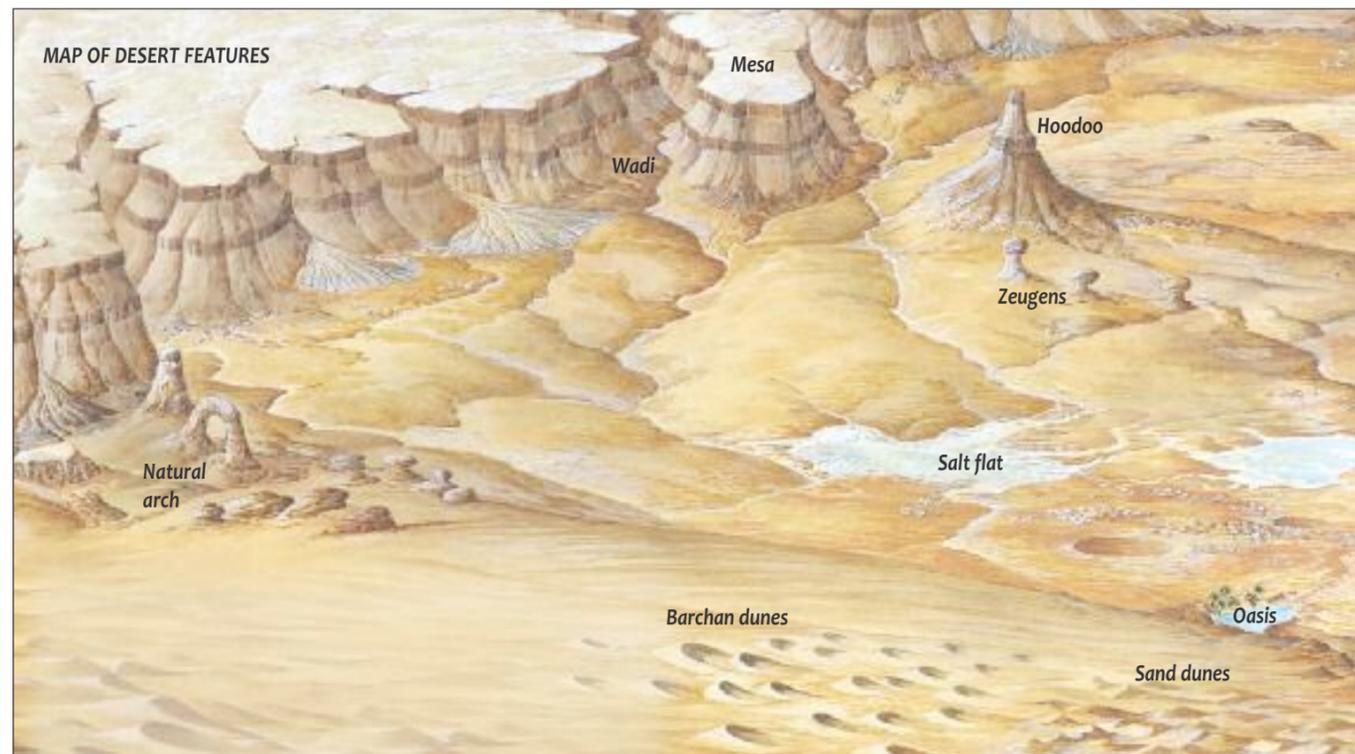


An oasis

Zeugen A mushroom-shaped rock in the desert. It is formed by wind erosion. Most of the sand carried by the wind is found about a metre above the ground. Zeugens form when wind-blown sand blasts away the base of a boulder, leaving a narrow, top-heavy rock formation. Zeugens are sometimes called **rock pedestals**.



MAP OF DESERT FEATURES



OCEANS

More than two-thirds of the Earth's surface is covered by vast expanses of salty water called oceans. The Earth has five oceans: the Pacific, the Atlantic, the Indian, the Arctic and the Southern. Areas of the oceans that are partly enclosed by land are called seas. The ocean floor lies at an average depth of around 4500 metres. It is mostly made up of the flat abyssal plain. Rising from the abyssal plain are mountains, volcanoes and ridges. In some places, deep trenches plummet deep into the plain.

Abyssal plain A flat region of the ocean floor that lies 4000-5000 m below the ocean's surface. It forms about 40% of the Earth's surface.



OCEAN CURRENTS (above): red arrows show warm ocean currents; blue arrows show cold currents.

Atoll A ring of coral islands. An atoll forms where a coral reef has grown around a volcanic island (♣12). When the volcano becomes extinct, it will sink back into the ocean floor. If it does this slowly, the coral reef will keep growing upwards. When the island disappears, the atoll is all that remains.

Black smoker A dark, rocky chimney, several metres high, found near hydrothermal vents. It emits mineral-rich water from beneath the Earth's crust.

Continental rise The gentle slope that leads from the steeper continental slope down to the flat abyssal plain.

Continental shelf The part of a continent that lies beneath ocean waters. It is no more than 200 m deep.

Continental slope The outer edge of the continental shelf that plunges down towards the abyssal plain.

Coral reef An underwater structure formed from the hard skeletons of tiny animals called polyps. Coral reefs are found in warm, clear, shallow waters.

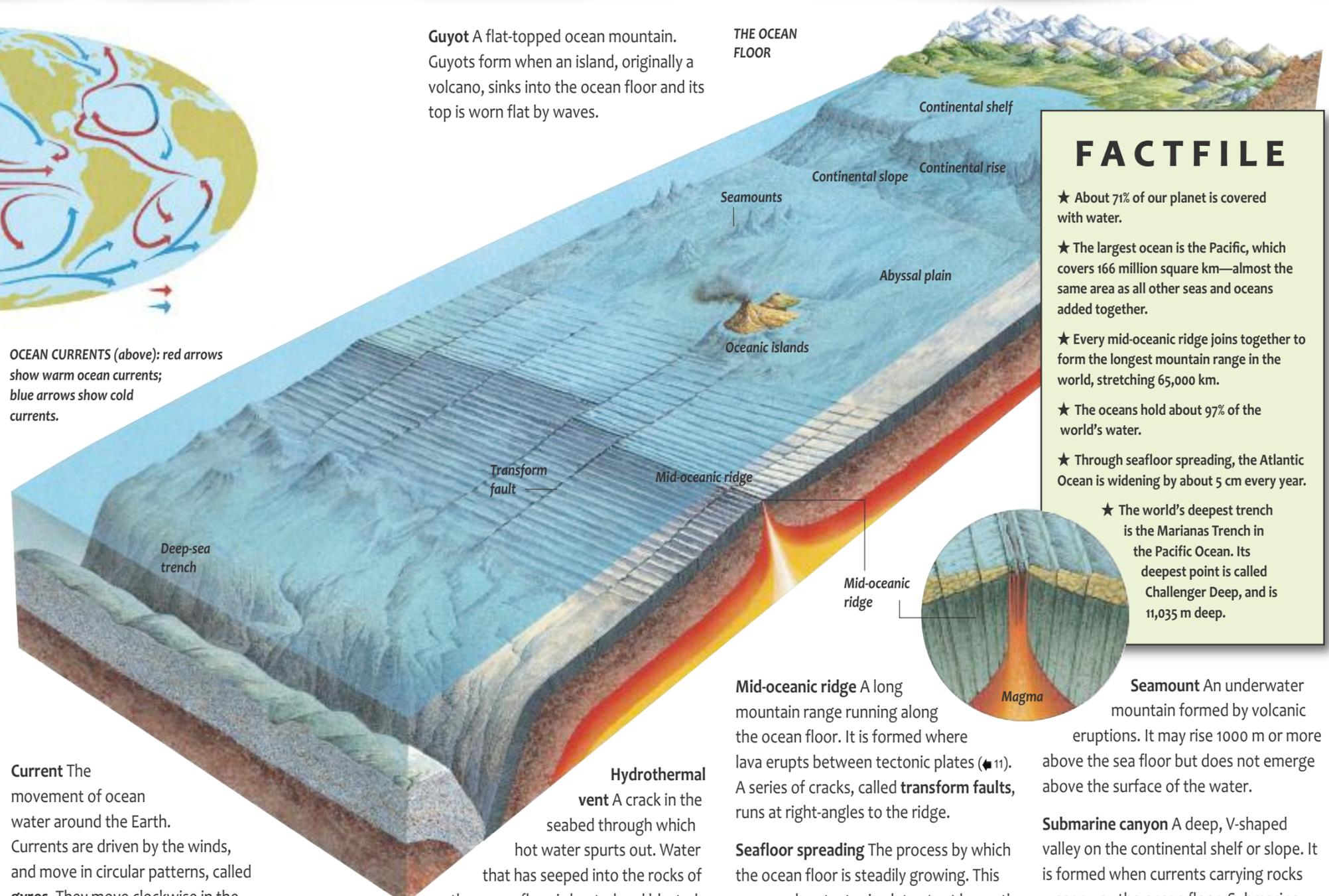
Current The movement of ocean water around the Earth. Currents are driven by the winds, and move in circular patterns, called **gyres**. They move clockwise in the northern hemisphere and anticlockwise in the southern hemisphere (♣28).

Deep-sea trench A long, very deep valley in the seabed, plunging to depths of 6000-10,000 m. Deep-sea trenches occur where two tectonic plates push together, forcing one plate underneath the other one (♣10).

Gulf Stream A warm current that flows north-east from North America to northern Europe. It brings mild, wet weather to north-west Europe.

Guyot A flat-topped ocean mountain. Guyots form when an island, originally a volcano, sinks into the ocean floor and its top is worn flat by waves.

THE OCEAN FLOOR



FACTFILE

- ★ About 71% of our planet is covered with water.
- ★ The largest ocean is the Pacific, which covers 166 million square km—almost the same area as all other seas and oceans added together.
- ★ Every mid-oceanic ridge joins together to form the longest mountain range in the world, stretching 65,000 km.
- ★ The oceans hold about 97% of the world's water.
- ★ Through seafloor spreading, the Atlantic Ocean is widening by about 5 cm every year.
- ★ The world's deepest trench is the Marianas Trench in the Pacific Ocean. Its deepest point is called Challenger Deep, and is 11,035 m deep.

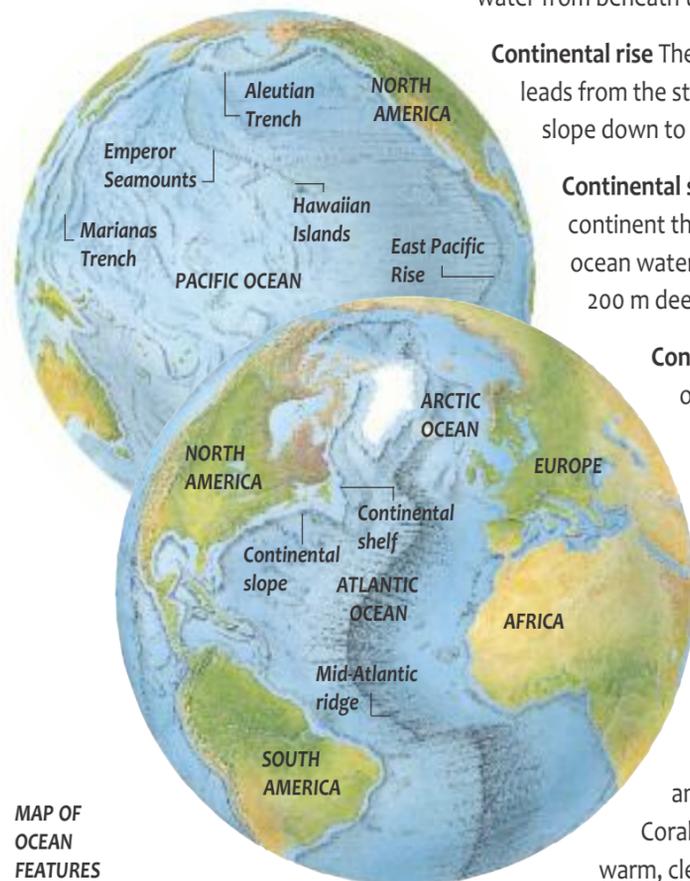
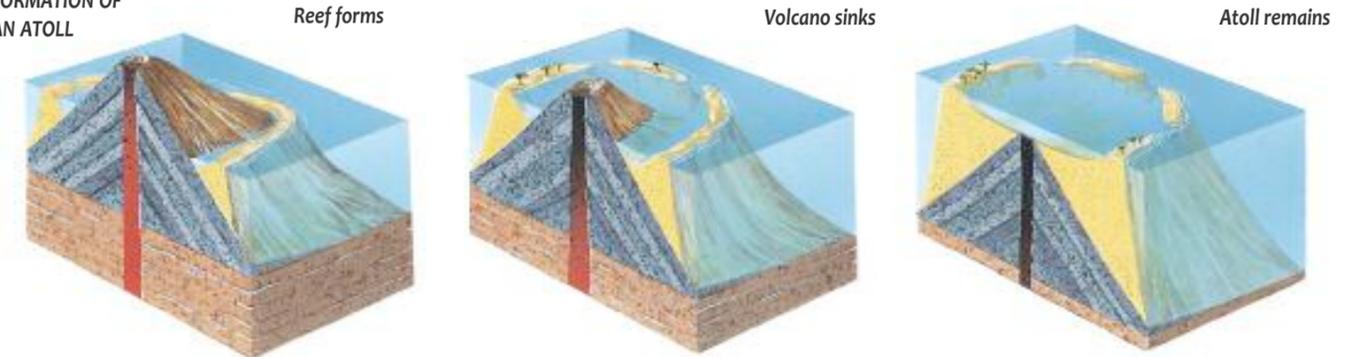
Mid-oceanic ridge A long mountain range running along the ocean floor. It is formed where lava erupts between tectonic plates (♣11). A series of cracks, called **transform faults**, runs at right-angles to the ridge.

Seafloor spreading The process by which the ocean floor is steadily growing. This occurs when tectonic plates (♣11) beneath the ocean pull apart. Molten rock wells up in the gap, forming new ocean floor.

Seamount An underwater mountain formed by volcanic eruptions. It may rise 1000 m or more above the sea floor but does not emerge above the surface of the water.

Submarine canyon A deep, V-shaped valley on the continental shelf or slope. It is formed when currents carrying rocks wear away the ocean floor. Submarine canyons are often found near the mouths of large rivers.

FORMATION OF AN ATOLL



MAP OF OCEAN FEATURES

COAST

The coast, or seashore, is the place where land meets sea. It can take the form of rocky cliffs, beaches or marshy wetlands. The shape and features of a coastline depend on its rocks, winds and currents. As powerful waves crash against cliffs, they gradually wear away the rocks, sometimes carving out caves, or stone arches. When pieces of rock fall into the sea, the waves grind them down into pebbles or sand and lay them down in sheltered places to form beaches.

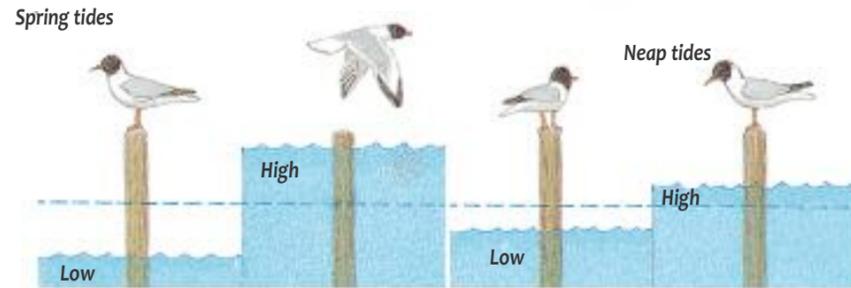
Bar A mound of sand and pebbles that builds up offshore. It is formed by waves and currents moving sand from one place to another.

Bay A wide, curving area of sea between two headlands. Bays form where soft rock has been worn away by the sea.

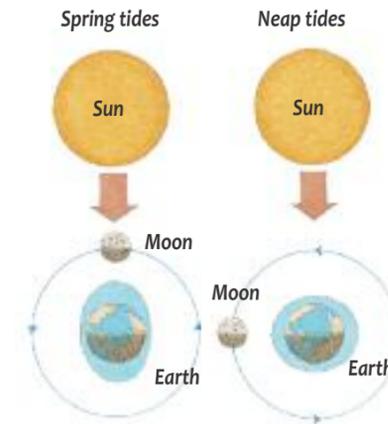
Beach An area of sand or pebbles on the seashore. Beaches are formed when waves wear cliffs down into sand and pebbles, which they then pile up on the **wave-cut platform**, the flat area between the cliff and the sea.

Blowhole A hole in the top of a sea cave. When waves pound at the cave, they push water and air up through the blowhole. It bursts out above the ground as a spray of water.

Cliff A steep, nearly vertical, wall of rock, often found along coastlines. Cliffs are shaped both by the waves and by rockfalls and landslides.



Coastal erosion The gradual wearing down of the coast by waves and the wind. Waves pick up rocks from the bottom of the sea and hurl them at the cliffs, knocking off fragments of rock. Sometimes air is trapped between a wave and a rock face. The force of the wave pushes the air into cracks in the rock, making the rock split open further.



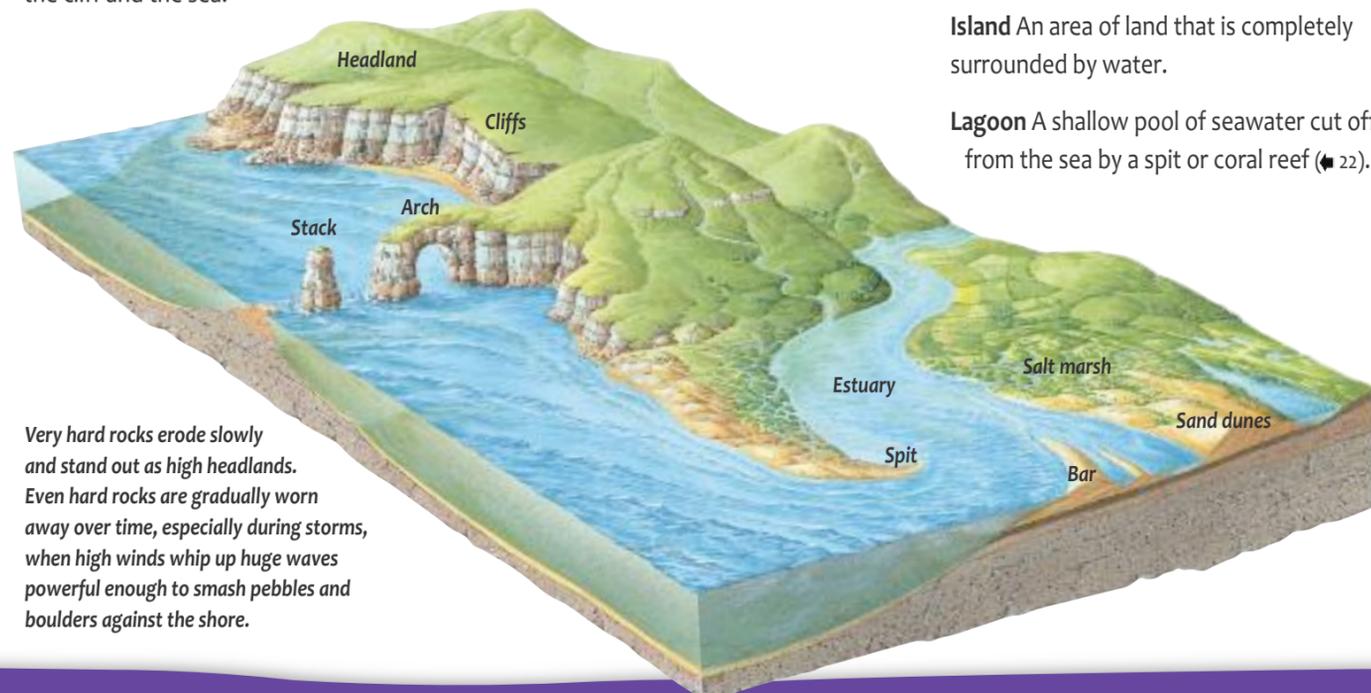
Estuary The wide part of a river near its mouth where it meets the sea and fresh and salt water mix.

Headland An area of land that projects out into the sea. It is sometimes called a **promontory**. It is formed from hard rock that resists coastal erosion.

Intertidal zone The part of the coast that is submerged by the sea during high tide and is exposed to the air during low tide.

Island An area of land that is completely surrounded by water.

Lagoon A shallow pool of seawater cut off from the sea by a spit or coral reef (22).



Very hard rocks erode slowly and stand out as high headlands. Even hard rocks are gradually worn away over time, especially during storms, when high winds whip up huge waves powerful enough to smash pebbles and boulders against the shore.



Longshore drift The sideways movement of sand and pebbles along the coast. It is caused by waves hitting the shore at an angle instead of head-on.

Neap tide A tide with a very small difference between high and low tide. Neap tides occur when there is a quarter Moon. The Sun and Moon are at right angles to one another, pulling in different directions, so that the force of their pull on the tides is lessened.

Pebble A small, round rock. Pebbles are formed when rocks that fall into the sea are worn down and smoothed by waves.

Peninsula An area of land that extends into the sea with water on three of its sides.

Salt marsh A low-lying area of coastline that is often flooded by the sea. Salt marshes usually form in sheltered areas, such as deltas. They are home to grasses and shrubs that grow in salt water.

Sea arch A section of headland that is shaped like an arch. A sea arch is formed when a sea cave is gouged through.

Sea cave A cave near the base of a cliff. Sea caves form when the sea crashes against cracks in a cliff's surface, pushing water and air into the cracks and forcing them to open wider.

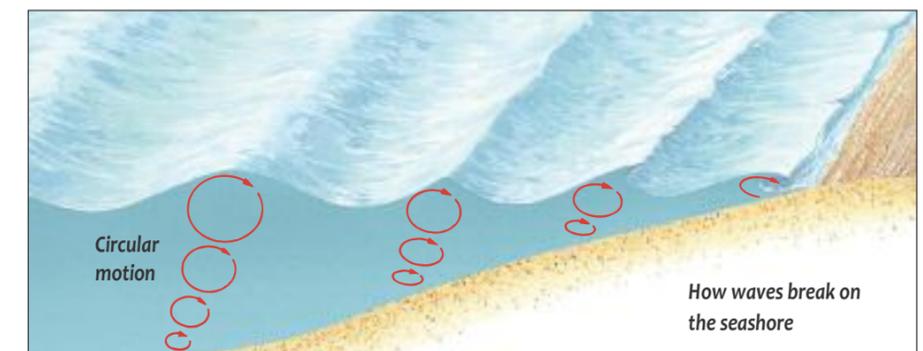
The twelve apostles are a set of giant rock stacks that line part of the coast in Victoria, Australia.

Spit A mound of sand or pebbles that extends out from the land into the sea. Spits are formed by currents that carry sand and shingle along the coast. When the current's path is interrupted, by meeting a headland or entering an estuary, the current weakens and drops the sediment.

Spring tide A tide with a very large difference between high tide and low tide. Spring tides occur when the Sun and Moon are in line. The Sun's gravity combines with that of the Moon to increase the pull on the water.

Stack A column of rock, created when the roof of a sea arch collapses, leaving one side of the arch standing alone.

Strait A narrow stretch of sea between two areas of land.



FACTFILE

★ The highest coastal cliff in the world is on the east coast of Moloka'i in Hawaii. The cliffs are 1010 m high.

★ The largest lagoon in the world is in Lagoa dos Patos in southern Brazil. It is 280 km long and is separated from the Atlantic Ocean by a sand bar about 5 km wide.

★ The tallest sea stack in the world is Ball's Pyramid in the Pacific Ocean. It is 562 m tall and is named after its pyramid shape.

★ The highest tidal range in the world occurs in the Bay of Fundy, a strip of water that lies between Nova Scotia in Canada and Maine in the United States of America. The sea level here changes by up to 16 m during one tidal cycle.

Tide The rise and fall of the sea usually every 12 hours 30 minutes. Tides are caused by the gravitational pull of the Sun and Moon. Ocean waters on the side of the Earth closest to the Moon (and the opposite side) bulge outwards, causing a high tide. At the same time, the rest of the Earth has a low tide. The Sun may either increase or lessen the effect of the Moon.

Wave The surging motion of the sea as it approaches the shore. Waves are caused by wind moving over the surface of the ocean. The water itself does not move but spins around on the spot. When a wave approaches the shore, the lower part drags on the seabed, while the upper part moves on. Eventually it topples over, or breaks, on the shore.

WEATHER

Weather describes the conditions and changes that take place in the lower atmosphere (p.28), up to about 20 kilometres above the Earth's atmosphere. It includes temperature, wind speed and direction, cloud type and cover, rain, hail, snow, frost, ice, drought and storms. The study of the weather is called meteorology.

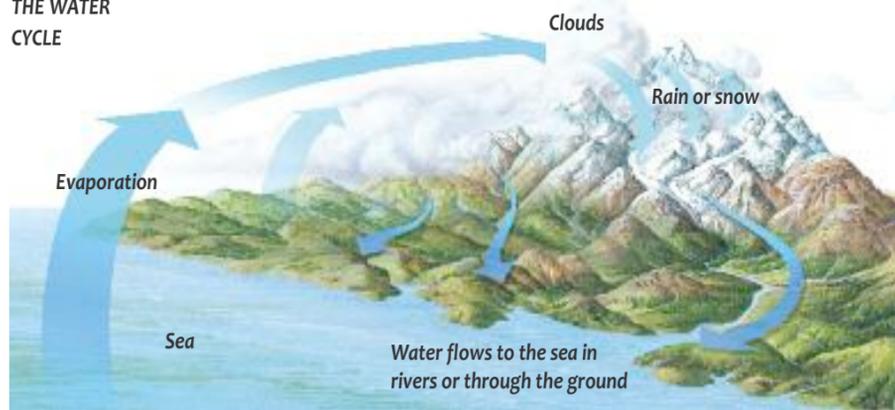
Air The mixture of gases, mostly nitrogen and oxygen, that surrounds the Earth.

Air mass A large body of air of a similar temperature and moisture content. Air masses are separated by fronts.

Air pressure The weight of air pressing down on the Earth. Air pressure is low where air masses are rising. The rising air will cool and condense, forming rain clouds. Pressure is higher where air masses are sinking. High air pressure is usually accompanied by dry weather.

Barometer An instrument that measures air pressure.

THE WATER CYCLE



Beaufort Scale A scale used to measure the strength of the wind, where 0 is complete calm and 12 is a hurricane.

Cloud A visible cluster of water droplets, ice crystals or both. The droplets are so small that they can remain in the air. Different types of cloud form at different heights and under different conditions.

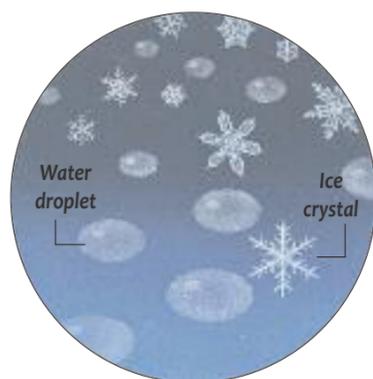
Condensation The process of a gas changing into a liquid when it is cooled. Water vapour condenses more easily if the air contains small particles, such as dust, salt or smoke for it to collect around.

Dew Droplets of water that cover the ground overnight. Dew forms when the ground cools down faster than the air, causing moisture in the air to condense.

Drought A period where there is significantly less rainfall than normal.

Evaporation The process in which a liquid changes into a gas when it is heated up or when the air above it is dry.

Flood An overflow of water on to areas of surrounding land. Flooding is usually caused by particularly heavy rain swelling the level of water in river channels. The rivers burst their banks and flood the land.



Fog A thick layer of cloud-like moisture formed by water vapour cooling at ground level. Fog is thicker than mist.

Front A boundary between two air masses. A warm front occurs when warm air flows up and over colder, heavier air. This makes the moisture in the rising air condense and fall as rain. A cold front occurs when cold air pushes against warm air, forcing it upwards where it forms clouds.

Frost A thin layer of sparkling ice crystals that forms when the air is below freezing and dew freezes on the ground.

Hail Precipitation that falls as ice. Hail forms in large cumulonimbus clouds where water droplets are tossed about by strong upward-moving air currents. Each time a raindrop is pushed into the freezing top of the cloud a thin layer of ice forms around it. When the drop is too heavy to be lifted by the currents, it will fall to the ground.

Humidity The level of moisture in the air. Air with lots of water molecules in it is very humid. Warm air can hold more moisture than cool air.

Hurricane A massive, spinning storm of wind and rain. Hurricanes form when warm, moist air from the oceans is stirred up into a huge, spinning mass. Strong winds and rain swirl around a calm centre, the "eye" of the storm. The spiralling winds are caused by the force of the Earth rotating on its axis.

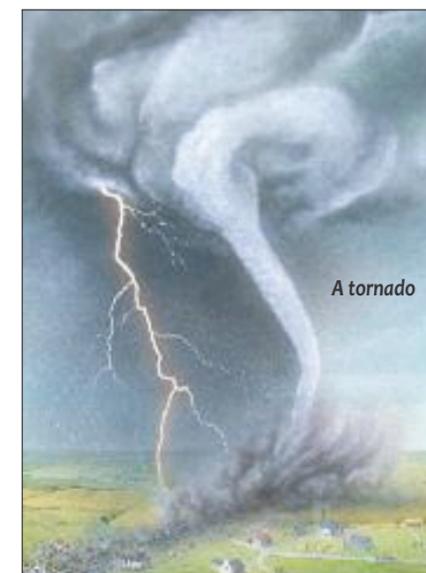


A hurricane easily tosses a car across a field.

Lightning A visible spark of electricity produced during a thunderstorm. Electricity can build up inside clouds when ice and water molecules bump against each other and become electrically charged. The light we see is a strip of air being suddenly heated by the electricity. **Fork lightning** travels from clouds to the ground. **Sheet lightning** occurs within clouds.

Mist A thin layer of cloud lying at ground level. Mist is thinner than fog.

Precipitation Water that falls in the form of rain, hail, sleet or snow. The temperature inside and outside a cloud determines which form it will take.



A tornado

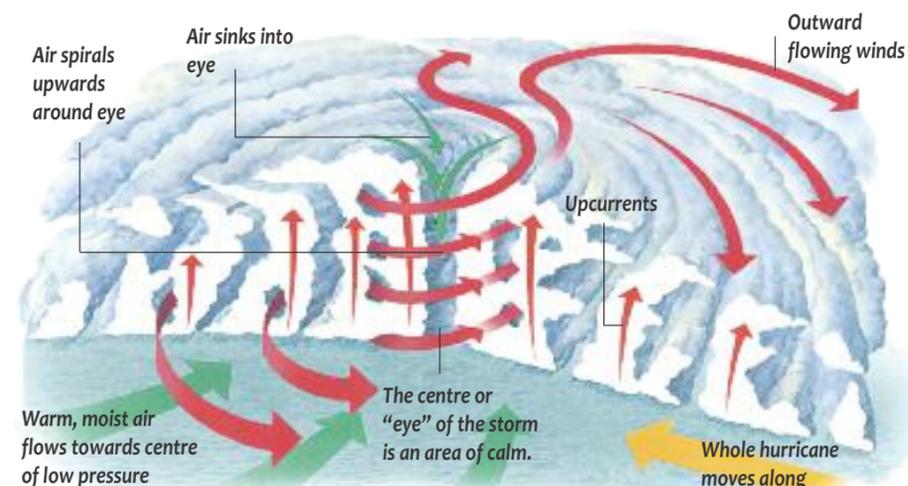
Rain Liquid water that falls from clouds.

Rainbow An arch of colours in the sky that forms when the Sun shines from behind you at rain falling in front of you. The raindrops split the light into all the different colours of the spectrum.

Sleet Snow that falls through warm air and is partially melted when it reaches the ground.

Snow Precipitation that falls to the ground as clumps of ice crystals, called snowflakes. All snowflakes have six sides, but no two are exactly alike.

Thunder The loud sound that accompanies a flash of lightning. The heat of the flash makes the air around it expand so fast it makes a loud boom.



FACTFILE

★ Lightning heats the air to around 30,000°C—five times the temperature on the surface of the Sun.

★ The winds inside a tornado are the fastest winds ever recorded on Earth. They can travel at speeds of up to 500 km/h.

★ Spinning, circular storms are known as hurricanes in the Caribbean, the north Atlantic and the north east Pacific oceans. In the west Pacific Ocean they are known as typhoons, and in the Indian Ocean they are known as cyclones.

★ The heaviest ever hailstone weighed about 1 kg. It fell in Bangladesh in 1986.

Tornado A twisting column of air that extends from the base of a cloud to the ground, like an upside-down funnel. Its winds are so powerful, it can pick up people, cars and even houses.

Water cycle The process by which water circulates from the land or oceans to the atmosphere and back again. When it is warmed by the Sun, water evaporates and rises. As it does so it cools and condenses, forming clouds. Rain and snow fall to the ground, where it flows into rivers, lakes and seas and the cycle continues.

Wind Air moving from one place to another. The Sun makes some regions of air warmer than others. When warm air rises, cooler air flows in to take its place.

ATMOSPHERE, SEASONS & CLIMATE

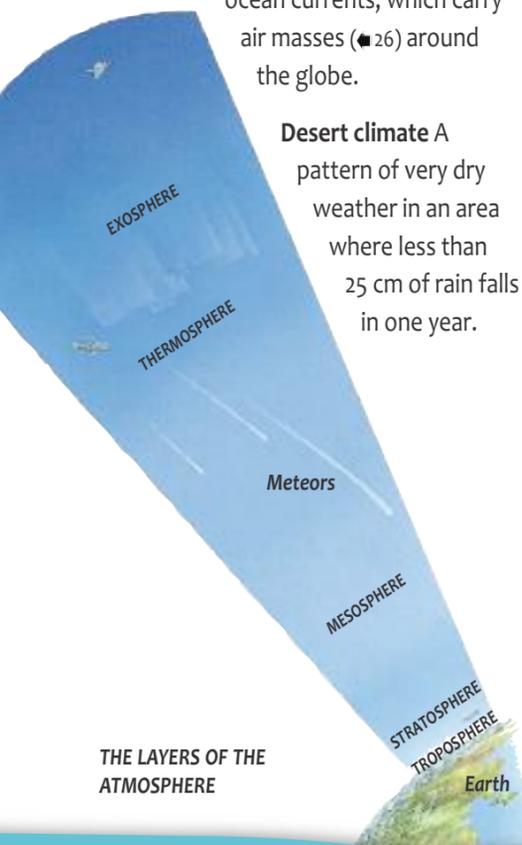
The atmosphere is the blanket of gases surrounding the Earth. It has several different layers. About 800 kilometres above the ground, the atmosphere fades away completely and space begins. The seasons are time periods in the year, marked by changes in the weather. The climate is the pattern of weather over a long period.

Altitude Height above sea level.

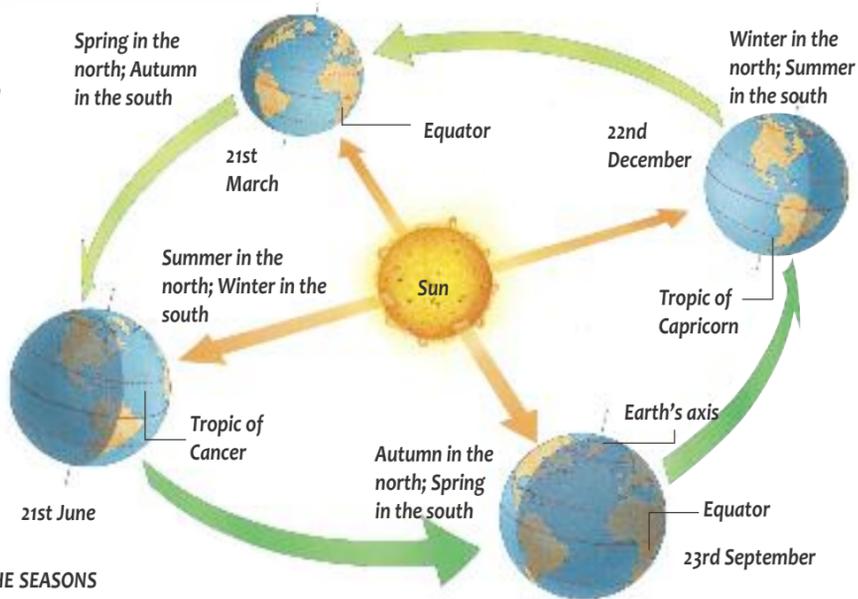
Atmosphere The blanket of gases surrounding the Earth.

Climate A long-term pattern of weather. An area's climate mainly depends on its location on the Earth's surface, but is also affected by altitude, and by winds and ocean currents, which carry air masses around the globe.

Desert climate A pattern of very dry weather in an area where less than 25 cm of rain falls in one year.



THE LAYERS OF THE ATMOSPHERE



THE SEASONS

Dry season A long period of very dry weather. It is one of two seasons that occur in tropical climates.

El Niño A climate pattern that occurs off the west coast of South America every four to seven years. Ocean currents change and warm water moves east. The air above the ocean is warmed, causing rain and storms. More distant areas may suffer droughts as a result.

Equator An imaginary line that runs horizontally around the centre of the Earth.

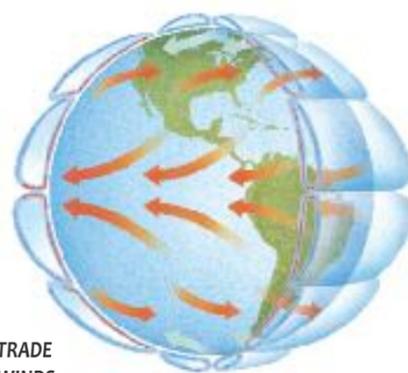
Exosphere The outermost layer of the atmosphere about 900 km above us. The air in the exosphere is so thin that one particle of gas may travel hundreds of kilometres before hitting another particle.

Hemisphere One half of the Earth's surface. The equator divides the Earth into northern and southern hemispheres.

Mesosphere The layer of the atmosphere 50-80 km above ground level, between the stratosphere and thermosphere. This layer is where meteors burn up.

Microclimate The climate of a particular local area. For example, towns are often warmer than the countryside around them. This is because concrete absorbs heat in the day and releases it through the night.

Monsoon Winds that change direction between summer and winter. In summer the winds bring torrential rain with them. Monsoons occur where there are great differences in temperature between oceans and land.



TRADE WINDS

Mountain climate A pattern of cold, windy weather that occurs in mountainous regions.

Ozone layer A thin layer of ozone gas that is found in the stratosphere. It absorbs 97-99% of the Sun's ultraviolet rays.

Polar climate A pattern of cold, dry, windy weather that occurs near the poles.

Seasons Time periods in the year, marked by changes in the weather. The seasons occur because the Earth is tilted on its axis. The half of Earth tilted towards the Sun has summer, while the other half has winter.

- Tropical
- Desert
- Temperate
- Cool temperate
- Polar
- Mountain

MAP OF CLIMATE ZONES



Stratosphere The layer of the atmosphere that lies 11-50 km above the ground, between the troposphere and mesosphere. Jet planes sometimes fly in this layer to avoid storms in the troposphere.

Temperate climate A pattern of weather with warm summers and cool winters.

Thermosphere The layer of the atmosphere that lies 80-140 km above the ground, between the mesosphere and exosphere. Temperatures can rise to 1400°C due to the Sun heating the thin air.

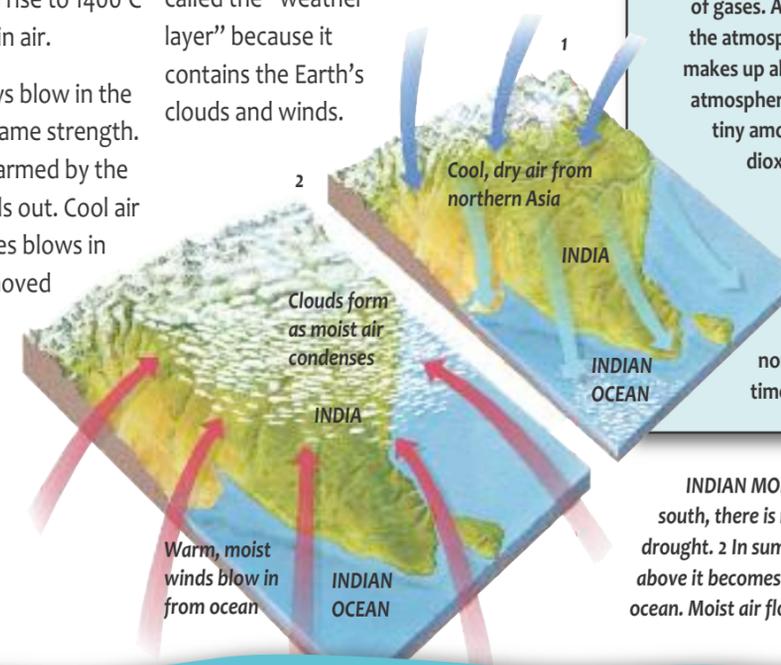
Trade winds Winds that always blow in the same direction and with the same strength. Near the equator, the air is warmed by the Sun so that it rises and spreads out. Cool air from the north and south poles blows in to replace it. The winds are shoved sideways by the Earth's rotation so that they always travel slightly east or west.

Tropic of Cancer An imaginary line that runs around the Earth between the equator and the north pole.

Tropic of Capricorn An imaginary line that runs around the Earth between the equator and the south pole.

Tropical climate A pattern of hot, wet weather throughout the year. Tropical regions lie close to the equator where the Sun shines directly overhead. There are only two seasons: wet and dry.

Troposphere The layer of the atmosphere that is closest to the Earth. It is sometimes called the "weather layer" because it contains the Earth's clouds and winds.



Wet season A long period of very wet weather. It is one of two seasons that occur in tropical climates, where it is dry for half the year and wet for the other half.

FACTFILE

- ★ The troposphere contains 99% of the water vapour in the atmosphere.
- ★ This air in the atmosphere is a mixture of gases. About four-fifths of the air in the atmosphere is nitrogen. Oxygen makes up about one-fifth of the atmosphere. The rest is made up of tiny amounts of argon, carbon dioxide, hydrogen, ozone and water vapour.
- ★ El Niño is Spanish for "the Christ Child", named because the weather change normally occurs around the time of Christmas.

INDIAN MONSOON: 1 In winter, dry air flows south, there is no moisture and there is drought. 2 In summer, the land heats, and the air above it becomes warmer than the air over the ocean. Moist air flows in, bringing heavy rains.

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