HOW THE WORLD WORKS

Discover
our amazing planet
and its wonders!

What on Earth happened?

We live on a unique planet, which travels around one of billions of stars in our Universe. But how did it all begin? Astronomers think that 13.7 billion years ago, the whole Universe emerged from a tiny invisible dot. Mind-boggling, isn't it?

The Sun

The Sun is the closest star to us and is at the centre of our Solar System. It is a massive ball of burning gas that produces light and heat. Without the Sun, there would be no life on Earth.

The planets

Eight planets travel around, or orbit, the Sun at different speeds, rotating like spinning tops. The four planets closest to the Sun, including Earth, are made of rocks and metals. The four outer planets are bigger and are made of gas.

So, which planet is which?
1. Mercury 2. Venus 3. Earth 4. Mars 5. Jupiter 6. Saturn 7. Uranus 8. Neptune

Asteroids

Asteroids are chunks of rock left over from the formation of the Solar System. Millions travel around the Sun between Mars and Jupiter.

Comets

Comets are giant lumps of ice and dust that orbit the Sun. As they come close to the Sun, they begin to melt, leaving an impressive trail behind them.

Did you know that Pluto isn't considered a planet any more? It's too small! It's now called a dwarf planet.

The Big Bang!

Where did all this come from?

Try to imagine Earth, the Moon, the Sun, the planets and the stars all squeezed together into something so small it's invisible. This is how we think the Universe started.

In less than a second, this invisible dot expanded incredibly fast, throwing out lots of dust, gas and other particles. Over billions of years, these gradually stuck together to form all the stars, planets and moons in the Universe.

What goes around...

comes around. Over time, we have put thousands of objects into orbit around the Earth to learn more about our planet and what lies beyond it.

Space station

The International Space Station is as big as a football pitch. It was built by 15 countries working together so that astronauts can live in space for months on end.

Hubble telescope

This telescope is the size of a bus. It takes photographs and collects information about the Universe.

Satellites

Satellites take pictures of the Earth to forecast the weather and make maps. They also bounce signals across the globe for communication, radio and television.

Space junk

Millions of nuts, bolts, tools and other objects left over from rockets and satellites or dropped by astronauts are still floating around Earth. There's a lot of junk out there!

Why is Earth unique?

As far as we know, Earth is the only planet in the Solar System where life can exist. The conditions are perfect: it's not too hot or too cold, there is air to breathe and water to drink.

Earth's orbit

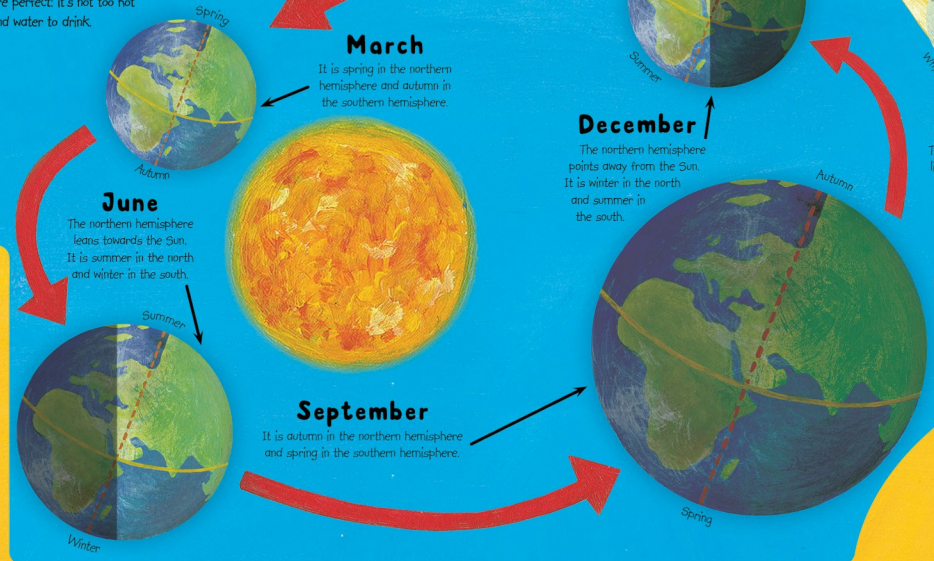
The Earth leans to one side while spinning around the Sun. This tilt creates the seasons because as Earth travels around the Sun, different areas receive different amounts of sunlight.

Earth facts!

Age: Nearly 4.6 billion years old

Length of year (the time it takes to orbit the Sun): 365 days, or, to be precise, 366 days, 6 hours, 9 minutes and 9.54 seconds!

Diameter: 12,756 Kilometres (as planets go, Earth is quite small!)



March
It is spring in the northern hemisphere and autumn in the southern hemisphere.

June
The northern hemisphere leans towards the Sun. It is summer in the north and winter in the south.

September
It is autumn in the northern hemisphere and spring in the southern hemisphere.

December
The northern hemisphere points away from the Sun. It is winter in the north and summer in the south.

Day and night

The Earth rotates once in 24 hours. As it spins, one side is lit by the Sun, and it is daytime. The other side is dark, and it is nighttime. Imagine that the torch is the Sun and the ball is Earth.

The Moon

Our nearest neighbour in space is the Moon: a huge ball of rock. The Moon orbits Earth, so every night we see a different part of it lit up by the Sun. This is why it seems to change shape in the sky.

What if there was no Moon?

Earth would spin faster, so the days would be much shorter. The Moon's gravity slows down the Earth's rotation.

Gravity

If you drop something, it falls to the ground. This is because of gravity, a force that makes the objects in the Universe pull towards each other. Earth's gravity pulls us towards the ground, stopping us from whizzing off into space. Gravity also keeps the planets in orbit around the Sun and the Moon in orbit around the Earth.

When did life begin?

The answer is 3.8 billion years ago! When the Earth formed (around 4.6 billion years ago), it was a lifeless ball of molten rock wrapped in poisonous gas and bombarded by meteorites. It was very dark and very hot. Millions of years later, the first signs of life appeared and changed very slowly into today's plants and animals.

Earth's history in 24 hours!

Imagine the whole history of the Earth squeezed into one day. One minute would equal about 3 million years and one second 50,000 years! Look to the clock to find out what happened at different times if the Earth's history was squeezed into 24 hours!

Earth forms 00:00

The molten Earth slowly cools down and its solid crust develops. Gases from volcanoes help create the atmosphere. Rain begins to fall, making oceans.

Slime! 03:57

The first forms of life appear in the ocean: tiny, slimy things called bacteria. One type of bacteria begins to produce oxygen from water.

The first bacteria appeared in the ocean 3.8 billion years ago.

Animal explosion 21:07

The sea starts to fill with plants and odd-looking creatures, including sponges, coral, jellyfish, bony fish, water scorpions and giant woodlice called trilobites.

Fossils help us find out about ancient plants and animals.

Giant woodlice called trilobites appeared in the sea 545 million years ago.

Land plants 21:40

Plants start to grow on land. It will take millions of years for these clumps of moss to be replaced by grassy plants and leafy trees.

Plants spread over the land 440 million years ago.

Land animals 22:05

The first animals crawl out of the sea. They grow legs and learn to breathe air. Insects and reptiles appear on the scene.

The first reptiles appeared 360 million years ago. This one is called Dimetrodon.

Dinosaurs 23:06

A group of huge reptiles called dinosaurs rule the world. After millions of years, a meteorite hits the Earth, wiping out all the dinosaurs and many other creatures.

About 170 million years ago, the biggest reptiles of all, the dinosaurs, roamed the Earth.

Mammals 23:39

Small mammals survive, from which animals of all shapes and sizes develop. Upright apes emerge from the forests of Africa and start to make tools and use fire.

What's next for life on Earth?

The woolly mammoth and other big mammals developed 65 million years ago.

Modern humans 23:59

Less than 1 second before midnight at 23:59:46, modern humans appear in Africa and then migrate around the world.

How did life begin?

Nobody knows for sure. Scientists agree that a very long time ago, life sprang from chemicals floating in the oceans. What we don't know is exactly how these chemicals turned into life.

Recipe for life

1. Find a planet.
It should be just the right distance from a star, so it is not too hot and not too cold, just like Earth.

Perfect distance

2. Bring the volcanoes to a boil.
When they erupt, the surface of the planet will be covered with burning hot lava.

3. Add a rocky moon.
This will stop the planet from spinning too fast.

4. Add an atmosphere.
Release gases from the volcanoes to create an atmosphere which will cool the planet down. Stir until you have the right mixture of gases, moisture and warmth.

5. Cool and add water.
Cool the planet for billions of years, then throw icy comets at it. In the atmosphere, the ice will turn into vapour. This will cause rain to fall, creating oceans.

Comet attack!

The oceans form

6. Add the special ingredients for life.
Season the oceans with carbon, hydrogen, oxygen, nitrogen, a pinch of calcium, sulphur and other elements. Mix well.

Evolution

The British scientist Charles Darwin carefully studied fossils of plants and animals. He described how living things have evolved over millions of years to suit the different environments in which they live. In 1859, he came up with the idea that all living things, from trees to fish to humans, come from one common ancestor. In a nutshell, we're all descended from slimy bacteria!

How did these chemicals turn into life?

1. Primordial soup
One idea is that life started in shallow pools containing a brew of chemicals. Then lightning sparked a chemical reaction that turned simple molecules into more complex ones called amino acids – the vital ingredients for life.

2. Meteorites
Another idea is that amino acids came from meteorites hitting the planet billions of years ago.

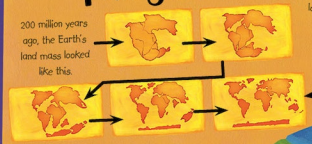
3. Hydrothermal vents
New scientists believe that life began near vents in the sea floor, where hot volcanic gases rich in minerals bubbled up from the Earth's core. These minerals may have provided food and warmth for early forms of life.

Another theory...
Some people think that life on Earth is the result of experiments by aliens who sent life to the planet millions of years ago. But this is very unlikely!

Since humans turned up, the flightless dodo bird, the Tasmanian tiger and many more animals have become extinct.

Pangaea

200 million years ago, the Earth's land mass looked like this.

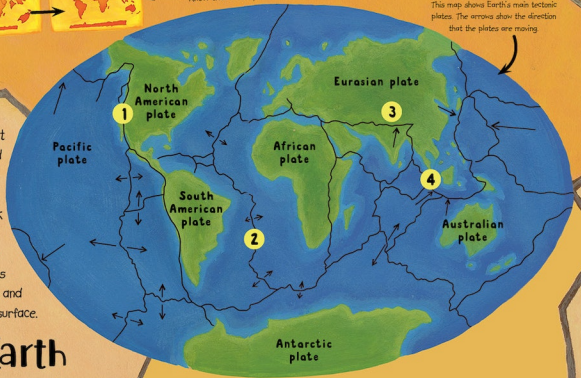


The continents as we know them today.

Have you ever noticed that the continents could fit together like the pieces of a jigsaw puzzle? Scientists believe that a long time ago, the continents were joined together to form one huge land mass, called Pangaea. About 200 million years ago, this supercontinent started to break apart, spreading out to form today's continents.

Pangaea's landscape would have been covered in tropical ferns and palm trees.

This map shows Earth's main tectonic plates. The arrows show the direction that the plates are moving.



Earth is made up of different layers. The outer layer, called the crust, is broken up into big pieces called tectonic plates. These float on a thick layer of hot, flowing rock called the mantle. Over time, the movement of these plates creates mountains, volcanoes and earthquakes on the Earth's surface.

IS the Earth moving beneath our feet?

In a word, YES! While you are reading this book, the Earth's surface is moving at a speed of up to 12 centimetres a year!

How do we know that the plates move?

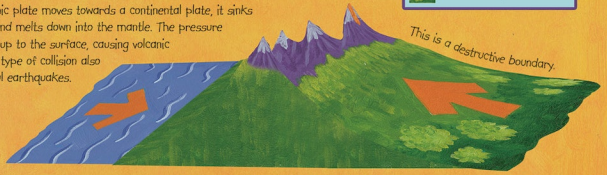
All over the world we can see evidence of this:

1. **San Andreas Fault**
   The plates slide against each other, creating earthquakes.
2. **Mid-Atlantic Ridge**
   The sea floor is spreading because the plates are moving apart, creating a long, high ridge under the sea.
3. **Himalayas**
   These mountains were formed because two plates collided.
4. **Krakatoa**
   This volcanic island is part of the Ring of Fire: a chain of volcanoes around the Pacific caused by plates colliding.

When plates collide...

Oceanic plate
Continental plate

When an oceanic plate moves towards a continental plate, it sinks underneath it and melts down into the mantle. The pressure forces magma up to the surface, causing volcanic eruptions. This type of collision also causes powerful earthquakes.



This is a destructive boundary.

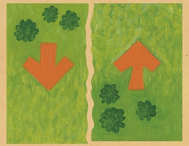
When two continental plates collide, the crust buckles to form mountains. As the plates continue to move towards each other, the mountains become taller.

This is a collision boundary.

When plates slide...

If two plates slide past each other, a huge amount of friction is caused and this sudden movement creates earthquakes. More than one million quakes rattle the Earth each year!

The Richter scale measures the size of an earthquake. 1 is mild, 10 is EPIC!



This is a conservative boundary.

When plates move apart...

Where oceanic plates move away from each other, magma rises from the mantle, creating new crust. A chain of volcanoes can form here. If a volcano rises high enough, it can make an island.

This is a constructive boundary.
The world's largest active volcano is Mauna Loa in Hawaii.