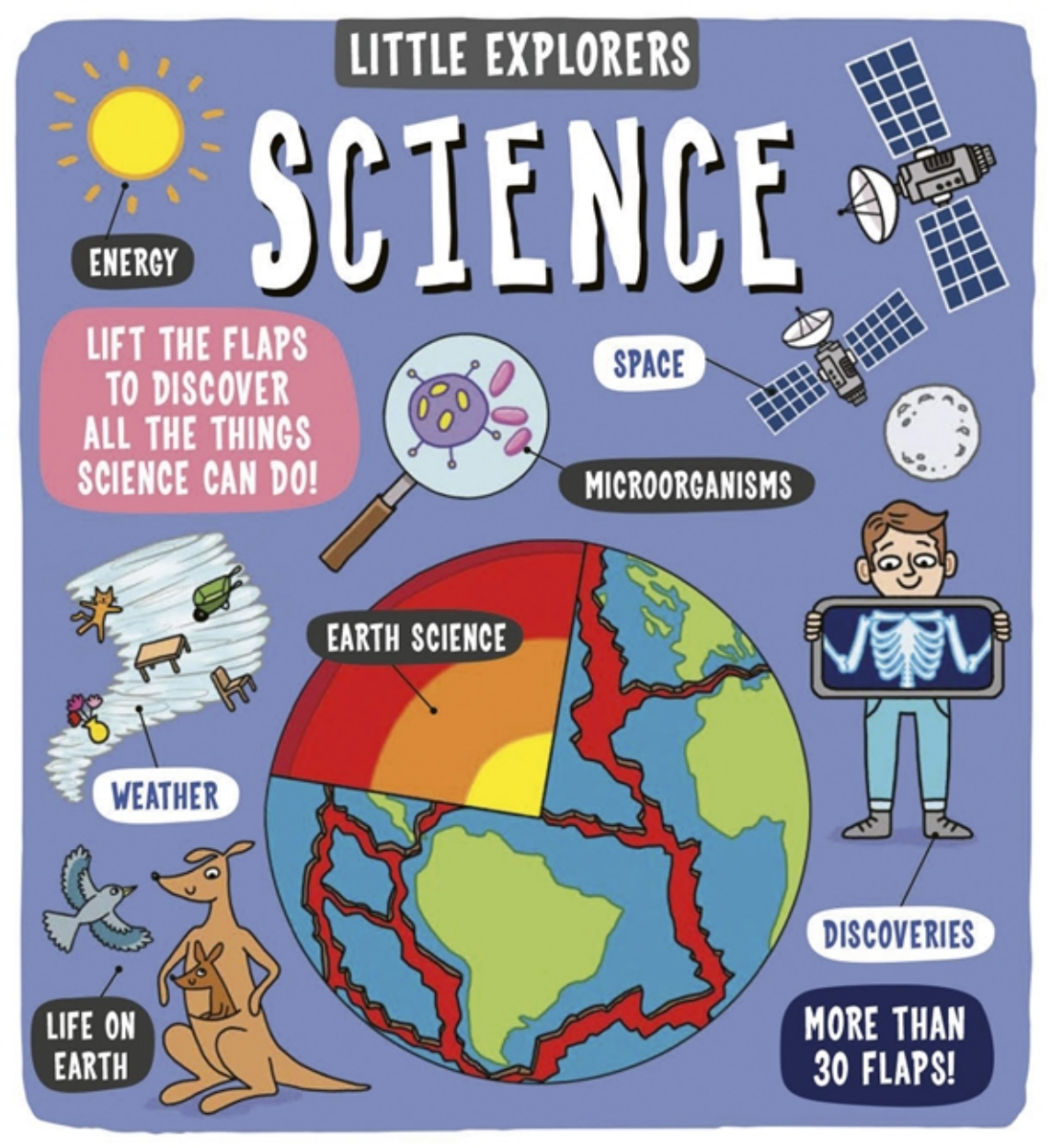

LITTLE EXPLORERS
SCIENCE
ENERGY
LIFT THE FLAPS TO DISCOVER ALL THE THINGS SCIENCE CAN DO!
SPACE
MICROORGANISMS
EARTH SCIENCE
WEATHER
LIFE ON EARTH
DISCOVERIES
MORE THAN 30 FLAPS!

WHAT IS SCIENCE?

Science helps us to learn about the world and find answers to our questions about it. There are lots of types of science. Each one looks at a different part of the world around us.

All kinds of science!

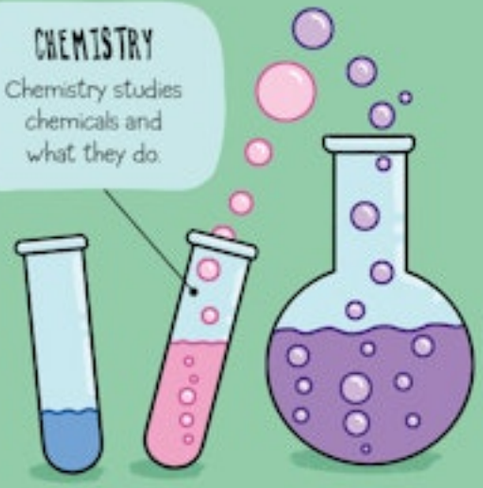
Each scientific area has its own special name. Here are just a few of them...

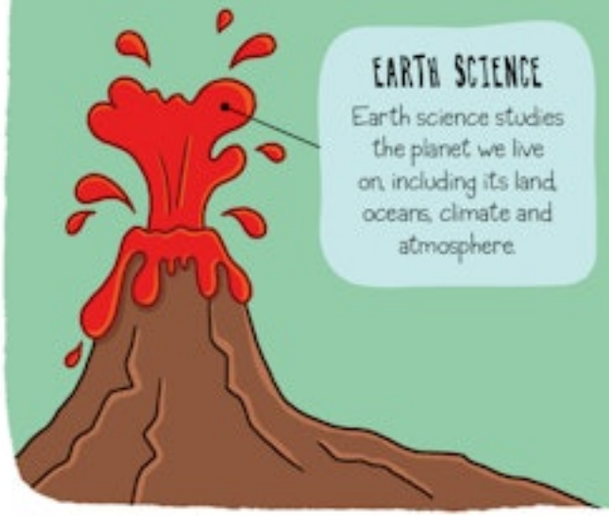
BIOLOGY

Biology studies things that are alive.

CHEMISTRY

Chemistry studies chemicals and what they do.





EARTH SCIENCE

Earth science studies the planet we live on, including its land, oceans, climate and atmosphere.

PHYSICS

Physics studies energy, forces and what things are made of.

What is a scientist?

Scientists are people who study science. They come up with new ideas, then test them with experiments to discover new information. Some scientists work in laboratories, but others work outdoors. A few scientists even work in space!

Step by step

Scientists work very carefully to avoid making mistakes. They often carry out an experiment several times, following the same steps.

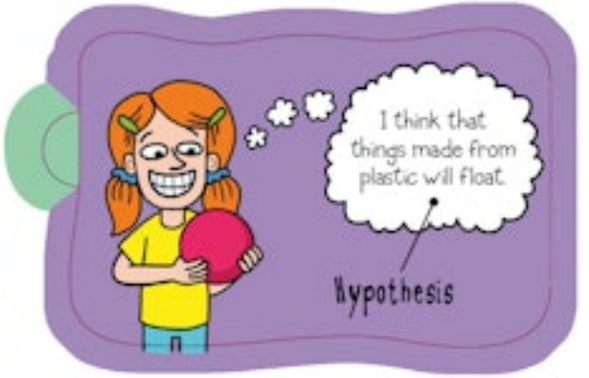
What's the big idea?

An idea that a scientist wants to test is called a hypothesis. Scientists don't make guesses. They use things they already know or can see, called observations, to help them come up with their hypotheses.

What is data?

'Data' is the word scientists use for the information they gather when they do an experiment. The data might be measurements, or things that they have noticed.

This scientist is learning about a group of wild gorillas. She is a zoologist. Zoology is the science of studying animals, including where they live and what they do.



1. Come up with an idea to test.
2. Do the experiment.
3. Record exactly what you see.
4. Study the results to work out what happened.
5. Repeat the experiment several times to check the results or find any problems.

This scientist is measuring how much rain has fallen to gather data.

This is called the scientific method. If you don't follow it, people cannot be sure that your results are right.

Scientists often use special equipment to collect data, such as scales to weigh things, a thermometer to take the temperature, or a stopwatch to time how long something takes. Sometimes, they just watch things very closely to see what happens.

Anyone can become a scientist. You just need to be interested in the world around you and want to find out answers.

OUT OF THIS WORLD

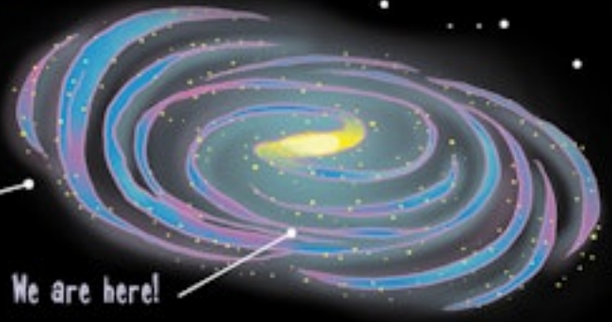
The Universe is everything that exists, including all the planets, stars and galaxies in outer space. It is so huge that we don't know where it ends. It might even go on forever! Scientists who study space and the things in it, including planets, stars and galaxies, are called astronomers.

Our Solar System

Our planet, Earth, is part of the Solar System. This is a group of eight planets that move around, or orbit, a star called the Sun.

The Milky Way

Our Solar System is just a tiny part of a massive, swirling group of stars called a galaxy. Our galaxy is named the Milky Way.



Earth

Moon

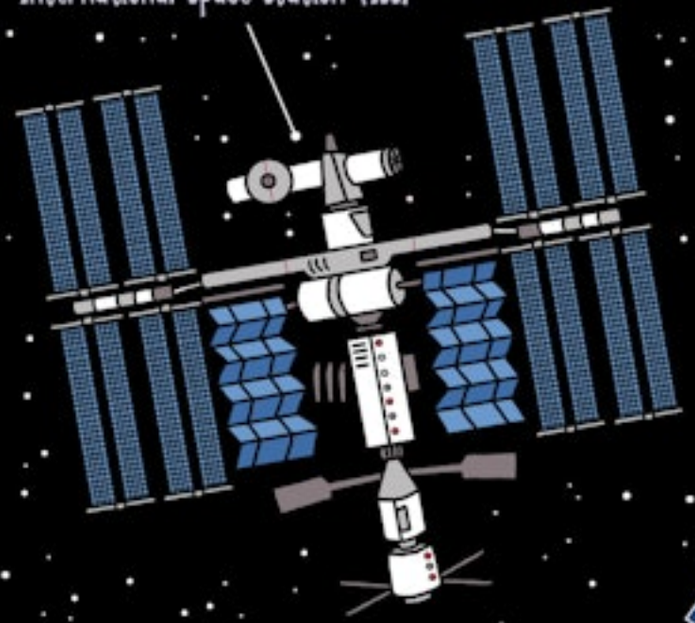
A moon is a large object that orbits a planet. Earth has one rocky moon. See if you can spot the Moon tonight after dark. Some planets, such as Saturn, have lots of moons!

How far to the stars?

Distances in space are so big that we measure them in light years. A light year is the distance light travels in one year – 9.5 trillion kilometres! Apart from the Sun, the nearest star to Earth is 4 light years away.

Vostok 1

International Space Station (ISS)



Working in space

The first spacecraft to orbit Earth with a person onboard was *Vostok 1*, over 60 years ago. Now, humans can live and work in space. The International Space Station is a giant spacecraft, about the size of a football field, that orbits Earth. It is home to a crew of astronauts and scientists, who carry out experiments in space.

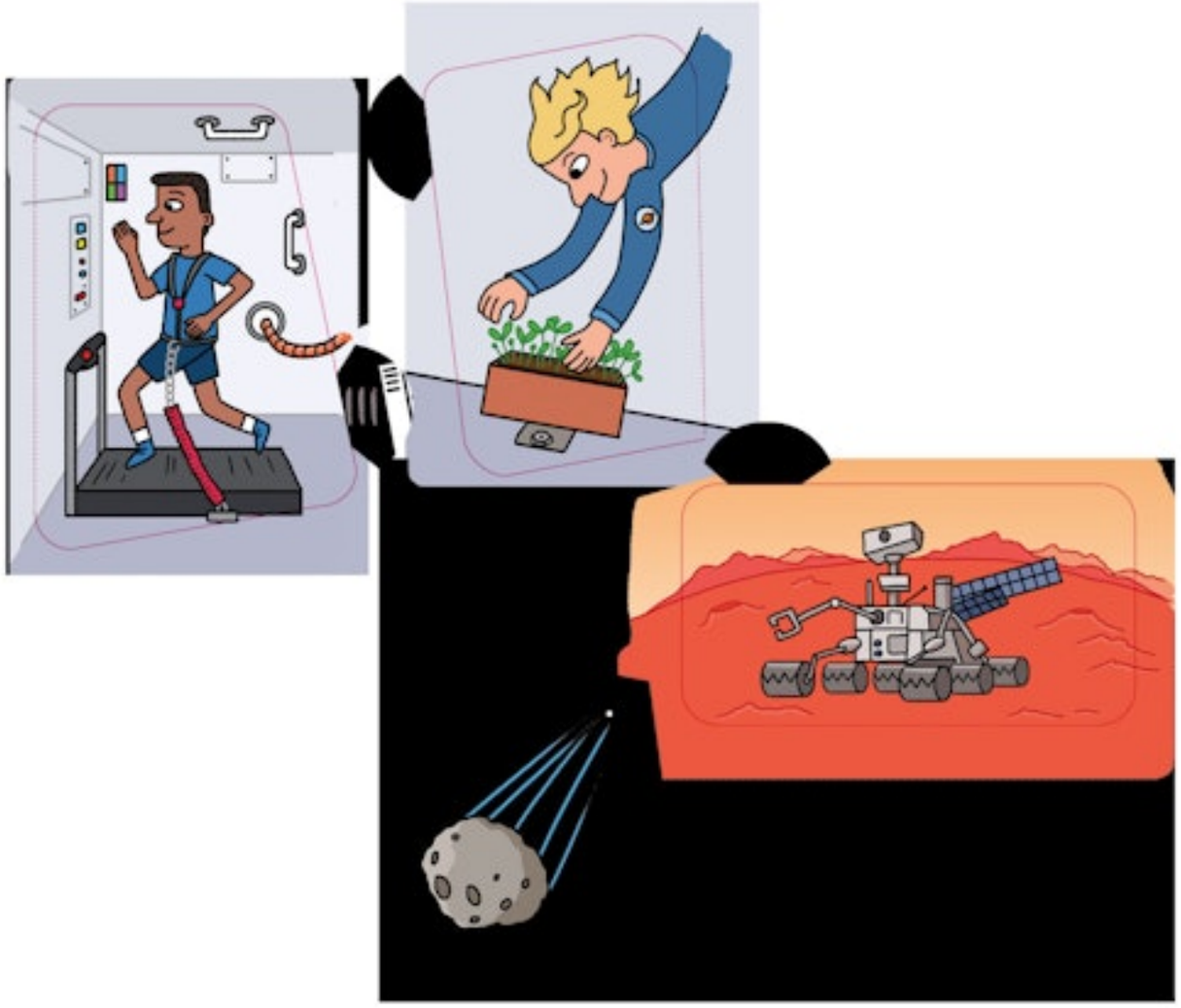
Space snowballs

Enormous lumps of frozen rock and ice, called comets, travel around the Solar System, too. When they pass near the Sun, something exciting happens...

Satellites

Lots of satellites made by humans orbit our planet. These machines are sent into space to do jobs, such as send TV signals or study the weather on Earth below.


Earth is the only planet we know of that supports life.
Spiral – the Milky Way is a spiral galaxy
Elliptical – like a stretched-out ball
Irregular – no particular shape



There are billions of galaxies in the Universe. They come in all sorts of shapes and sizes. Here are 3 different kinds.

When comets pass near the Sun they heat up, creating bright trails of gas and dust.

Scientists use robots to explore distant planets. Mars Rovers are robotic vehicles that travel over the surface of the planet Mars. They collect information about the land, climate and atmosphere and send it back to Earth.

This scientist is doing an experiment to find out how plants grow in space.

There is no gravity in space, so the crew float around. This astronaut is tied to a running machine to do some exercise.

The climate on Earth is perfect for life. A layer of gases, called the atmosphere, wraps around our planet, protecting it from the Sun and dangerous space rays. This allows liquid water to exist. Without water life on Earth could not survive.

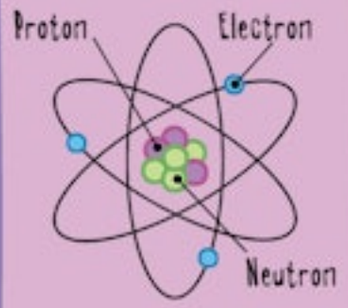
A HIDDEN WORLD!

Some scientists study tiny things that can't be seen without the help of special machines. Some things are so small that they can't be seen at all, though scientists can see what they do.

What is the world made of?

Everything in the Universe, from the air we breathe to the stars in the sky, are kinds of matter. Even people are matter. Matter is made up of tiny things called molecules. Molecules are made of even tinier bits called atoms. Scientists who study matter are called physicists.

What is an atom made of?



Atoms are made of even tinier parts called protons, neutrons and electrons. The protons and neutrons are packed in the nucleus, at the centre of the atom, which is surrounded by electrons.

States of matter

What do these three pictures have in common? They all show water. The ice cube is solid water, the water in a glass is a liquid, and the steam from the kettle is a gas. These are called the three states of matter. Most things can exist in more than one state of matter.

Chemical reactions

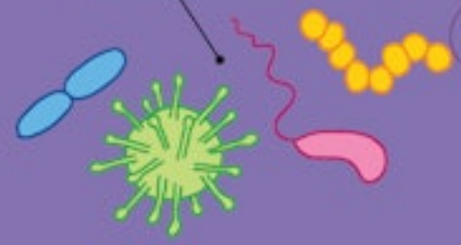
What happens to a bicycle made of steel (which is mostly iron) when you leave it in the rain? A chemical reaction happens!

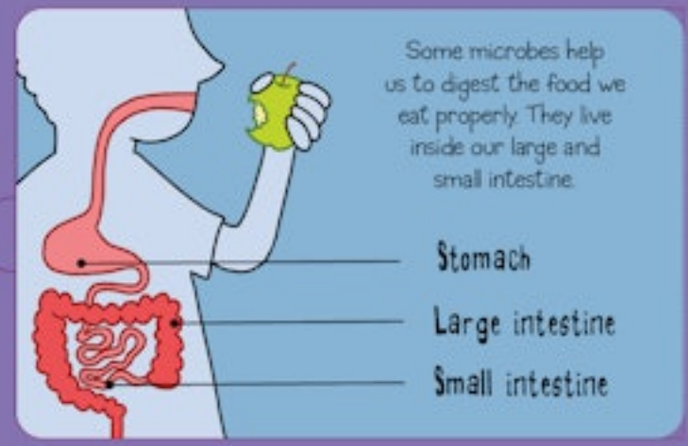
The building blocks of life

All living things are made of minuscule building blocks called cells (which, in turn, are made of molecules). Some living things, such as bacteria, only have one cell, but most plants and animals are made up of millions of cells. Scientists use a microscope to look at cells up-close. It can make them look hundreds of times bigger!

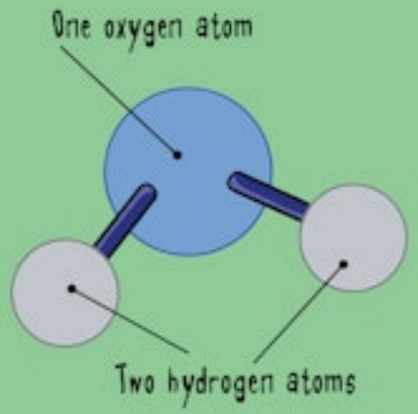
Microbes everywhere!

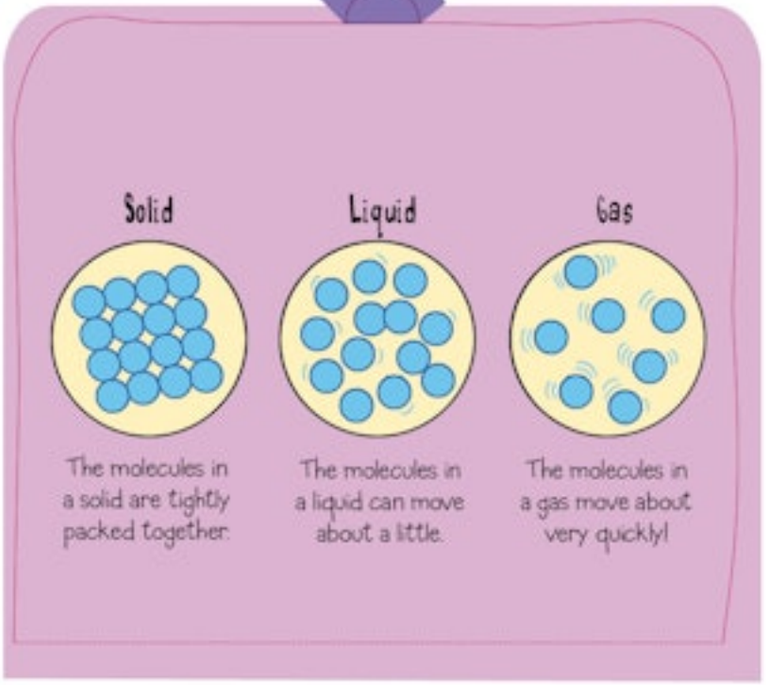
Microbes are tiny living things found all around us, though we can't see them without a microscope. They live in soil, water, air, and even inside our bodies. Some microbes can make us ill, but others help and protect us.

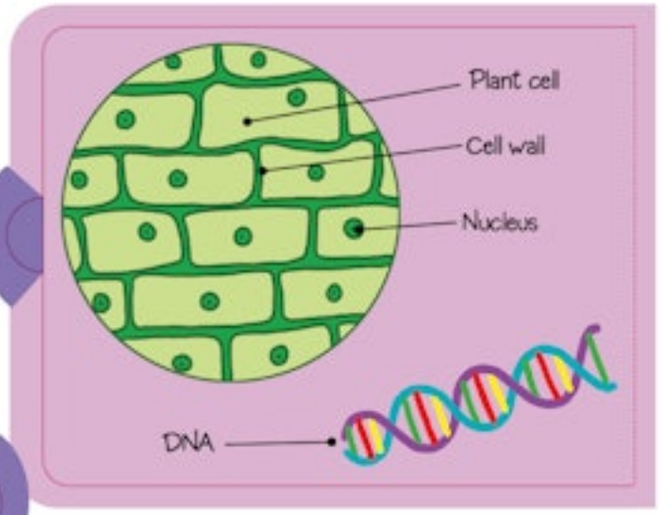




A water molecule is made of:







Animal cells and plant cells are different, but they all have a nucleus. The nucleus is the cell's control centre. It contains instructions for how to work and grow. This information is stored in a twisting string of chemicals called DNA.

Scientists who study cells are called biologists.

The metal reacts to the rain water, and to oxygen in the air, and changes into something new – rust.

There are lots of different kinds of atom. Some matter (like gold) is made from just one kind of atom. But most things are made from two or more kinds of atom joined together.

Matter made from one kind of atom is called an element. Matter made from two or more kinds of atom is called a compound. Water is an example of a compound. It is made from two elements – hydrogen and oxygen.

We can protect ourselves from germs by washing food before we eat it, and by keeping ourselves clean and washing our hands regularly to get rid of harmful microbes.

What happens when you heat ice? It melts!

We can heat or cool water to make it change from one state of matter to another.

WHAT IS CHEMISTRY?

All the matter in the Universe is made up of substances called elements. Chemistry studies elements, and how they are joined together to make new substances.

The periodic table

So far, scientists have discovered 118 elements. These are arranged in 'the periodic table', which groups similar elements together to help organise them.

Group of elements

26
Fe
Iron

Element

1 H Hydrogen																	2 He Helium
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium											13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Caesium	56 Ba Barium	57 / 71	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89 / 103	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mv Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson

57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

1
H
Hydrogen

92
U
Uranium

26
Fe
Iron

13
Al
Aluminium

8
O
Oxygen

2
He
Helium
10
Ne
Neon
18
Ar
Argon
36
Kr
Krypton
54

85
At
Astatine

Hydrogen is the lightest element. It is a colourless gas and has no smell, but is very flammable and burns with an invisible flame.

Each element has a written symbol. Fe stands for the metal, Iron. It comes from the Latin word for iron - ferrum.

All the elements in this group are called noble gases. They all have no colour or smell, and don't change much in chemical reactions.

Oxygen is the most common element in the Earth's crust

Aluminium is a very light metal and quite soft. Most elements are metals

Astatine is the rarest element. Only about 25g of it occurs naturally on Earth at any one time.

The periodic table was invented by a scientist called Dmitri Mendeleev in 1869. When he created it, scientists only knew about some of the elements. Mendeleev believed that scientists in the future would find more, so he left gaps in the table to fill in. He was right! New elements are still being discovered.

Each element has a different atomic number. It tells you the number of protons in the nucleus of the atom

LET'S GET THINGS MOVING!

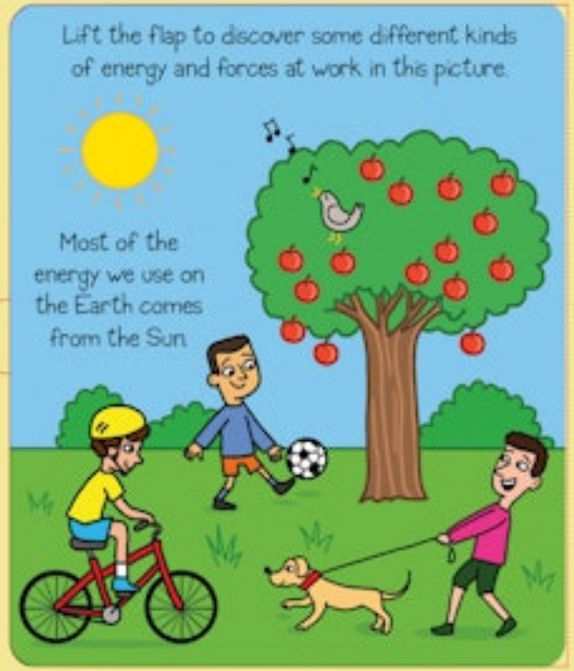
As well as studying matter, physics is all about energy and forces, and how they make things move and change.

What is a force?

Forces push or pull things. They can make something change speed, shape, or direction. Some forces work without touching anything, such as gravity. Gravity attracts objects or matter towards other objects or matter.

What is energy?

Energy makes things happen. Without it, the Sun wouldn't shine, plants and animals wouldn't grow, and machines wouldn't work. The world would be dark, still, and very quiet!



Pass it on!

Energy is never destroyed. It just passes from one thing to another.

Electrical energy

Electrical energy, or electricity, is a kind of energy that moves. It is created when tiny electrical particles move, or flow, from one place to another. A bolt of lightning in a thunderstorm is natural electrical energy. We make electrical energy, too.

Stored energy

Some kinds of energy, such as chemical energy, can be stored until they are needed. Batteries store chemical energy.

A torch uses the chemical energy stored in a battery to work.

Keep it clean!

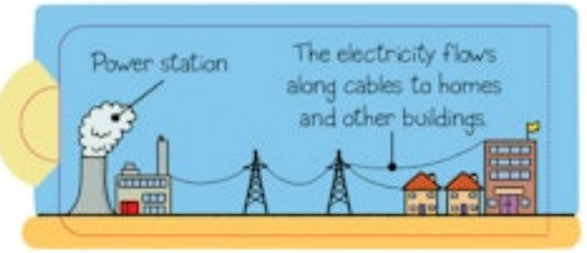
Fossil fuels, such as gas, oil, and coal are dug from the ground. When we burn them to release energy, it creates pollution. And if we keep on using them, eventually there won't be any left! Scientists are working to develop cleaner energy from things that won't run out, such as the power of the Sun, waves and wind.

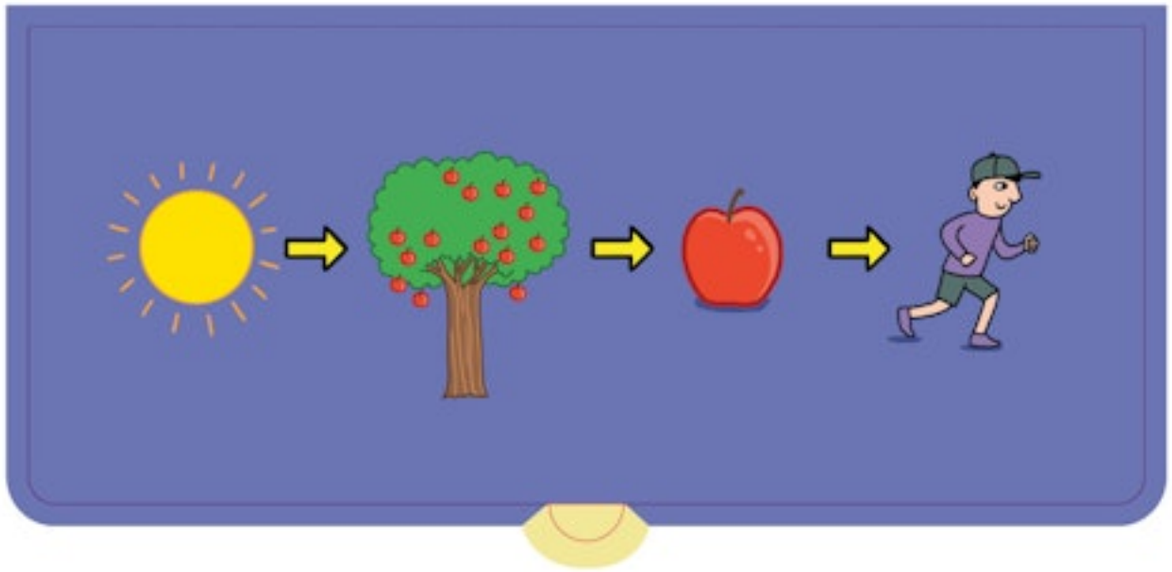
Wind turbines use the power of the wind to make electricity.

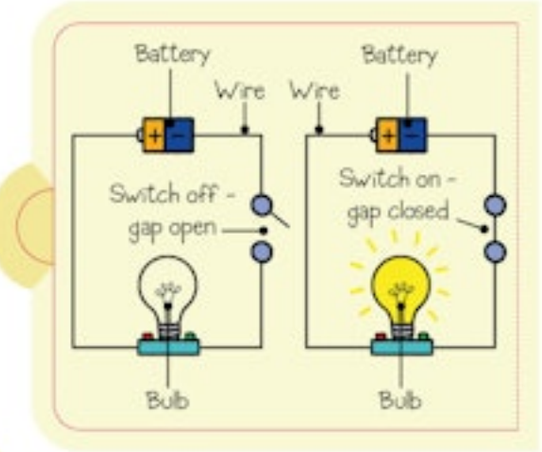
What is magnetism?

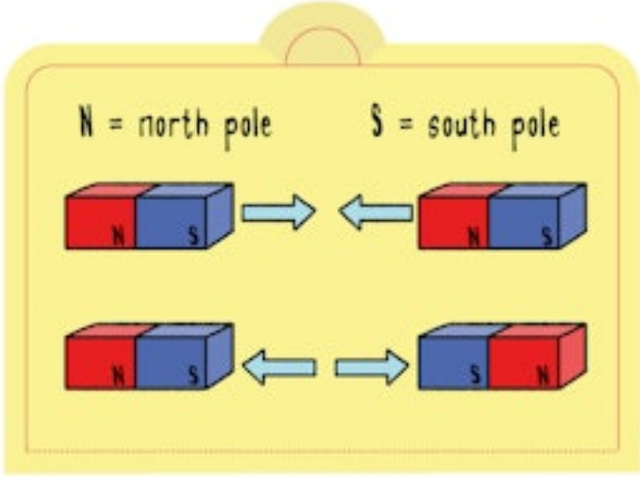
A magnet is a piece of rock or metal that can pull some other metals towards it without touching them. This pulling force is called magnetism. It happens because lots of the electrons inside the magnet's atoms are spinning in the same direction, creating a magnetic force. Magnets attract objects that contain iron, steel, nickel, or cobalt.


The Sun gives off light and heat energy
The singing bird gives off sound energy
The moving bicycle releases kinetic (moving) energy
When the boy kicks the ball he pushes it away from him
The dog is pulling the boy along


Power station
The electricity flows along cables to homes and other buildings




Battery
Wire
Switch off - gap open
Bulb
Battery
Wire
Switch on - gap closed
Bulb


N = north pole
S = south pole
N
S
N
S
N
S
S
N

Fossil fuel power stations burn fuels such as gas, coal or oil to heat up water and make steam. The steam turns a machine called a turbine, which makes electrical energy.

How it works

A chemical reaction inside the battery makes tiny particles of electricity flow along the wire. If you switch off the torch, it makes a gap in the wire. The electricity stops flowing, so the bulb does not light up. When you switch the torch on, it closes the gap to complete the circuit. The electricity flows all around the wire and the bulb lights up.

All living things need energy to survive. This energy comes from food. Plants make their own food using energy from the Sun. Animals eat plants or other animals to get food energy. The energy gets passed on from one living thing to another. This is called a food chain.

Magnets can either attract or push away other magnets. This happens because every magnet has two poles or ends – a north pole and a south pole. If two poles are the same, they push each other away. If two poles are different, they attract each other.

An apple tree takes light energy from the Sun and stores it as chemical energy in its fruit. When we eat an apple, the chemical energy in it is passed on. We use the apple's chemical energy to power our muscles, so that we can move.

BURSTING WITH LIFE!

Our planet is bursting with life, from tiny insects to towering trees, and sea creatures that are bigger than a bus. Biology is the science that studies all this amazing life!

There are millions of different plants and animals on Earth. To understand them better, scientists divide them into groups with similar features. This is called classifying. Lift the flaps on this page to discover one way to classify plants and animals.

This tree is busy making the food it needs to grow.

CLASSIFYING ANIMALS

Invertebrates

Animals that don't have a backbone, such as snails, are called invertebrates.

Vertebrates

Animals that have a backbone, such as birds, are called vertebrates.

All the animals on Earth belong in one of these two groups.

What do you think is inside these eggs?

Bees and other insects carry pollen from flower to flower to pollinate them, so they can make seeds and have babies.

Plants and animals change as they grow. This caterpillar will turn into a butterfly one day.

Scientists are still discovering new plants and animals!

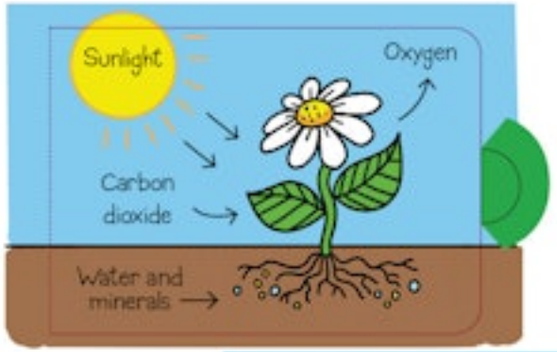
Animal babies

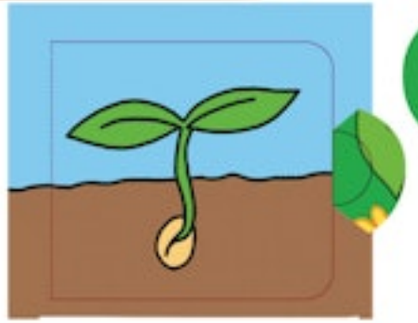
All animals have babies. Most fish, birds, amphibians and reptiles lay eggs. The babies hatch out of the eggs. Nearly all mammals grow babies inside their body, then give birth to them.


Fungi

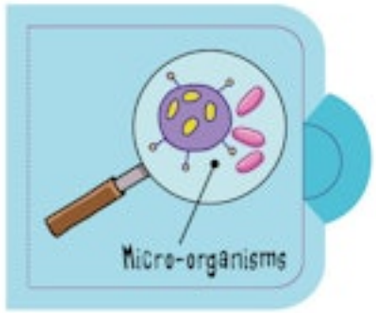

Animals

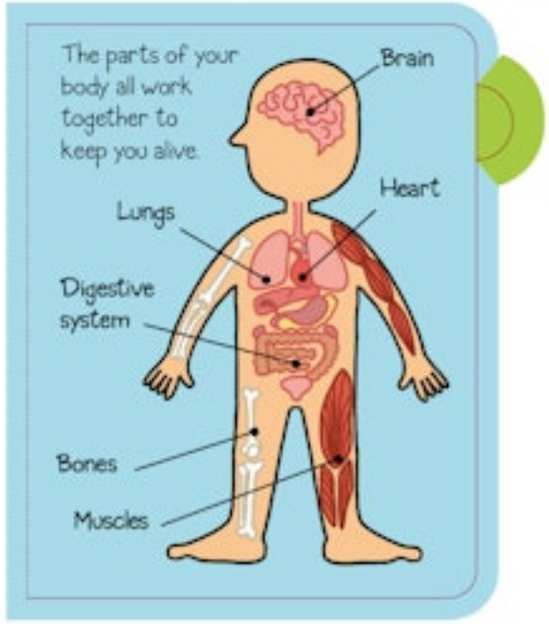

Plants


Sunlight
Oxygen
Carbon dioxide
Water and minerals




There are many kinds of vertebrate. Scientists group, or classify, them into these 5 groups.
Fish
Amphibians
Birds
Reptiles
Mammals


Micro-organisms


The parts of your body all work together to keep you alive.
Brain
Heart
Lungs
Digestive system
Bones
Muscles


Marsupials, like this kangaroo, are mammals that carry their babies in a pouch. The tiny baby lives and feeds inside the pouch until it grows big and strong enough to get around on its own.

Fish usually have scaly skin, gills for breathing in water, and lay eggs.

Amphibians have slimy skin and lay eggs in water.

Reptiles have dry, scaly skin and lay eggs on land.

Birds have feathers and lay eggs. Most can fly.

Mammals have fur or hair and feed their babies with milk.

Mammals and birds are warm-blooded. This means that they can make their own body heat. Fish, amphibians, and reptiles are cold-blooded. They must soak up heat from the Sun to warm up.

A green chemical in leaves traps energy from sunlight. The tree uses this energy to turn water and minerals from the soil and carbon dioxide from the air, into food it can use. This is called photosynthesis. It also makes oxygen, which passes out of the plant into the air.

When a flower has been pollinated, it can make seeds. The seeds fall to the ground and grow into new plants.

Scientists who study plants are called botanists.

Scientists who study fungi are called mycologists.

Scientists who study animals are called zoologists.

The human body is made of lots of different kinds of cells. These cells join up to make all the parts of your body, each with its own job.

Bones – give your body shape.

Muscles – allow you to move.

Digestive system – processes food to take from it everything your body needs to grow and stay healthy.

Brain – controls the whole body.

Heart – pumps life-giving blood around the body.

Lungs – breathe air.

Scientists who study micro-organisms are called microbiologists.

Baby plants

Plants make seeds that grow into new plants, but they reproduce in other ways, too. For example, some, such as strawberry plants, send out runners along the ground that grow roots and turn into new strawberry plants.

WHAT ON EARTH...?

Our planet may be just one of many millions in our galaxy, but it is truly amazing. Earth science studies the planet we live on, including its land, ocean, climate and atmosphere.

The atmosphere is a blanket of gases around the planet. It shields Earth from the Sun, keeping the temperature comfortable for living things, and allowing liquid water to exist.

Earth is a squished ball shape that bulges out around the Equator. This bulge is caused by the pull of gravity as Earth spins around.

Two-thirds of Earth's surface is covered in water.

By looking at ancient rocks, scientists have worked out that Earth is about 4.5 billion years old.

Earth's land is covered in mountains, valleys, volcanoes and plains.

What's inside?

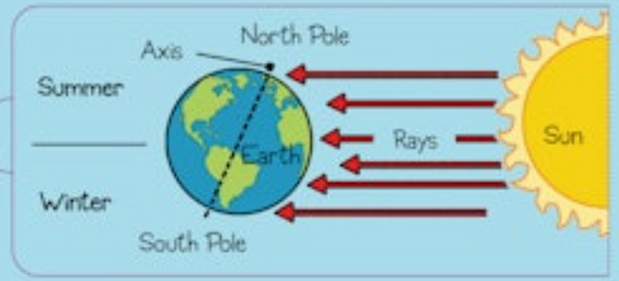
If you could slice open Earth, you would find four layers inside – the crust, the mantle, the outer core and the inner core.

Constantly moving

Earth's surface, or crust, is broken into giant pieces called tectonic plates. These plates are always moving.

The seasons

Earth has seasons because it is tilted on an axis – an imaginary line through the middle of the planet from the North Pole to the South Pole. As Earth travels round the Sun, different parts of it are tilted nearer to the Sun at different times of the year.



Rocks and minerals

Earth's crust is made of different kinds of rock. Each one is made from one or more crystallized chemicals, known as minerals, clumped together. A scientist who studies rocks is called a geologist.

Some minerals, such as diamonds, are very precious because they are so rare!

The water cycle

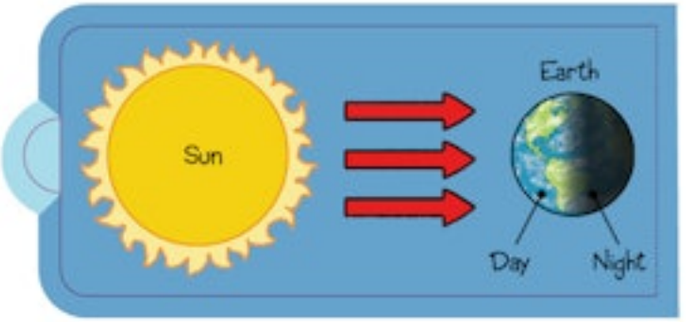
Earth is often called the Blue Planet. That's because most of its surface is covered with water, so it looks blue from space. The amount of water on Earth never changes. It just keeps moving between the sea, the land and the atmosphere in a never-ending loop. This is known as the water cycle.

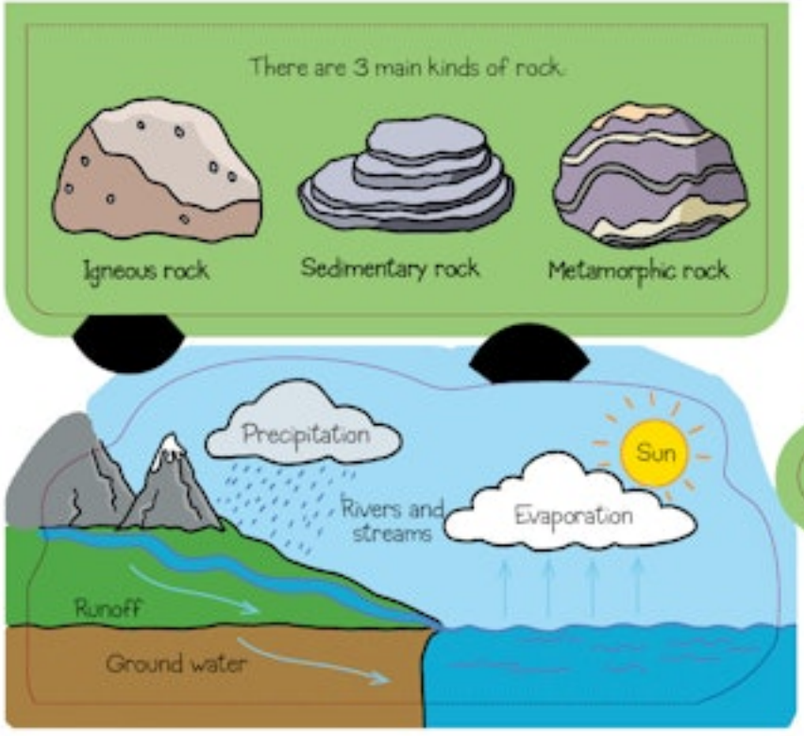
Whatever the weather!

As the air and water in Earth's atmosphere move about, they create wind, rain and other kinds of weather. Scientists who study and predict the weather are called meteorologists. Sometimes, it is much hotter, colder or windier than normal. This is called extreme weather.

A tornado is a swirling, moving column of air. It is caused when warm, wet air hits cold, dry air.


Crust
Mantle
Outer core
Inner core
Plate
Plate boundary


Sun
Earth
Day
Night


There are 3 main kinds of rock.
Igneous rock
Sedimentary rock
Metamorphic rock
Precipitation
Sun
Rivers and streams
Evaporation
Runoff
Ground water


Scientists who study climate are called climatologists.

Day and night

As Earth moves around the Sun it constantly spins on its axis. The side facing the Sun has daytime and the other side is in darkness, or night.

Igneous rock: Molten rock from inside the Earth comes to the surface and cools to form igneous rock.

Sedimentary rock: Tiny particles of rock or sand build up on a river or ocean bed and are packed together to form layers of sedimentary rock.

Metamorphic rock: Existing rock can be changed by great heat or pressure to form metamorphic rock.

Climate is the normal pattern of weather in a place over a long time. A country's climate depends on where it is on the planet. Places close to the Equator have a hot climate. Places close to the North and South Poles have a cold climate.

Heat from the Sun makes water in the ocean evaporate into the air (turn into a gas). The tiny water droplets in the air join to form clouds. When the droplets get heavy enough, they fall back down to Earth as rain, snow, sleet or hail (precipitation). The water finds its way into rivers or streams that run back into the sea, and the whole cycle starts again.

THE PAST AND THE FUTURE

Science is a tool to help us understand our world – and the Universe beyond it! It allows us to learn new things and use that information to make our world a better place. Here are a few scientific discoveries that have changed things forever.

Our place in the Universe

Italian scientist, Galileo Galilei, lived nearly 500 years ago, but he made the world think very differently about the Solar System.

The very first vaccine

In 1796, a doctor called Edward Jenner did a famous experiment. He infected a scratch on a boy's arm with a tiny amount of the germ that causes the disease cowpox.

World health care

In 2015, Chinese scientist Tu Youyou received the Nobel Prize in Medicine for her work on a treatment which has saved millions of lives around the world.

Splitting the atom

Scientists have known about atoms for hundreds of years – but they didn't understand what was inside them or how they worked. In 1911, Ernest Rutherford came up with an explanation.

Multiple discoveries

Polish scientist Marie Curie discovered two new elements – radium and polonium. She was awarded the Nobel Prize for Chemistry for this work.

New science!

Scientists are constantly working on new ideas. The future will be a very different, exciting place!

In the future, planes will use clean kinds of fuel. Scientists are developing planes, which use less fuel when they fly, too.

One day, homes will use clean energy. The tiles on this roof are solar panels. They use light from the Sun to create electricity.

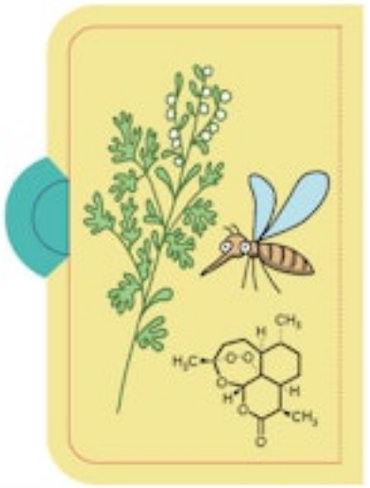
Robotic pets are already here. They might not be warm and fluffy, but at least you don't have to clean up after them!

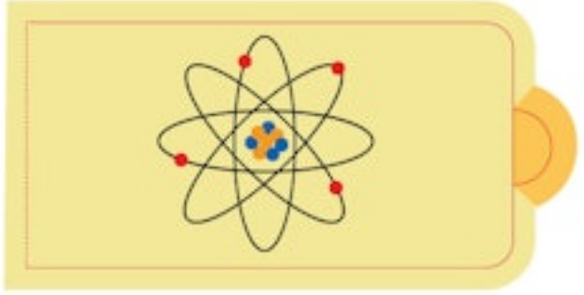
Fashion will use fabrics that can be composted or recycled. Clothing will be able to change shape, colour or temperature.

Cars will have cleaner and safer engines. Some cars will be able to drive themselves or check that their drivers are driving safely.

Computers of the future will be smaller, more powerful, and super-smart! You might even wear one on your head!

Scientists are creating crops that give bigger harvests, to help feed all the people in the world. They are also working out how to grow meat in factories and create new kinds of food from plants.





Using her knowledge of traditional Chinese medicine, Tu Youyou found a substance called artemisinin in the herb sweet wormwood. She worked out that it could be used as a treatment for the deadly disease malaria. She even volunteered to be the first human it was tested it on!

Long ago, people believed that the Sun and the other planets in our Solar System travelled around the Earth. Galileo proved that it was the other way round!

Jenner believed that catching mild cowpox would protect the boy from getting a bad disease called smallpox. He was right! It was the first successful vaccine! Since then, vaccines have saved millions of lives.

Marie Curie also helped to invent X-ray machines, which take pictures of the bones inside your body. She was awarded the Nobel Prize for Physics for this work, too.

Rutherford said that an atom is mostly empty space, and that its mass is packed in a tiny nucleus in the middle. Over the years, scientists have learned a lot more about atoms, but Rutherford's work was the start of the journey.