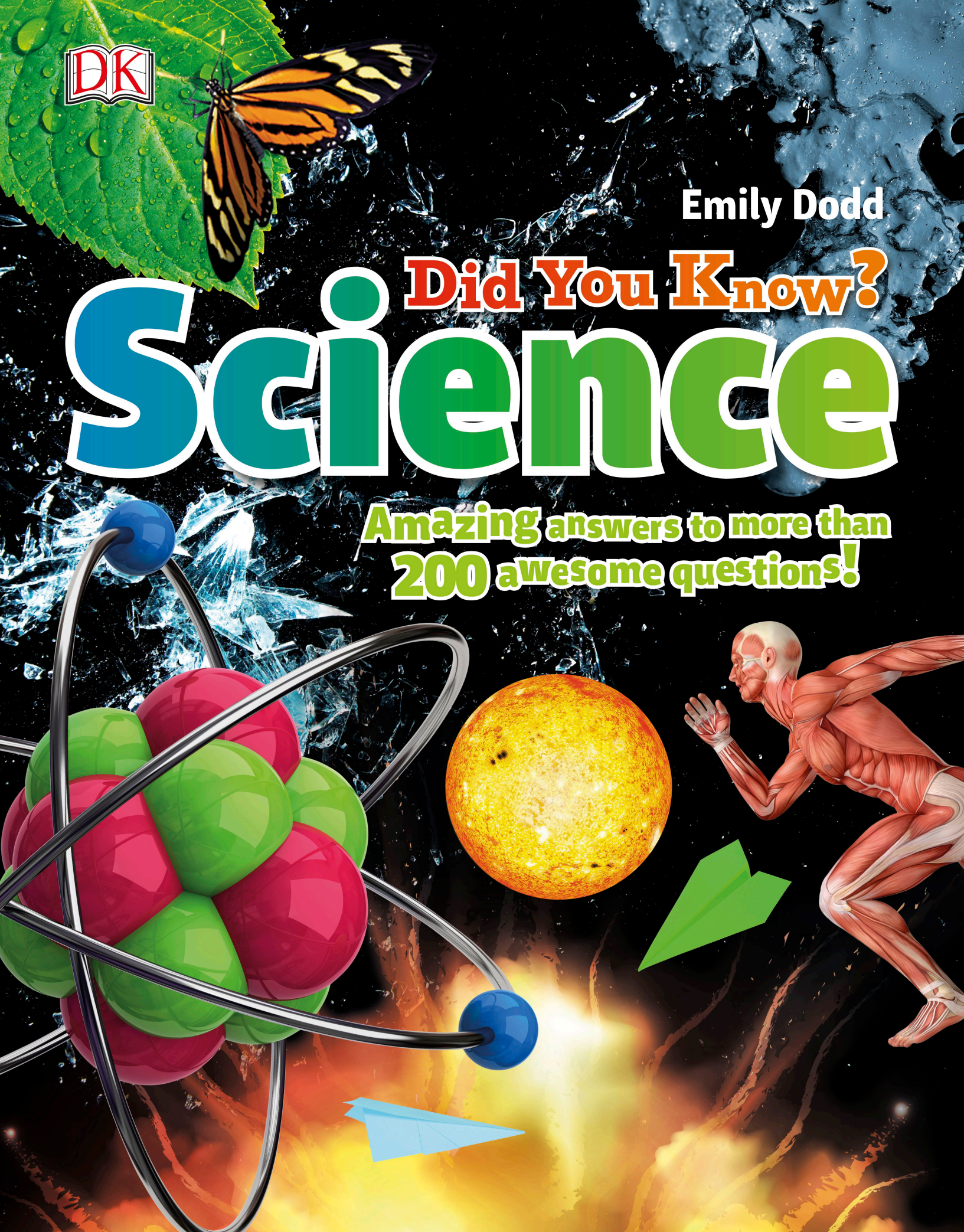
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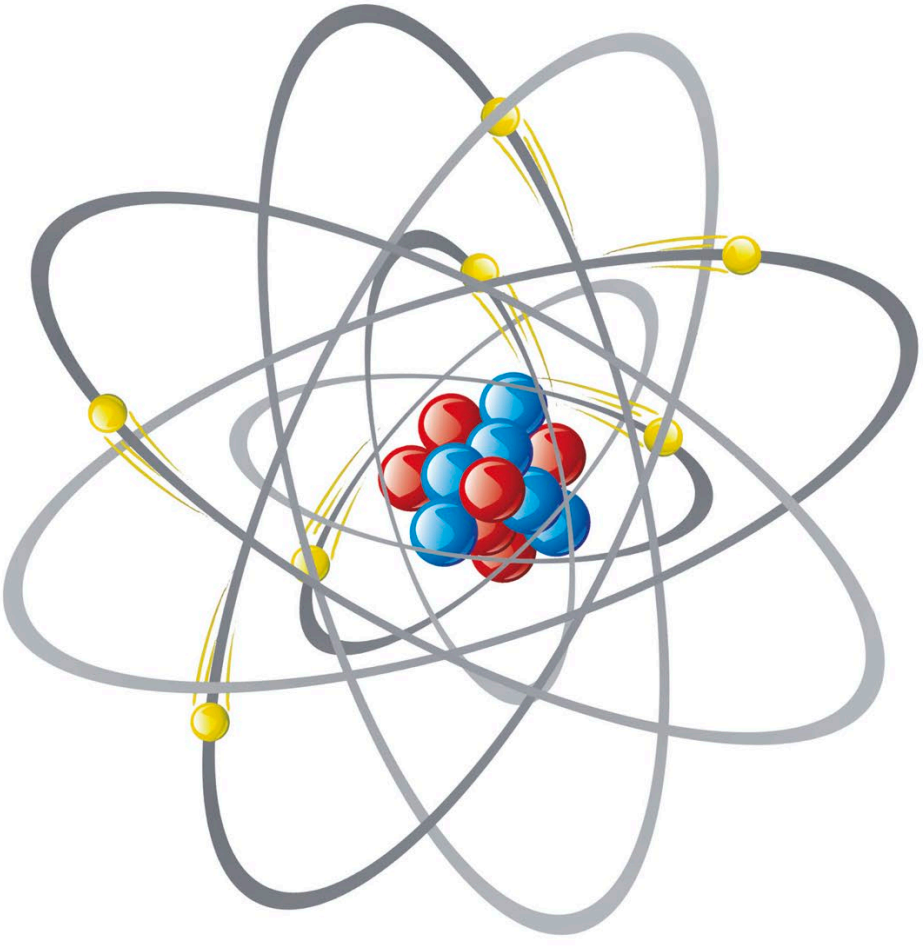

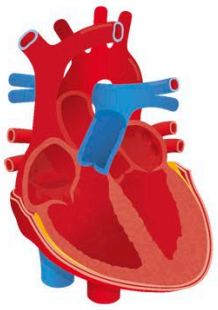


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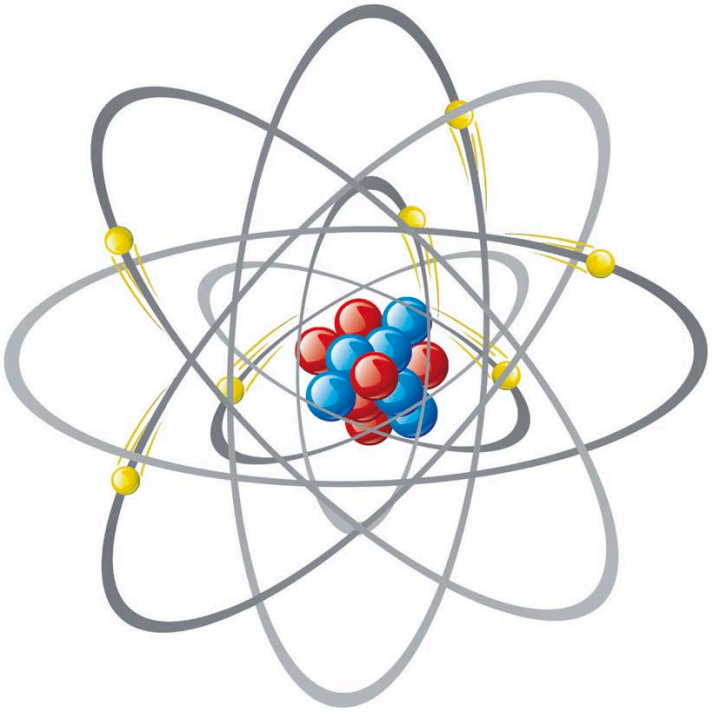

Emily Dodd

Penguin Random House

Author Emily Dodd
Consultant Fulbridge Academy

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A WORLD OF IDEAS:
SEE ALL THERE IS TO KNOW

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Human body

Find out why my fur is so soft on page 25.

The material world

Energy

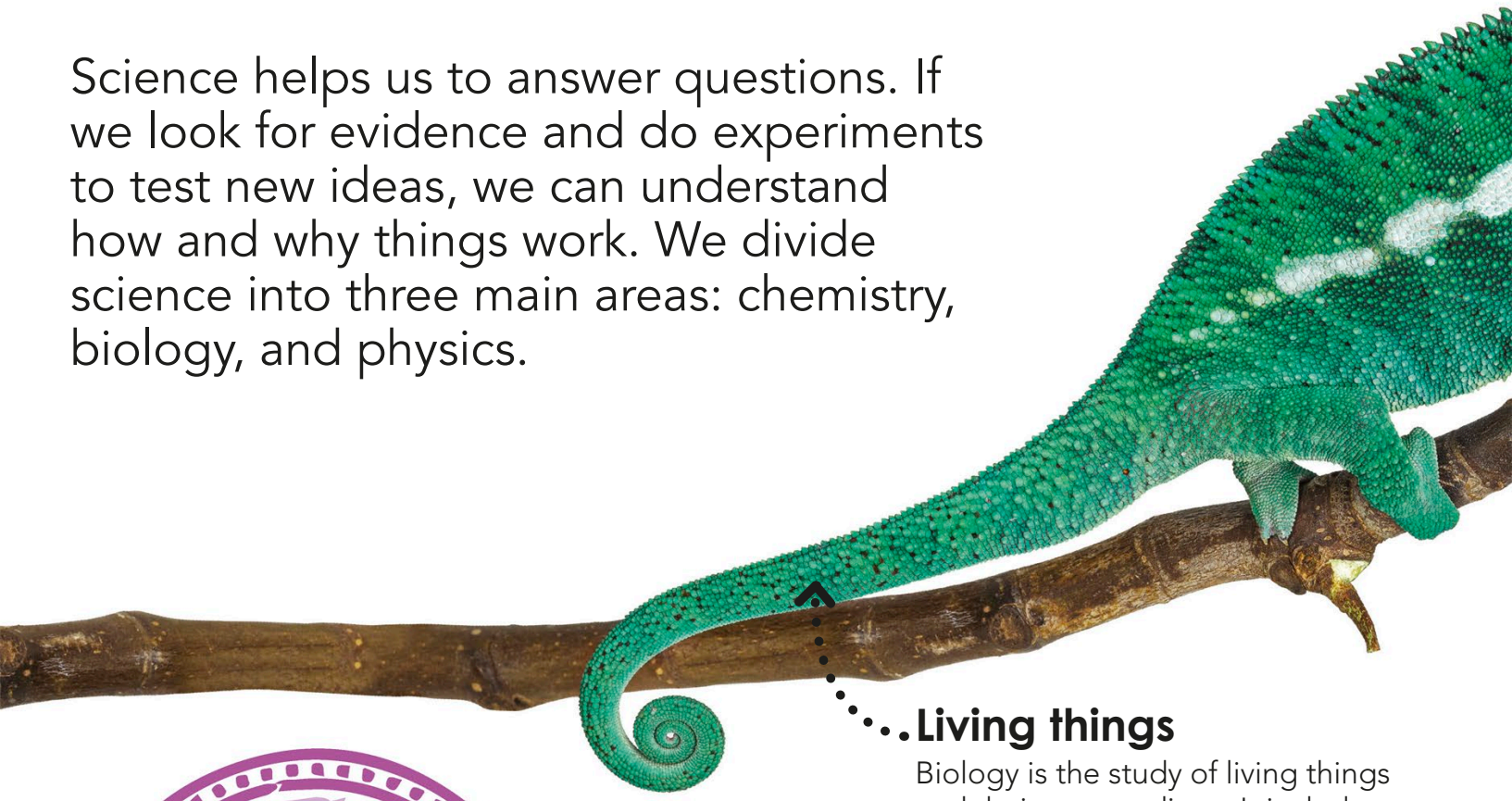
Forces and movement

Our planet

Discover what makes lemon juice taste sour on page 71.

What is science?

Science helps us to answer questions. If we look for evidence and do experiments to test new ideas, we can understand how and why things work. We divide science into three main areas: chemistry, biology, and physics.



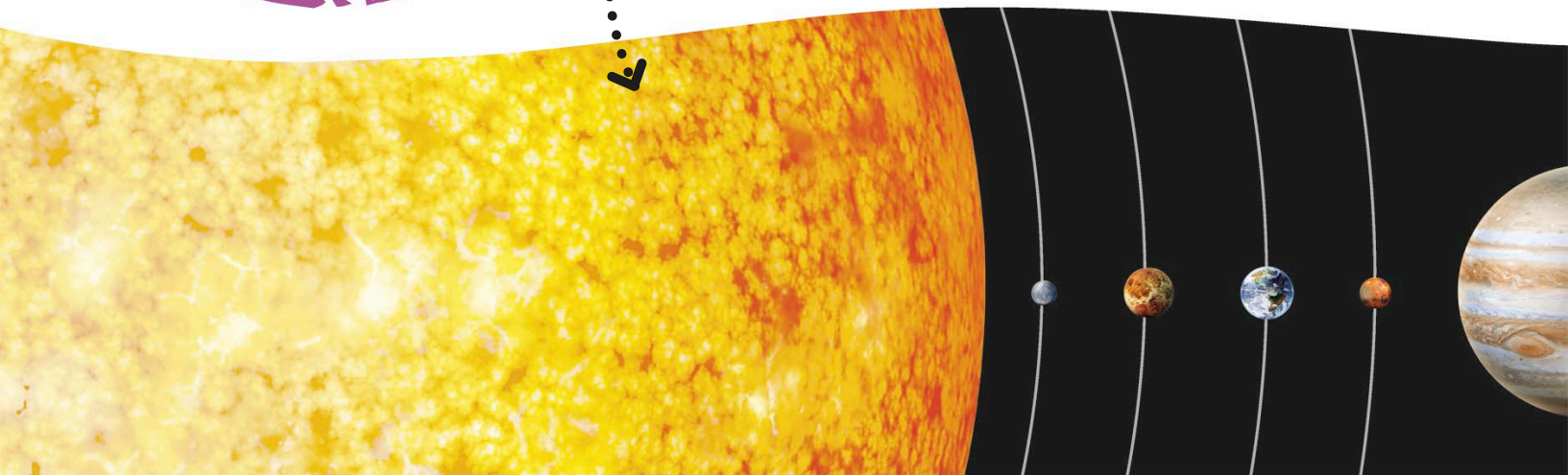
Living things

Biology is the study of living things and their surroundings. It includes how humans, plants, and animals behave, grow, and adapt to changes in their environment.

Science has helped invent every new technology, from the wheel to the iPad.

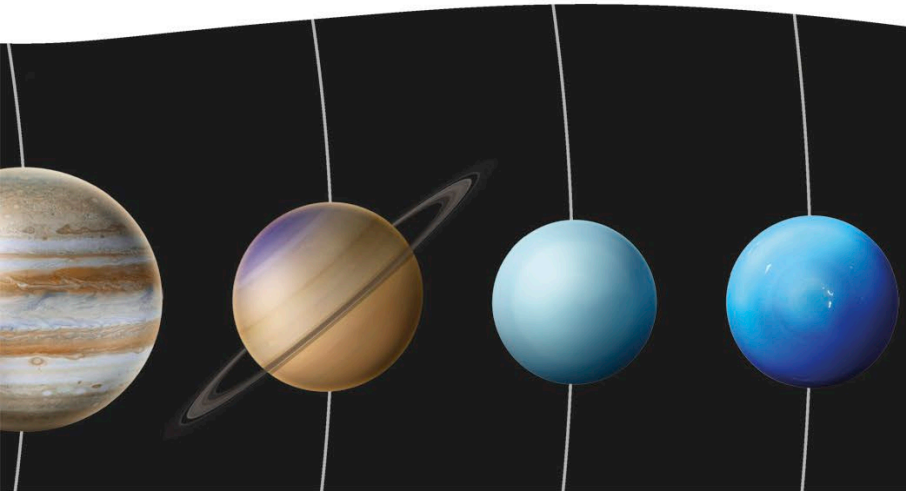
Movement and forces

Physics is the study of gravity, magnets, light, electricity, waves, sound, heat, energy, forces, and how objects move.



Materials

Chemistry is the study of what things are made from. It explores how tiny particles called atoms can be arranged and changed to make different materials.



Why is science useful?

Expanding knowledge

When scientists investigate ideas and do experiments, they discover new information about the world around them. People can use that information to come up with more new ideas.

Solving problems

When we know more about how things work, we can invent new things to help us. For example, if we understand motion we can design faster cars.

True or false?

1. Chemistry is the study of living things.

2. New discoveries can be unpopular when scientists first make them.

See pages 132–133 for the answers

The Living World

Our world is bursting with life. From tiny bacteria to giant elephants, all living things need food and air to survive here on planet Earth.

What do living things need to survive?

All life on Earth needs a few basic things to survive. These are food, water, light, air, shelter, and a steady temperature. Occasionally, life can survive without one of these things, for example, in a dark cave.

Air

Living things take in gas from the air. They use it to turn food into energy. This is called respiration.

Water

Animals and plants are mostly made from water and need water to stay alive. Animals have to find water to drink, while plants get it from the soil using their roots.

True or false?

1. Giant tortoises are the animals that live longest.
2. Tardigrades can survive in space without any air.
3. Bristlecone pine trees can live for up to 5,000 years.

See pages 132–133 for the answers

There are around 8.7 million different types of living things on Earth.

Sunlight

Heat and light from the Sun provide warmth. Most plants and animals need a constant temperature to survive.

Shelter

Animals need shelter to keep themselves and their young safe and at the right temperature. Shelter also allows them to hide from other animals.

Food

Living things need food to grow, move, and reproduce. Plants use sunlight to make their own food, and animals eat plants or other animals.

Which animals can survive in difficult environments?

Tardigrade

This microscopic animal can survive extreme temperatures. Tardigrades have been found living in the deep sea, the icy Antarctic, and even around volcanoes.

Anglerfish

The anglerfish survives at very low temperatures in the deep sea. Most animals would get crushed with so much water pushing down on them.

What is an animal?

Animals are living things that breathe, communicate, move, have babies, and can sense the world around them. They eat food to get energy. We sort animals into different groups depending on how similar they are to each other.

Amphibians

Amphibians include frogs, toads, and newts. They are cold-blooded since their body temperature is controlled by their environment. Most of them live part of their life in water and part on land.

Fish

Fish live in water and breathe oxygen by squirting water through gills on the sides of their bodies. Sharks are a type of fish.

Mammals

Mammals give birth to live young and feed them with milk. They have hair and are warm-blooded. Humans are mammals.

Invertebrates

Invertebrates are animals that don't have a backbone. A huge 97 percent of animals are invertebrates, including insects, spider, crabs, and squishy things like snails.

Birds

Birds are the only animals with feathers, and most birds can fly. Birds lay eggs and have light bones. They have beaks and claws.

Reptiles

Reptiles are cold-blooded with dry, scaly skin and claws. They usually lay eggs. Some reptiles have shields or plates on their backs.

Are all living things animals?

Plants

Plants don't eat food. They make food from sunlight and carbon dioxide gas.

Fungi

Fungi include mushrooms, mold, and yeast. They are living things related to plants and animals.

Picture quiz

What group does the jellyfish belong to?

See pages 132–133 for the answer

How big are bacteria?

All living things are made from tiny parts called cells. Bacteria are made from just one cell. They are the smallest living thing on Earth—so tiny that you can only see them with a microscope. Some bacteria are useful to us, while others make us sick.

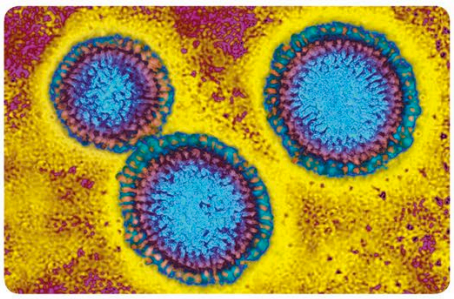
Multiple shapes

Bacteria come in three shapes—rod-shaped, circular, or spiral. They reproduce by splitting themselves in half.

Microorganisms

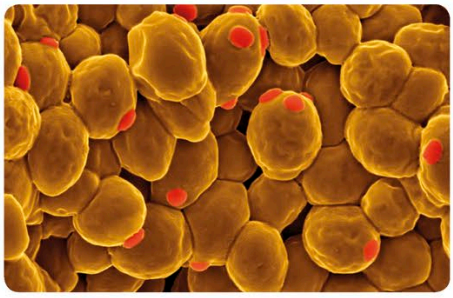
This photo of bacteria was taken using a microscope. Microscopic living things are called microorganisms.

What other things are microscopic?



Viruses

Viruses are even smaller than bacteria. They live inside the cells of living things. When they reproduce they burst out of the cell, passing the virus on.

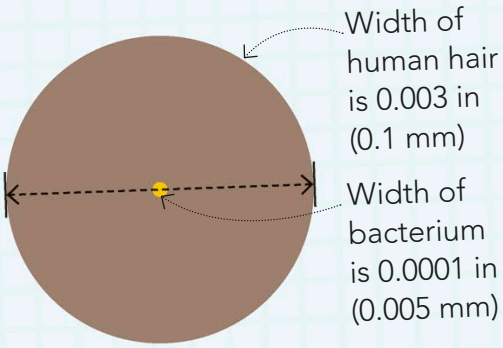


Fungi

Some fungi are microorganisms. Yeast is a single-celled fungus related to mushrooms. It eats sugar and releases gas. It is used in bread to make it rise.

How tiny is microscopic?

This yellow dot shows the size of a bacterium compared to the thickness of a human hair. Twenty bacteria could fit in a row across one hair.



The width of a bacterium compared to the width of a human hair

True or false?

1. Bacteria are used to make yogurt and cheese.
2. Bacteria come in four different shapes.
3. There are 10,000 bacteria on every 0.15 sq in (sq cm) of your skin.

See pages 132–133 for the answers

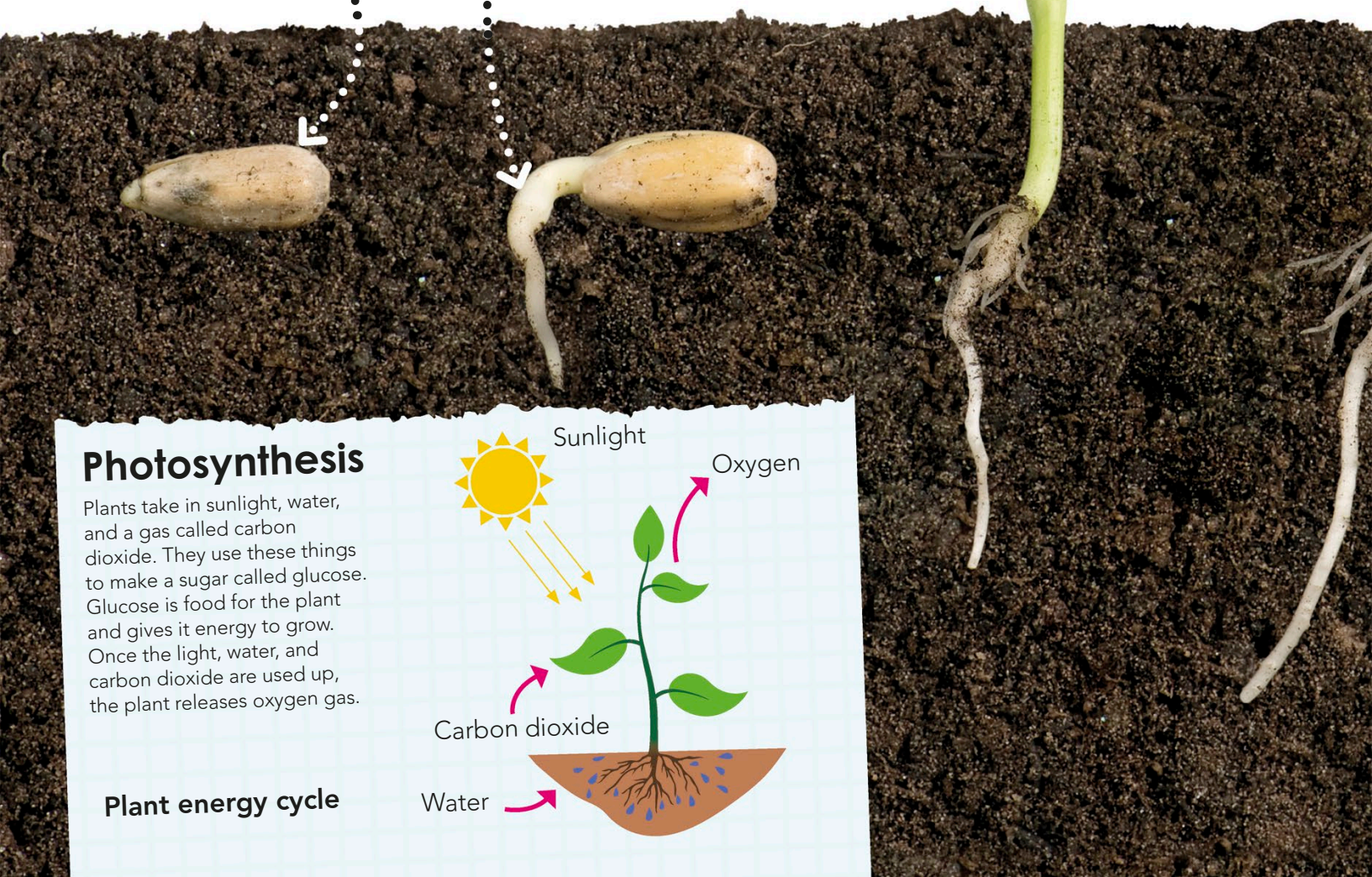
How do plants grow?

Plants begin as seeds. Seeds are little packets that contain everything a plant needs to grow, in the right conditions. Plants grow upward and downward, using energy from sunlight.

Shoot
The shoot grows upward. There are two first leaves already on it.

Seed
The seed is protected by a shell called a coat. It breaks open when it's the right temperature and wet enough.

Root
The root breaks out and moves down to fix the plant in place. It takes water and food from the soil.

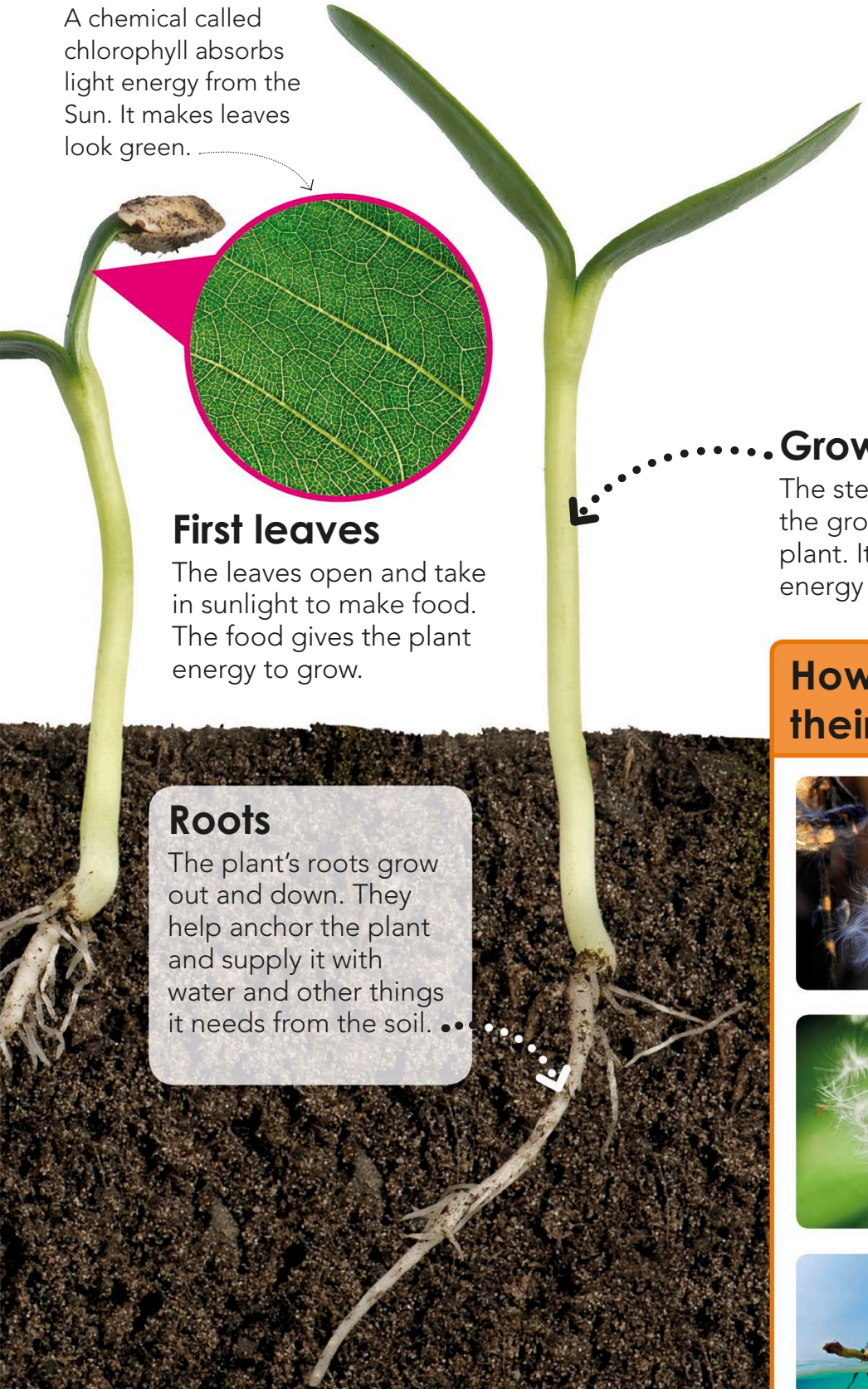


Photosynthesis

Plants take in sunlight, water, and a gas called carbon dioxide. They use these things to make a sugar called glucose. Glucose is food for the plant and gives it energy to grow. Once the light, water, and carbon dioxide are used up, the plant releases oxygen gas.

Plant energy cycle

A chemical called chlorophyll absorbs light energy from the Sun. It makes leaves look green.



First leaves

The leaves open and take in sunlight to make food. The food gives the plant energy to grow.

Growing upward

The stem brings water from the ground to the rest of the plant. It grows upward using energy made by the leaves.

Roots

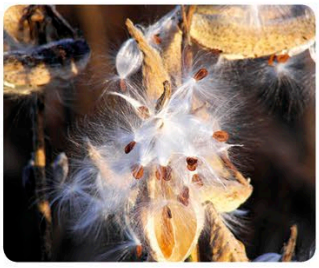
The plant's roots grow out and down. They help anchor the plant and supply it with water and other things it needs from the soil.

True or false?

1. Seeds can "sleep" for years before starting to grow.
2. Most plants can grow without sunlight.
3. Dandelions spread their seeds in the wind.

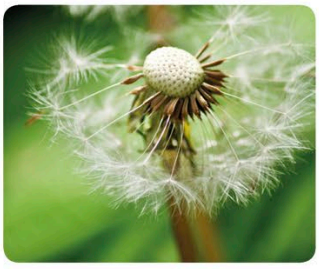
See pages 132–133 for the answers

How can plants spread their seeds?



Exploding pods

Some plants grow their seeds in pods that burst open, sending seeds in all directions.



Wind

Some seeds are very light and shaped to float. They can spread to new locations in the wind.

Water

Many seeds float. They can travel down streams and along rivers to begin life in a new location. Coconuts float in the sea.

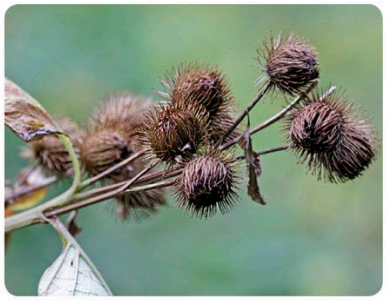
What makes things sticky?

Nature has many different ways to make things sticky. Sometimes things stick using hooks, suckers, or hairs. Other things stick using a sticky fluid or slime. Some plants produce fluids to catch insects that land on them.

Sticky ends

Tiny hairlike tentacles have blobs of sticky, sweet fluid on the end. Insects are attracted to the smell.

How else do things stick?



Burrs

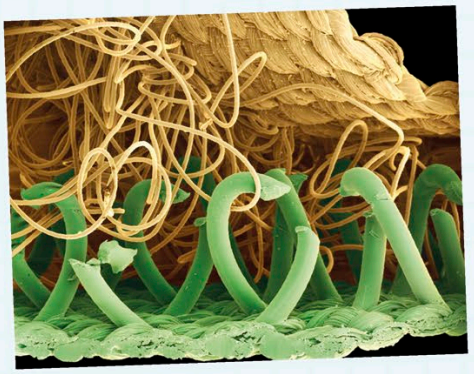
Some plants spread their seeds by using hooks to attach themselves to an animal's fur. They fall off as the animal moves around.

Limpets

Limpets use a sticky fluid and a strong foot muscle to attach themselves to rocks. They twist and grind on the rock for a perfect fit.

Velcro

Velcro is a human-made material that has hooks on one side and loops on the other to stick and unstick things like shoes and coats. Unlike glue, which dries and hardens, it can be reused.



Hooks and loops

Pretend petals

The sticky leaves of the sundew plant are arranged to look like flower petals, which trick insects into visiting.

? True or false?

1. Some plants produce a sticky fluid to trap insects.
2. The glue on sticky notes was invented by accident.
3. Spiders' feet have lots of tiny sticky blobs on them to help them climb up walls.

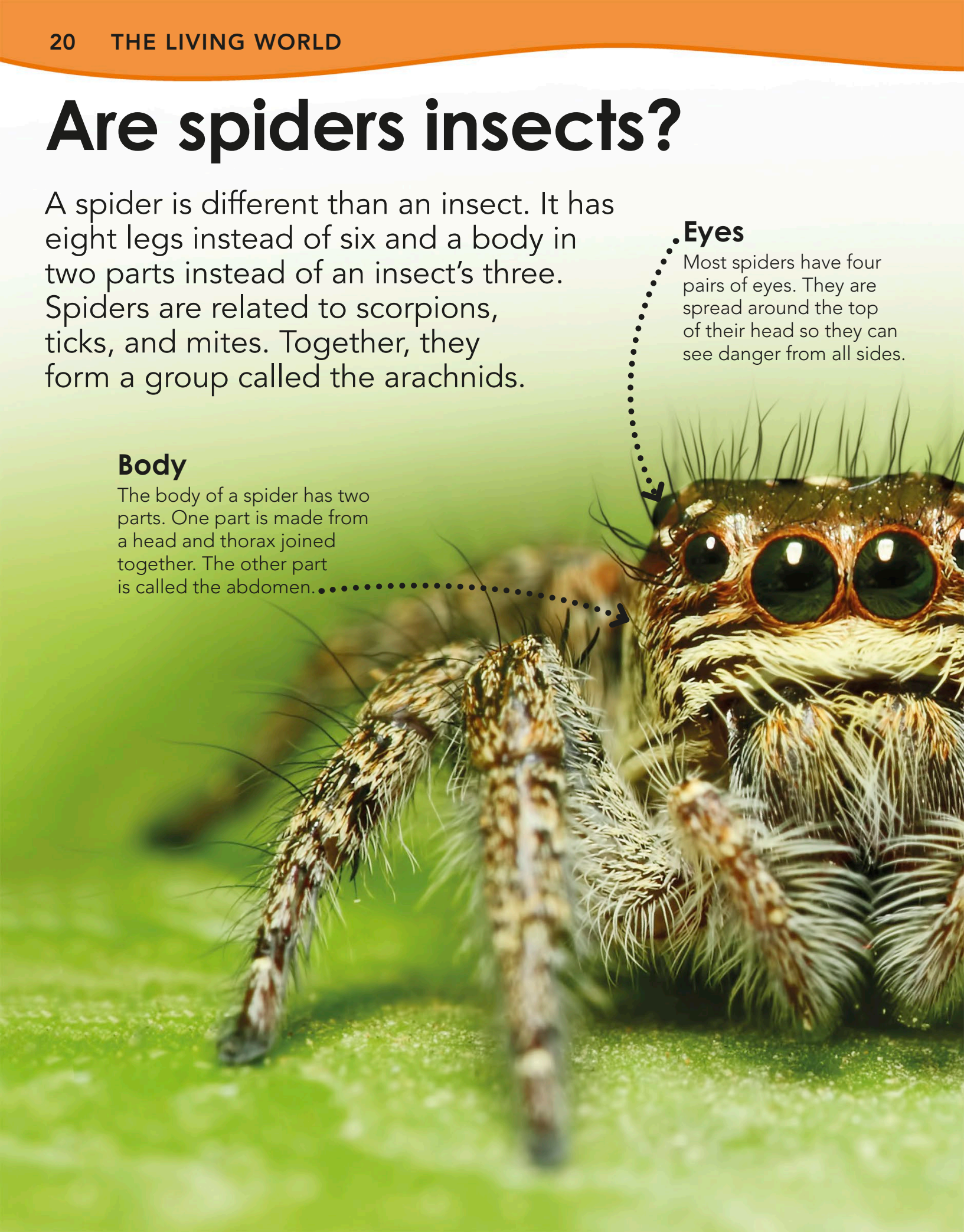
See pages 132–133 for the answers

Are spiders insects?

A spider is different than an insect. It has eight legs instead of six and a body in two parts instead of an insect's three. Spiders are related to scorpions, ticks, and mites. Together, they form a group called the arachnids.

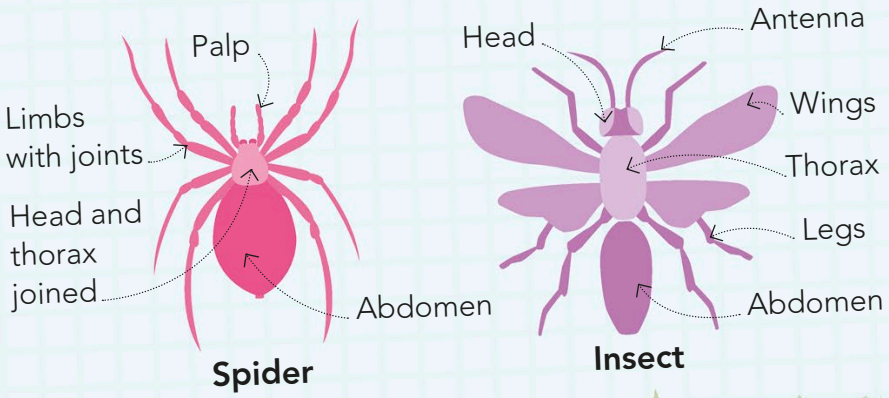
Eyes
Most spiders have four pairs of eyes. They are spread around the top of their head so they can see danger from all sides.

Body
The body of a spider has two parts. One part is made from a head and thorax joined together. The other part is called the abdomen.



Insect vs spider

The main differences between insects and spiders are body segments, legs, and wings.



Legs

Spiders have eight jointed legs—four on each side. The hairs on their legs act like ears, picking up tiny movements in the air.

Why do spiders make silk?

To make egg cases

Female spiders make a silk bed and lay several hundred eggs in it. They wrap it in a silk ball and hang it somewhere safe.

To make webs

Spiders release silk to make sticky webs and nets to catch their food. They wrap trapped insects in silk and eat them later.

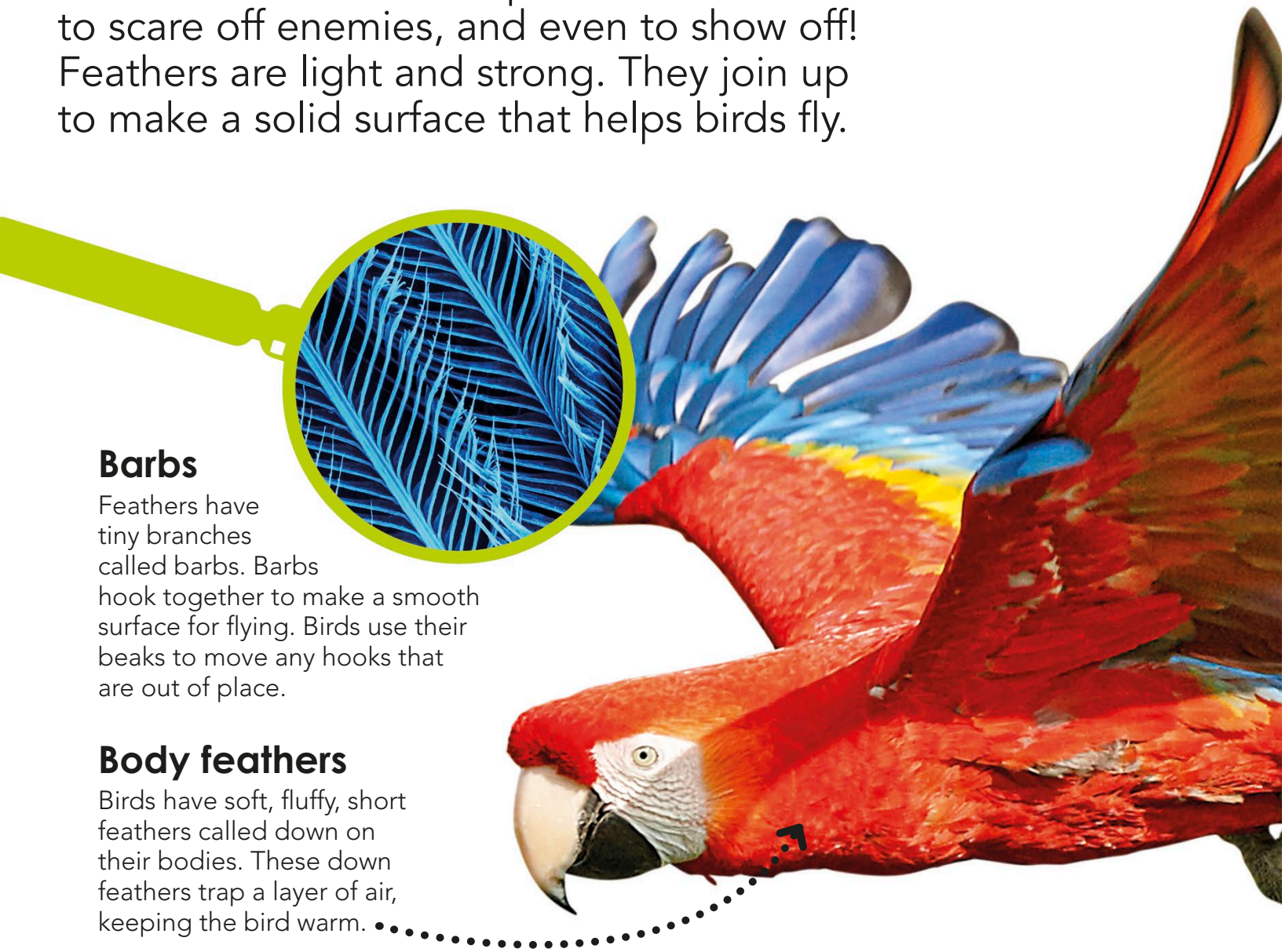
? True or false?

1. Some types of spiders have wings.
2. All spiders can make silk.
3. Spiders and insects both have a protective outer shell called an exoskeleton.

See pages 132–133 for the answers

What are feathers for?

Birds use feathers to keep warm, to hide, to scare off enemies, and even to show off! Feathers are light and strong. They join up to make a solid surface that helps birds fly.



Barbs

Feathers have tiny branches called barbs. Barbs hook together to make a smooth surface for flying. Birds use their beaks to move any hooks that are out of place.

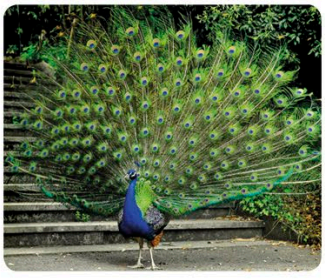
Body feathers

Birds have soft, fluffy, short feathers called down on their bodies. These down feathers trap a layer of air, keeping the bird warm.

Why else do birds have feathers?

Camouflage

Many birds have feathers that blend in with their surroundings so they can hide from animals that eat them. This American bittern is brown like the marsh it lives in.



Display

Some male birds like the peacock show off their bright, colorful feathers to attract females. Others puff up their feathers to scare off enemies.

What are feathers made of?

Feathers are made of keratin, the same material fingernails and animal horns are made of. They have a strong tube in the middle called a quill. The soft part of the feather is called a vane.

Flight feathers

Flight feathers are all slightly different shapes and lengths. Together, they make the wing the best possible shape for flying.

Picture quiz

The heaviest bird in the world cannot fly. What is it?

See pages 132–133 for the answer

Lift

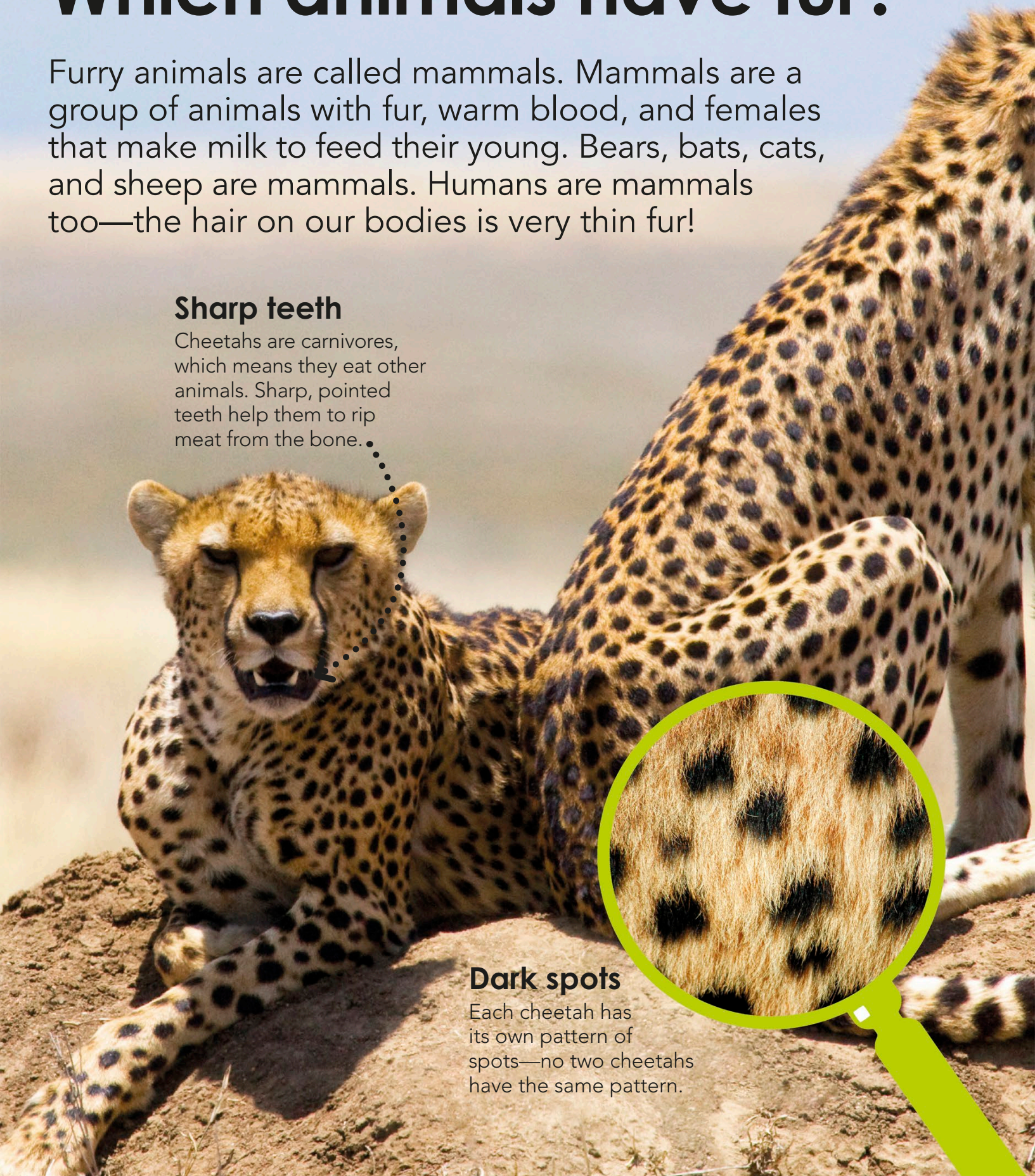
As the wing feathers push air downward, the air pushes back upward lifting the bird in the air. Birds can also use air movements to help them lift and glide.

Tail feathers

Birds use their tail feathers to steer and balance themselves while flying. They also help the bird slow down for landing.

Which animals have fur?

Furry animals are called mammals. Mammals are a group of animals with fur, warm blood, and females that make milk to feed their young. Bears, bats, cats, and sheep are mammals. Humans are mammals too—the hair on our bodies is very thin fur!



Sharp teeth

Cheetahs are carnivores, which means they eat other animals. Sharp, pointed teeth help them to rip meat from the bone.

Dark spots

Each cheetah has its own pattern of spots—no two cheetahs have the same pattern.

Seasonal fur

Some mammals have fur that changes over time. In summer, arctic hares have thick, dark fur. In winter, they shed their dark fur and grow a thick, white coat. This helps them stay camouflaged all year around.

Dark summer coat blends in with rocks and plants.

White winter coat blends in with snow.

Sensitive whiskers

Many mammals have a stiff, long type of hair called whiskers. Sensors at the base of these hairs tell the animal if they are touching an object.

Camouflage

The sandy color and spotted pattern on a cheetah's coat helps it stay hidden while hunting. This is called camouflage.

True or false?

1. All mammals live on land.
2. Reptiles also have fur on their bodies.
3. Sea otters have the thickest fur of all animals.

See pages 132–133 for the answers

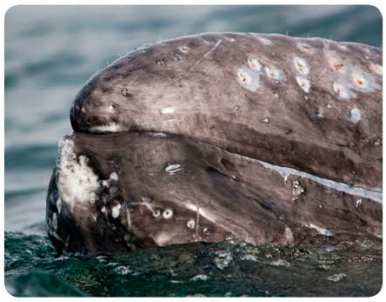
Do all animals have the same type of fur?

Hedgehog

Hedgehogs have stiff, sharp hairs called spines. They can roll into a spiky ball to protect themselves from danger.

Chinchilla

Chinchillas have incredibly soft fur because at least 60 hairs grow from each hair follicle. Humans have one to three hairs in each follicle.



Whales

Whales are born with a small amount of fur on their chin and upper jaw, somewhat like a beard and moustache. They lose this fur shortly after they are born.

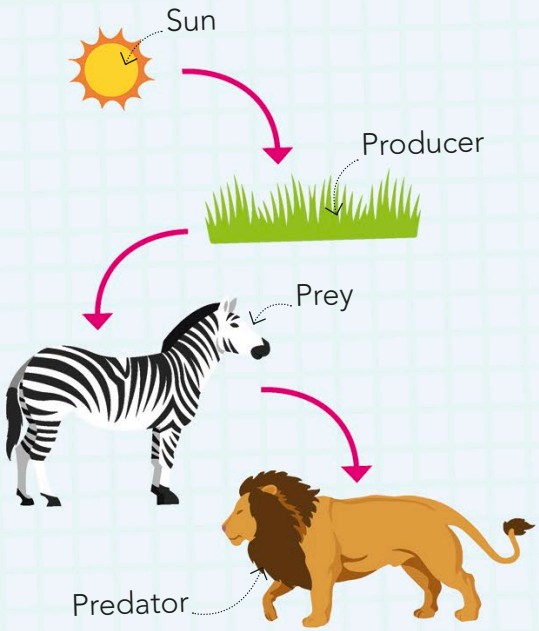
What do lions eat?

Lions choose from a range of animals that they can catch and eat. Hunters like lions are called predators. The animals they hunt are called their prey. Lions are at the top of the food chain because nothing hunts them.

Zebras have striped coats so lions can't see their shape in long grass.

Food chain

A food chain shows where energy comes from. The lion gets energy from eating the zebra. The zebra gets energy from eating grass and the grass gets energy from the Sun. The lion needs the whole food chain to survive.



The lion is at the top of the food chain.

What makes lions good hunters?

Sharp teeth and rough tongues

Lions have sharp teeth to help them tear into their prey, and rough tongues covered in tiny spines to scrape meat from the bones.

Strong claws and paws

Sharp claws and strong paws help lions catch and hold prey. A lion's paw is the size of a dinner plate! Loose skin on their bellies protects them from the kicks of hoofed animals like zebras.

On the run

Lions mostly eat animals their own size or bigger. They prefer young, old, or injured animals that are easier to catch.

Chasing prey

Lions hunt in packs, with lionesses doing most of the hunting. One chases the prey toward a group of other lions.

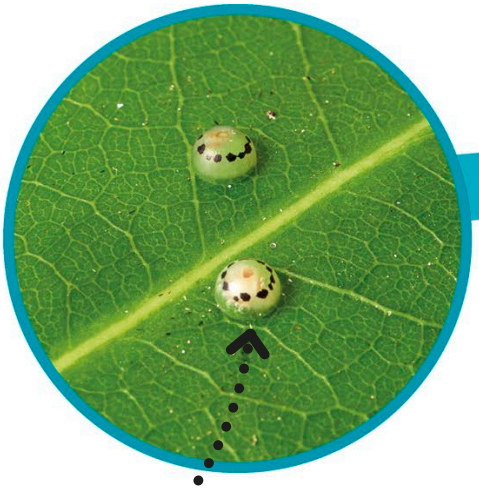
True or false?

1. Male lions do most of the hunting.
2. Lions spend 18–20 hours a day sleeping.
3. Wild lions live in Australia.

See pages 132–133 for the answers

How do butterflies grow?

Butterflies go through an amazing transformation from wiggly wormlike caterpillars to elegant, colorful flying insects. This life-changing process is called metamorphosis.



Eggs

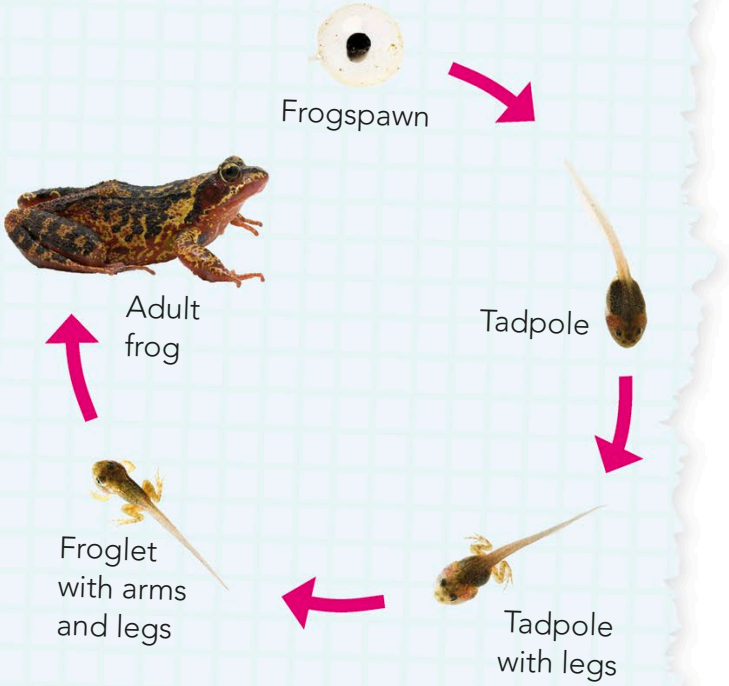
Female butterflies lay tiny eggs that they stick onto leaves. The eggs are different shapes depending on the type of butterfly that laid them.

Breaking out

The new butterfly breaks out of the chrysalis. Its wings are soft and damp. They must stretch and dry out before the butterfly can fly.

Frog life cycle

Butterflies aren't the only animals that go through the process of metamorphosis. Frogs change from eggs called frogspawn to fish-like tadpoles, then grow legs, arms, and lose their tails to become frogs.

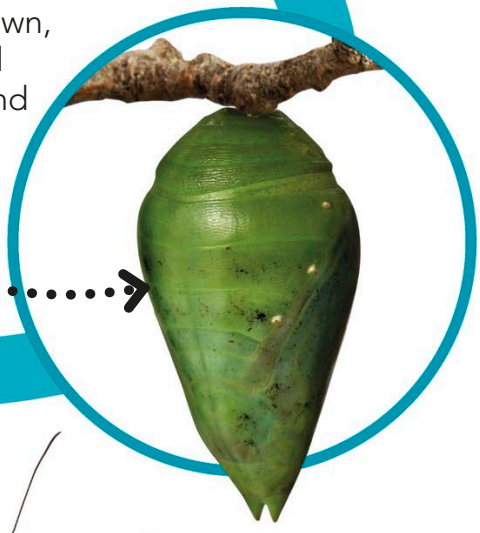


Caterpillar

Caterpillars hatch from eggs. They eat the leaf their egg was stuck to first. Then they eat more leaves from the same type of plant. They need to eat lots of leaves to grow bigger.

Chrysalis

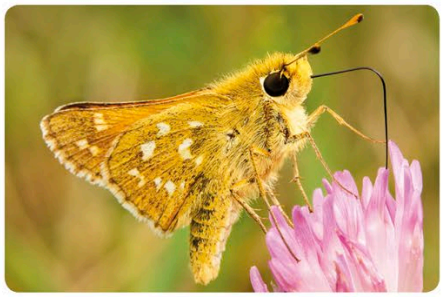
When caterpillars are fully grown, they stick to a leaf or twig and form a hard layer of skin around themselves, called a chrysalis. The caterpillar changes inside the chrysalis.



Adult

Adult butterflies have beautiful colors and are able to fly. Male and female adults mate to make new eggs.

Do butterflies have special features?



Tongue

Butterflies have long, straw-like tongues. They use them to sip a sugary liquid called nectar from flowers.

Wing "eyes"

Some butterflies have eyelike spots on their wings. The markings trick animals that might want to eat the butterfly into attacking its wings instead of the body.

? True or false?

1. Caterpillars grow bigger by shedding their skin.
2. Chrysalises are usually colored green or brown to blend in with surrounding plants.
3. Butterflies can taste with their feet.

See pages 132–133 for the answers

Why don't polar bears freeze?

Adaptions are things that make animals well suited to the place where they live. Polar bears have adapted to live in the freezing cold of the Arctic.

Eyes

A clear extra eyelid closes so the polar bear can see underwater. The eyelid also works in a snowstorm.

Nose

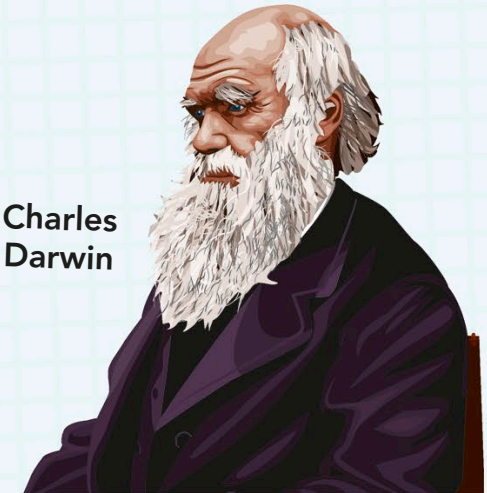
Polar bears have an amazing sense of smell to help them to find food. They can sniff out a seal over 18.5 miles (30 km) away!

Hollow hairs

Each polar bear hair is a clear, hollow tube. The sun's light travels through the hair to the bear's black skin, which absorbs heat.

Charles Darwin

Charles Darwin realized that over millions of years animals gradually change to become better suited to their environments. These changes are called evolution.



Charles Darwin

Fat
Up to 4 in (10 cm) of fat lies under the skin, to keep the bear warm.

Fur
A thick, shorter layer of fur traps air to keep the polar bear warm. Longer hairs stick together to form a waterproof layer in water.

Paws
Huge paws work like snowshoes on the slippery ice. They are also slightly webbed for swimming.

Polar bears can swim 60 miles (100 km) without a rest.

Which ice age animals became extinct?

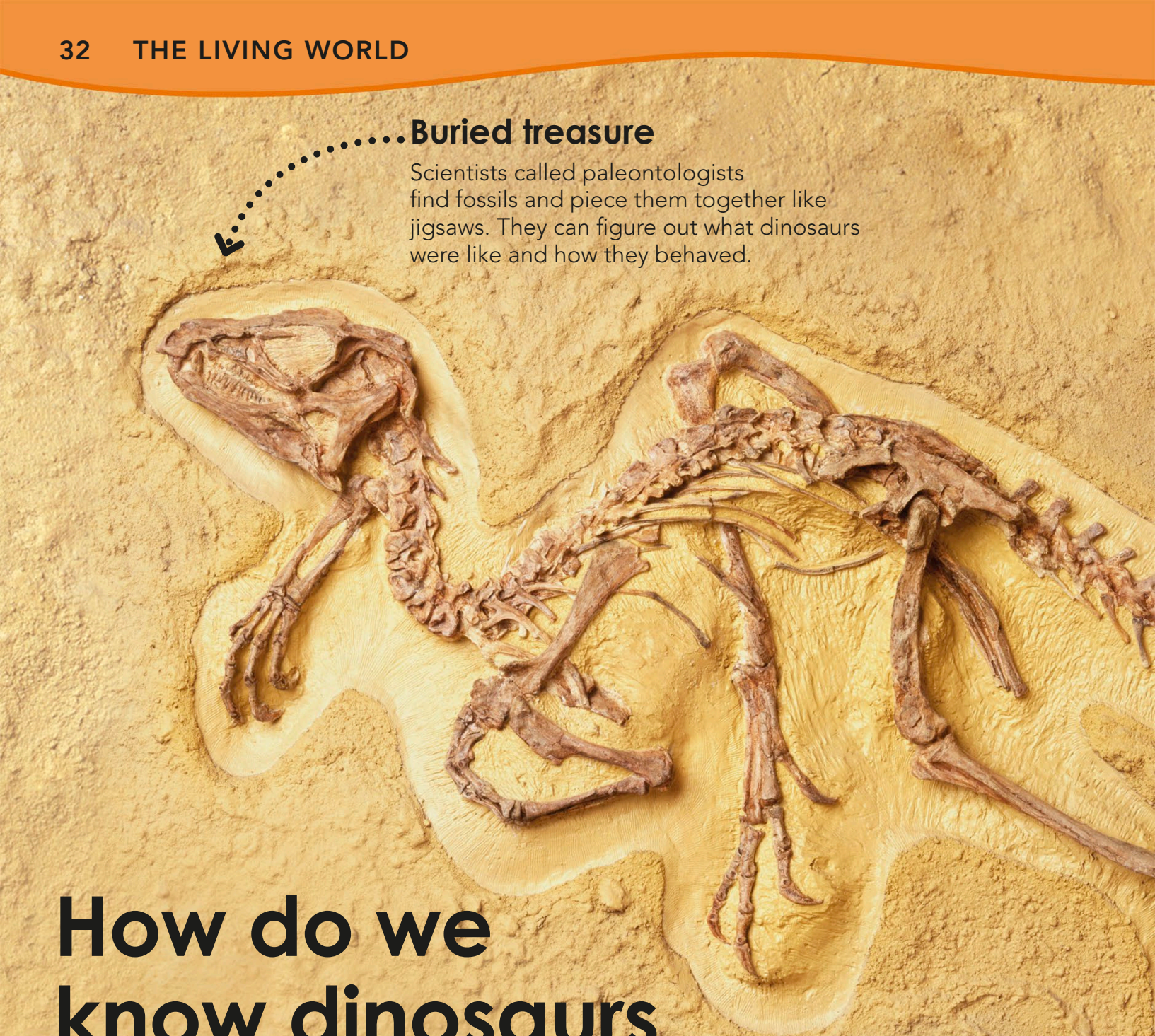
Irish elk
When the snow melted, the Irish elk may have gotten its giant antlers stuck in bushes, making it easy for other animals to hunt.

Woolly mammoth
When it got warmer, more humans hunted mammoths. Eventually there were none left. This is called extinction.

? True or false?

1. A polar bear's favorite food is penguins.
2. Ice age bears were even bigger than polar bears.
3. Polar bears live in the Antarctic.

See pages 132–133 for the answers



Buried treasure

Scientists called paleontologists find fossils and piece them together like jigsaws. They can figure out what dinosaurs were like and how they behaved.

How do we know dinosaurs existed?

Occasionally, after dinosaurs died, they were buried and squashed. Their bones eventually turned into rocks called fossils. There are also fossils of horns, shells, plants, poop, footprints, and even sand-ripple marks on seashores.

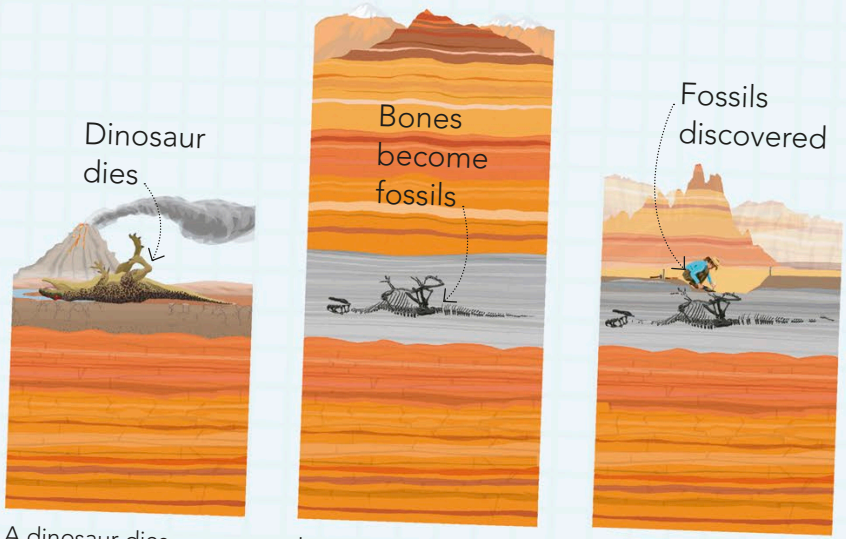
Quick quiz

1. Why are fossils very rare?
2. Can insects trapped in tree sap become fossils?
3. What is the name paleontologists use for fossilized dinosaur poop?

See pages 132–133 for the answers

How are fossils made?

Fossils are made when a dead dinosaur is quickly buried and the hard parts are replaced by minerals to become rock. We find fossils in the ground millions of years after the dinosaur lived on Earth.



A dinosaur dies and is quickly buried by sand, ash, or mud.

Layers squash the buried dinosaur, and the hard parts get replaced by minerals.

The rock lifts up and gets worn away over time and the fossils are uncovered.

Bone into rock

The hard parts of this dinosaur have changed into rock. Minerals and chemicals have slowly replaced the bones.

Prehistoric animals

Dinosaurs became extinct 65 million years ago but we know a lot about them from clues left behind in their fossils.

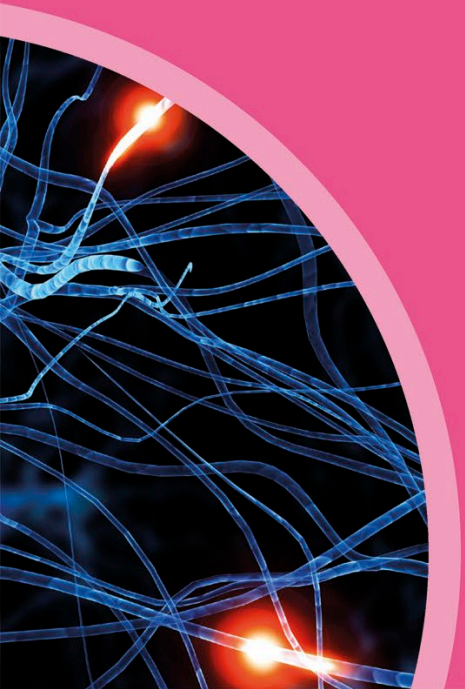
What else did dinosaurs leave behind?

Footprints

Some dinosaur footprints got buried under layers of sand, ash, or mud. They were fossilized in the same way as bones.

Coprolite

Fossilized dinosaur poop is called coprolite. It can tell paleontologists what dinosaurs ate.

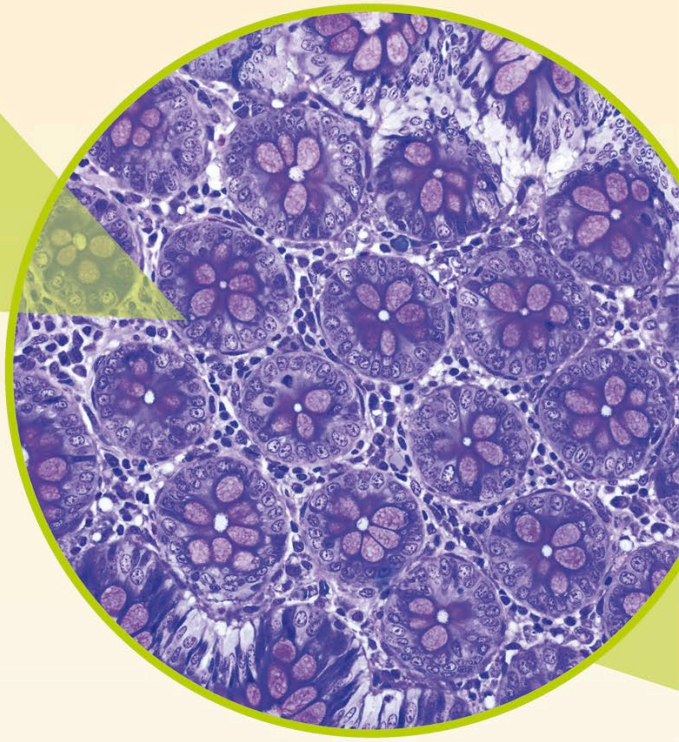


Human Body

Our bodies are made up of cells, organs, and systems. All these parts have important jobs to do to keep us living and moving.

Cells

Each type of cell is a different shape and size depending on the job it does. The intestines contain ruffled cells that absorb nutrients from food.



Tissues

Cells join together to make different types of tissue. The intestines are made up of four types of tissue. These include muscles that push your food through the intestines.

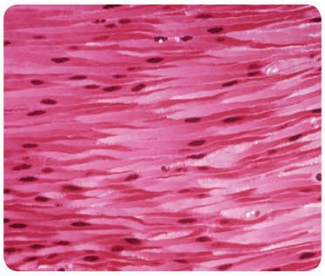
What is my body made of?

Everything in the body is made from tiny parts called cells. Lots of cells joined together make a tissue. Tissues work together as organs. Organs join together in systems. Everything has a job to do to keep the body working.

What jobs can cells do?

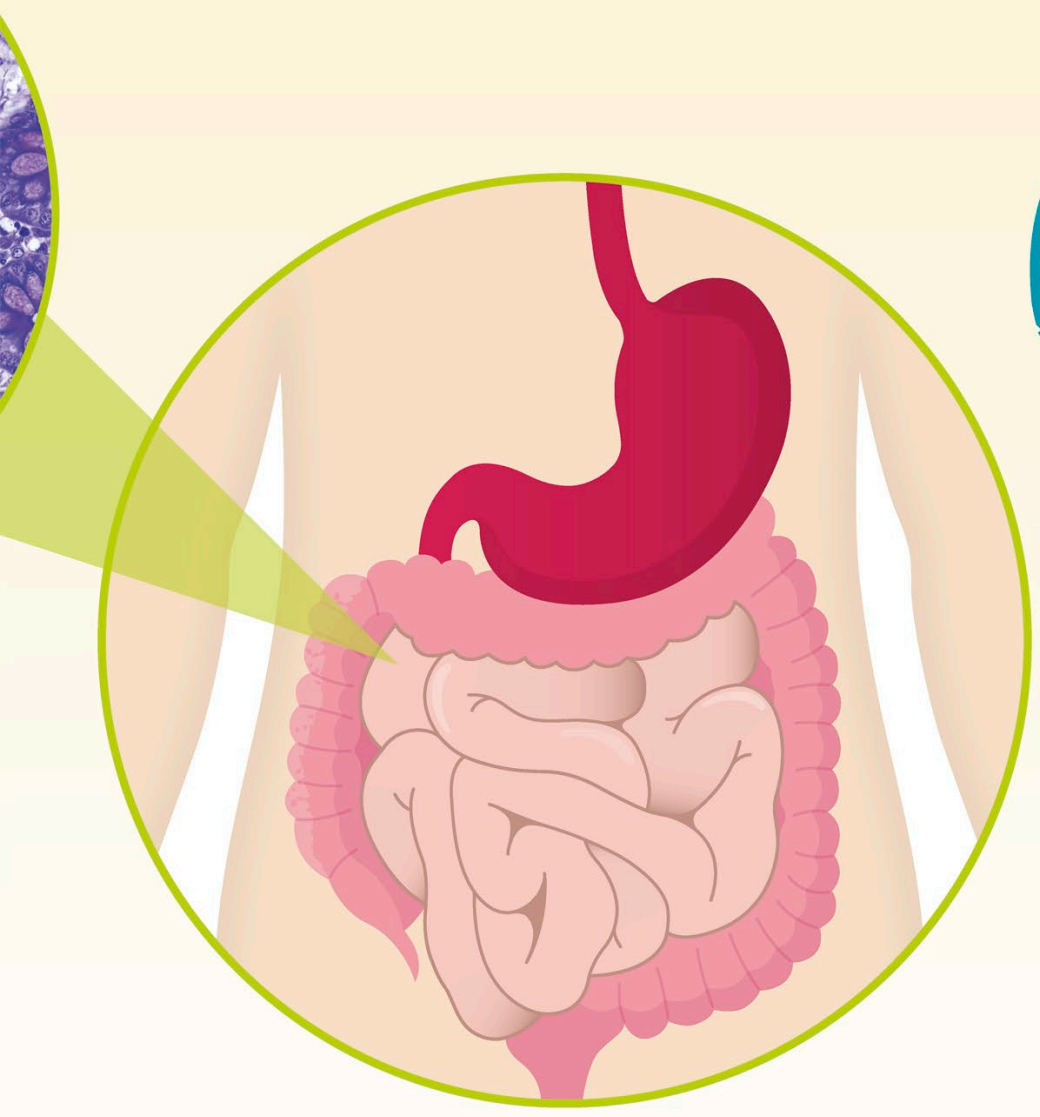
Carry signals

Nerve or neuron cells have lots of branches. Nerve cells connect together to carry electrical signals to the brain from all over the body.



Move things

Muscle cells use energy to tighten and become shorter. When they relax they go back to being long again. This lets them pull body parts around, such as your arms and legs.



Organ systems

Organs work together in groups called systems. The intestines are part of the digestive system. This system includes the organs that process food.

Stem cells can turn into skin, muscle, or blood depending on what your body needs.

Quick quiz

1. Which body cells are round and doughnut-shaped to carry oxygen?
2. Which body system processes food?
3. What is the heaviest organ in the body?

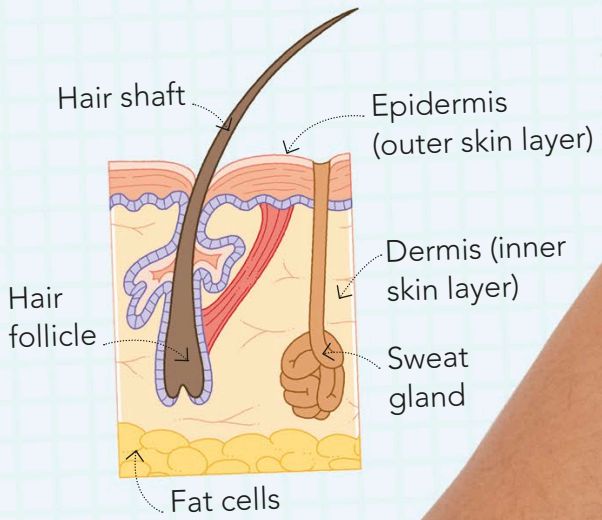
See pages 132–133 for the answers

How big is my skin?

The skin is the waterproof outer layer of the body. It protects our body from sunshine, keeps germs out, and keeps us at the right temperature. The skin is the heaviest of the body's organs.

Skin layers

Our skin has two main layers. The top layer is called the epidermis. The layer below, which hairs grow from, is called the dermis. Fat under the skin cushions us from knocks and bangs.



Skin color

The skin's color is created by a chemical called melanin. The more melanin you have in your skin, the darker it will be.

Fingerprint

Every single person in the world has a unique, swirly skin pattern on their fingertips. This is called a fingerprint.

Keratin

Skin is made of tiny parts called cells. These cells are made from a tough material called keratin.

Skin types

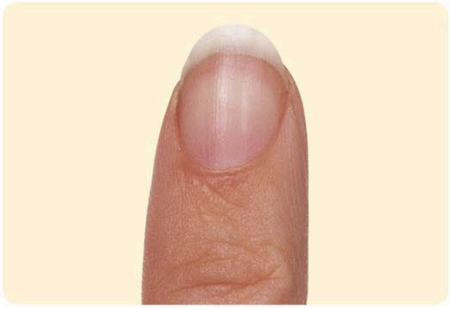
Skin on some parts of the body is different than on others. The skin on our hands is tougher and thicker than the skin on our face.

More than 10 million dead skin cells flake off our bodies every day!

What else is made of keratin?

Hair

Hair grows from holes called follicles in the skin's dermis layer. It grows everywhere on the body except the palms of our hands, soles of our feet, and lips.



Nails

Hard nails protect the ends of our fingers and toes. They also help our fingers to pick up objects or open things.

? True or false?

1. The thinnest skin is found on the eyelids.
2. Skin is waterproof.
3. Skin becomes less elastic with age, making it look wrinkly and saggy.

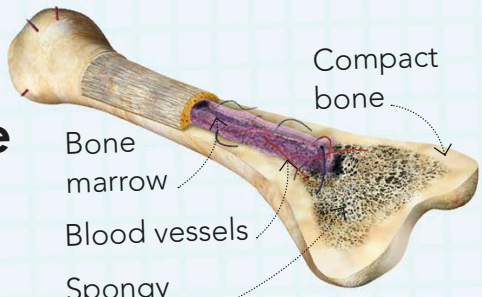
See pages 132–133 for the answers

What do bones do?

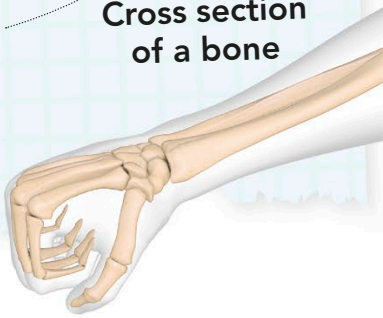
The human body contains 206 bones that form a skeleton. Some bones move, such as our legs when we walk. Other parts of the skeleton are there to protect our inner body parts and to support our body.

Inside a bone

The outer layer is made of strong compact bone. Beneath is spongy bone that contains bone marrow. Bone marrow supplies blood cells to the body.



Cross section of a bone



Pelvis

The pelvis is a circle of bones that include the hip bones. It protects the organs that are lower down in the body.

Femur

This is the strongest, heaviest, and longest bone in the body. The ball-shaped top allows the leg to rotate at the hip.

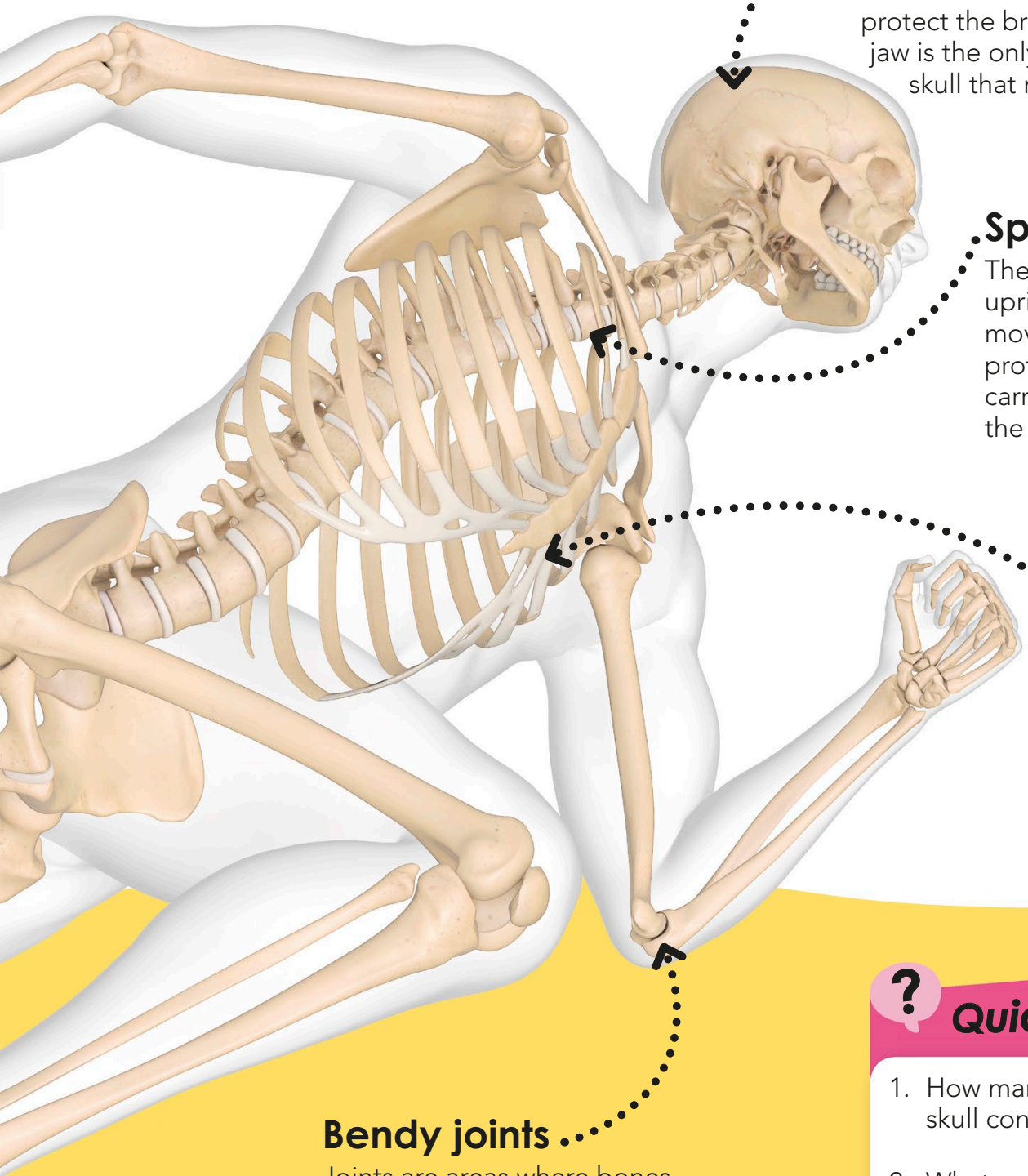
How do we see bones?

X-rays

Doctors shine waves of energy called X-rays through our bodies. X-rays bounce off our bones to show us what they look like.

Spongy bones

The head of the bone is mostly made of spongy bone. This type of bone has lots of little holes inside it that make it lighter.



Skull

The skull contains 22 bones that are locked together to protect the brain. The lower jaw is the only bone in the skull that moves.

Spine

The spine keeps us upright. It allows movement and protects the nerves that carry signals between the brain and the body.

Rib cage

This cage of bones protects the soft lungs and heart. It moves up and down to help inflate the lungs as we breathe.

Bendy joints

Joints are areas where bones join together. Joints allow us to bend or rotate parts of our body.

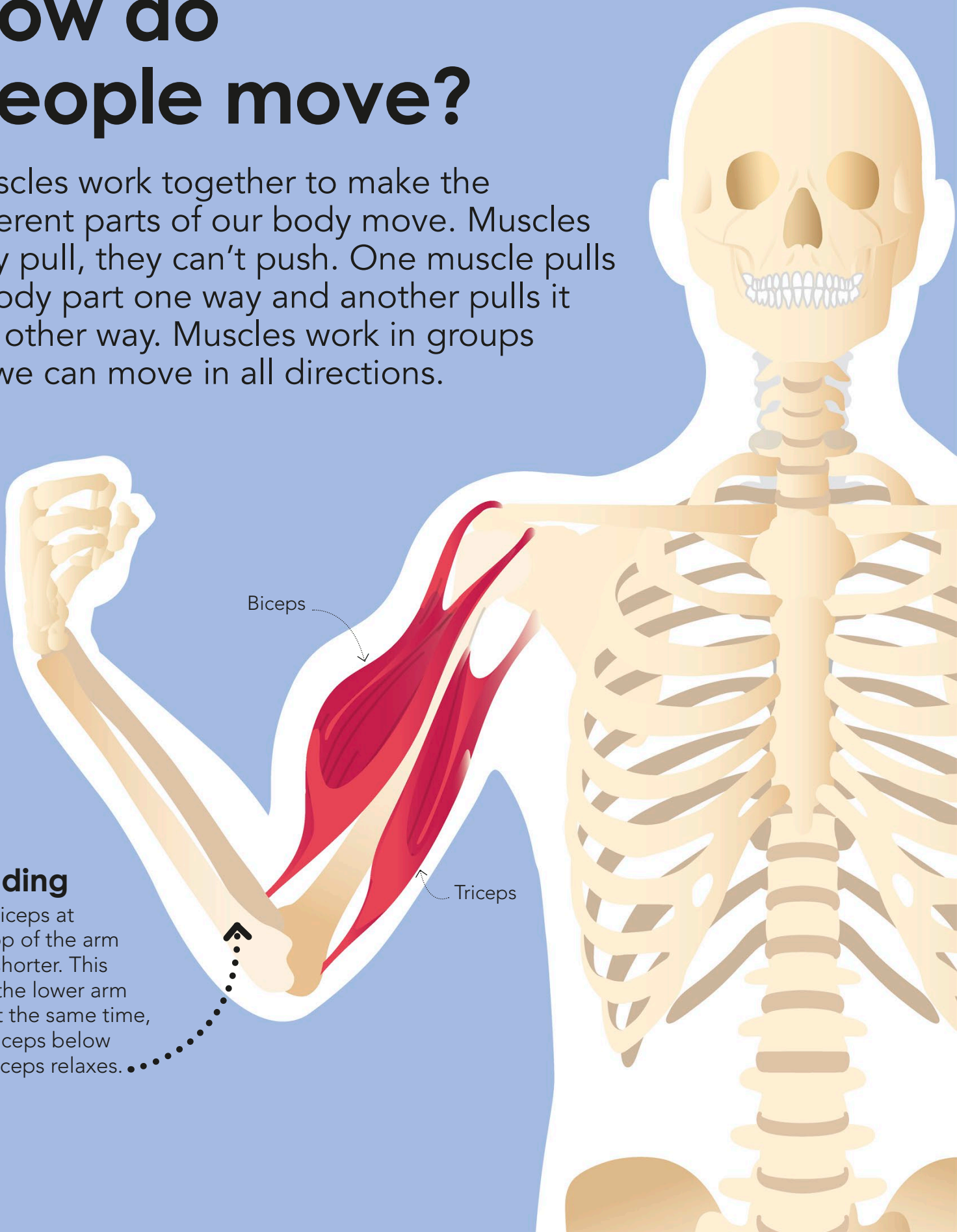
Quick quiz

1. How many bones does the skull contain?
2. What part of the body contains the most bones?
3. How many joints are there in a skeleton?

See pages 132–133 for the answers

How do people move?

Muscles work together to make the different parts of our body move. Muscles only pull, they can't push. One muscle pulls a body part one way and another pulls it the other way. Muscles work in groups so we can move in all directions.



Bending

The biceps at the top of the arm gets shorter. This pulls the lower arm up. At the same time, the triceps below the biceps relaxes.

What happens when a person exercises?

Stronger muscles

The body makes new muscle fibers after exercise. This means muscles get bigger and stronger the more you use them!

Longer and stronger

If you exercise regularly, you'll be able to do it for longer. Heart and breathing muscles get stronger when you use them more. Running, swimming, and cycling all exercise the heart and lungs.

Working together

Muscles work with joints to move the body around. Muscles are connected to the bones by tissues called tendons.

Biceps

Joints

Joints are the places where one bone joins another to allow you to move. Joints have fluid in them to help make movement smooth.

Triceps

Straightening

The triceps under the arm gets shorter, which pulls the lower arm down. At the same time, the biceps above it relaxes and the arm straightens.

? True or false?

1. The biggest muscle in our body is in our behinds.
2. You use 300 different muscles just to stand up without falling over.
3. Muscles can push or pull.

See pages 132–133 for the answers

How do I breathe?

Muscles pull air in and out of our lungs when we breathe. Air enters the body through the nose and mouth. It travels down the windpipe and into the lungs. We need to breathe to stay alive.

Air in

Air enters the lungs as we breathe in.

Ribs out

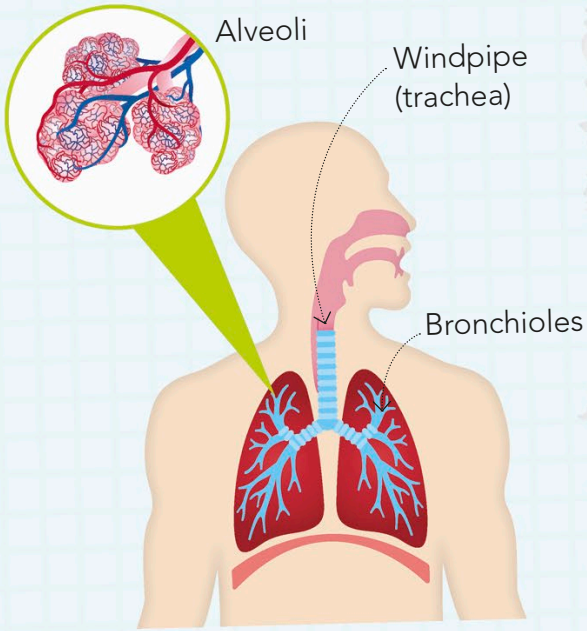
Muscles between the ribs pull the rib cage up and out when we breathe in.

Diaphragm down

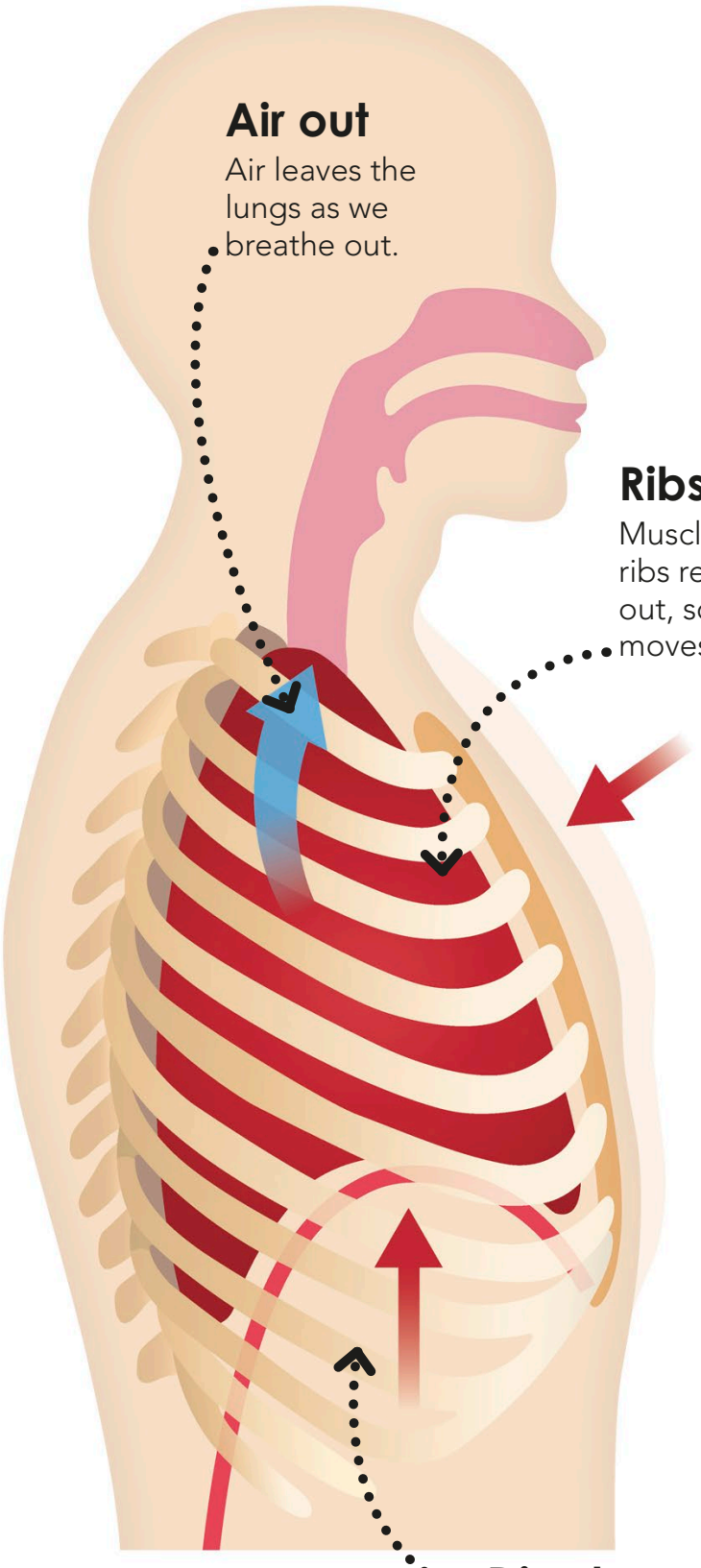
The diaphragm is a sheet of muscle that pulls down to inflate the lungs.

Inside our lungs

The lungs are big, spongy bags full of tubes that end in air sacks called alveoli. Alveoli transfer oxygen gas into the blood.



Inside the lungs



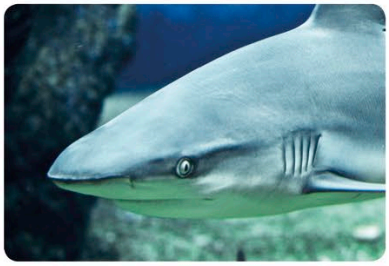
Air out
Air leaves the lungs as we breathe out.

Ribs relax
Muscles between the ribs relax as we breathe out, so that the rib cage moves back in.

Diaphragm up
The diaphragm relaxes to push air up and out of the lungs.

How do animals breathe under water?

Blowholes
Whales and dolphins hold their breath underwater. They must get to the surface of the water, where they breathe using a blowhole on the head.



Gills
Fish, like this shark, suck water into their mouth and push it through organs called gills that take the oxygen they need from the water.

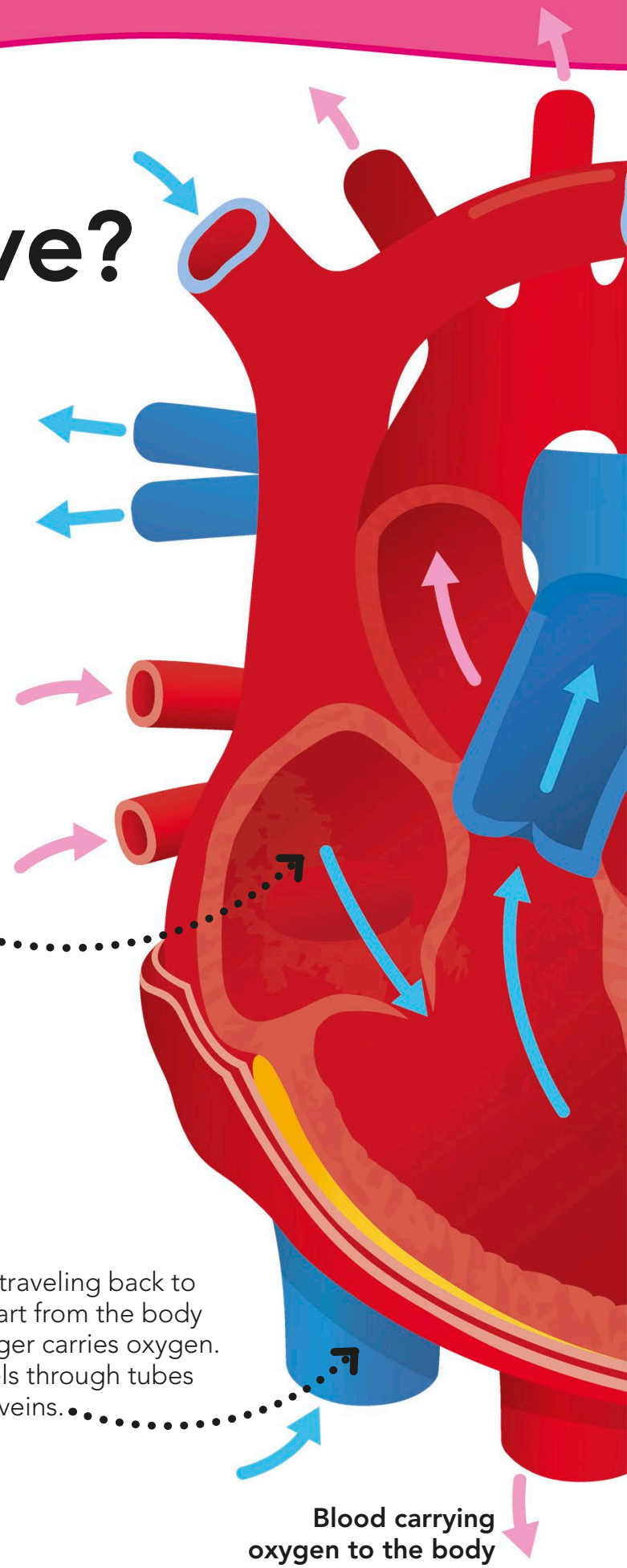
Quick quiz

1. Where does the oxygen we need come from?
2. How many breaths do we take a day?
3. What is another name for the windpipe?

See pages 132–133 for the answers

What makes my blood move?

The heart is a muscle about the size of a fist. It's a pump that squashes in and out around 80 times every minute, moving blood all around the body. If the heart stops pumping, the body stops working immediately.



Blood flow

Blood moves around the body in a circuit. It travels to the lungs to collect oxygen gas and delivers the oxygen around the body before coming back to the heart.

Vein

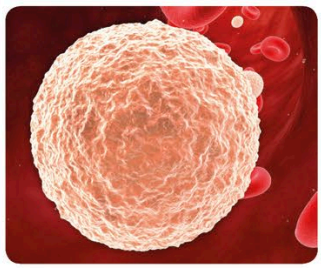
Blood traveling back to the heart from the body no longer carries oxygen. It travels through tubes called veins.

Blood carrying oxygen to the body

What do blood cells do?

Carry gases

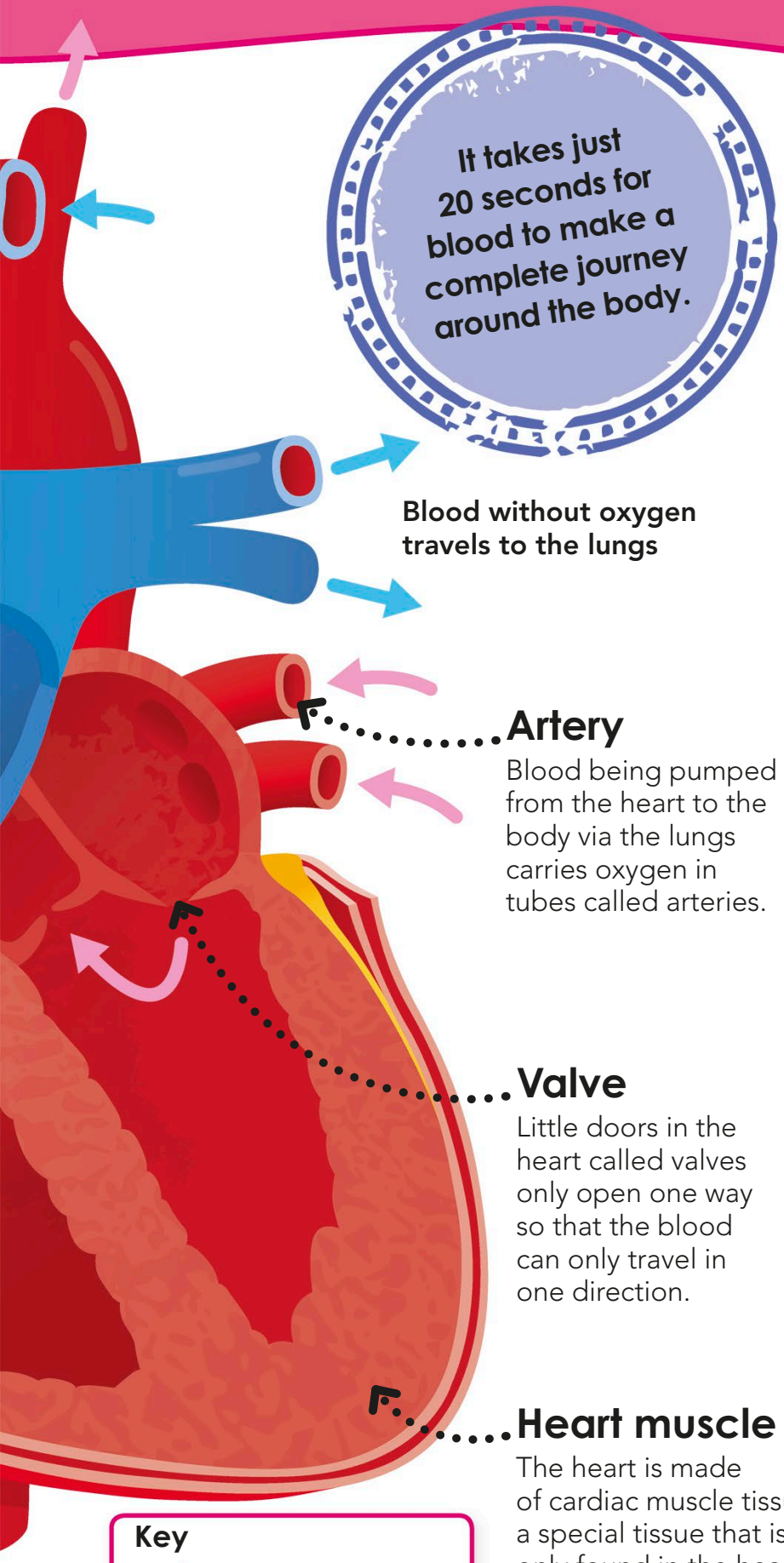
Red blood cells carry oxygen and release it around the body. They also carry waste gas called carbon dioxide.



Fight germs

White blood cells kill germs by squirting killer chemicals at them or by changing shape and swallowing them up.

It takes just 20 seconds for blood to make a complete journey around the body.



Blood without oxygen travels to the lungs

Artery

Blood being pumped from the heart to the body via the lungs carries oxygen in tubes called arteries.

Valve

Little doors in the heart called valves only open one way so that the blood can only travel in one direction.

Heart muscle

The heart is made of cardiac muscle tissue, a special tissue that is only found in the heart.

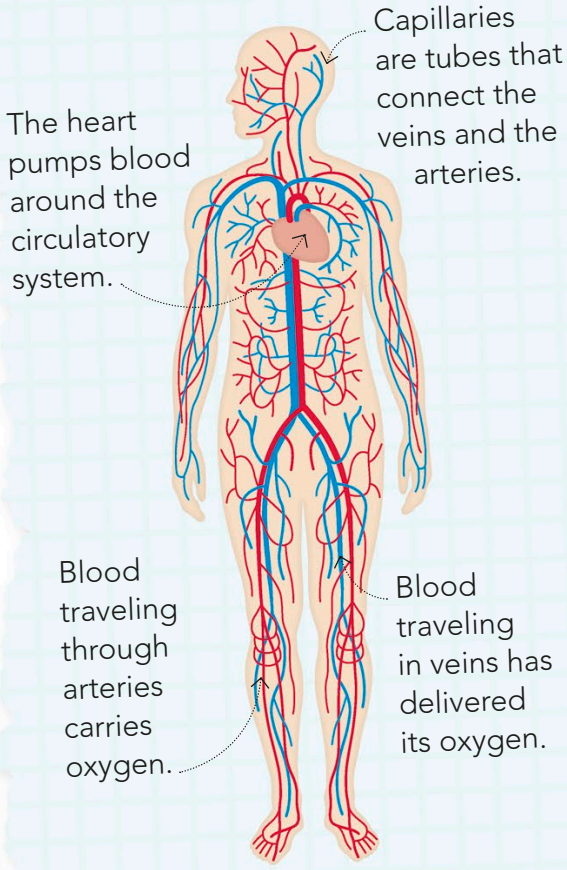
Key

With oxygen

Without oxygen

Circulatory system

The heart and tubes that connect the blood to the body are called the circulatory system. Blood carries water, gases, sugar, and heat.



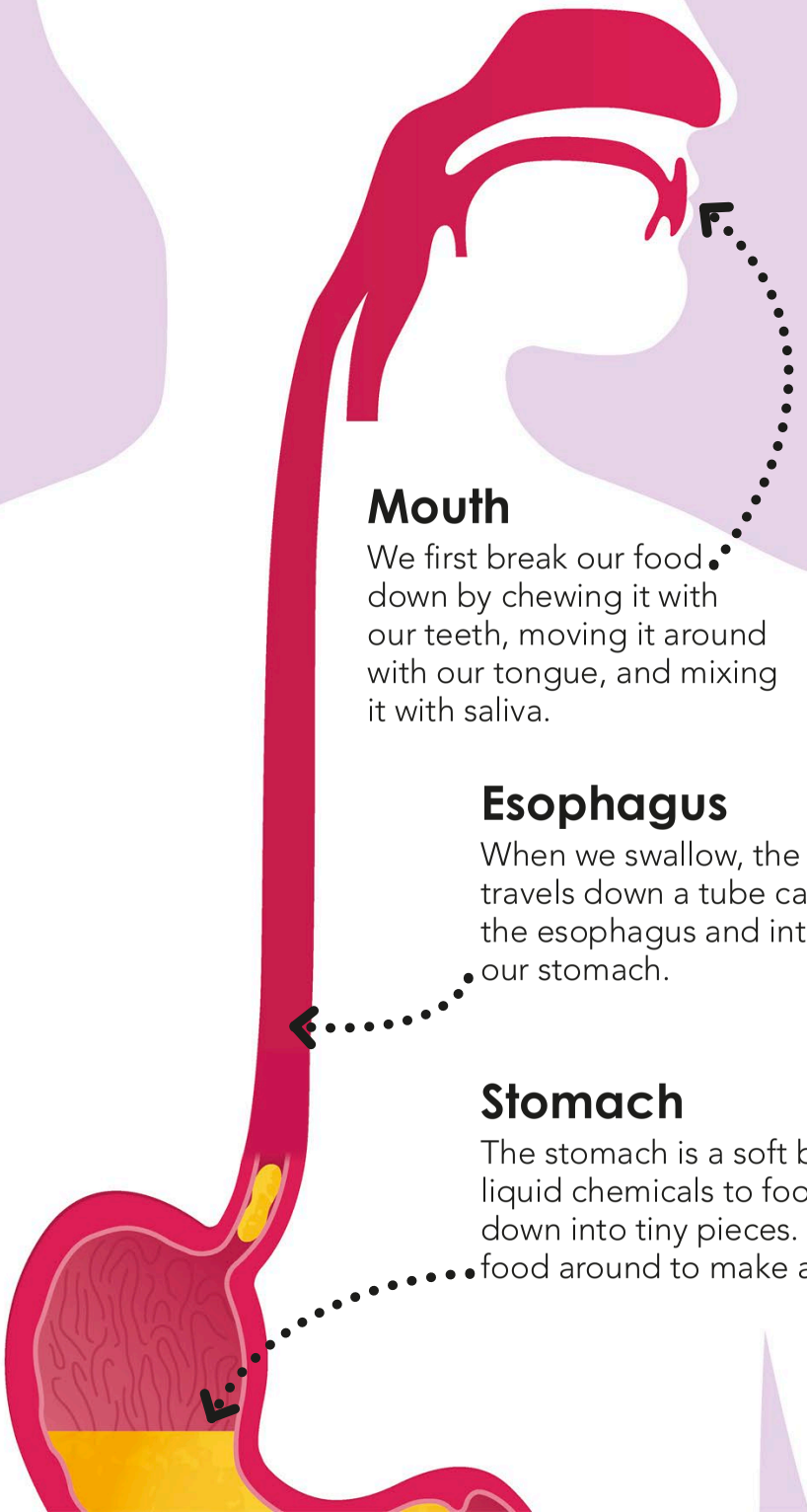
? True or false?

1. Blood is as salty as sea water.
2. Blood cells are made inside the lungs.
3. Blood that travels to the lungs doesn't contain oxygen.

See pages 132–133 for the answers

Where does my food go?

The food we eat goes on a journey through our bodies. It travels down a tube in the throat called the esophagus and into the stomach, where acid breaks it down. Next, it moves through the intestines. Then, finally, solid food waste is pushed out as poop.



Mouth

We first break our food down by chewing it with our teeth, moving it around with our tongue, and mixing it with saliva.

Esophagus

When we swallow, the food travels down a tube called the esophagus and into our stomach.

Stomach

The stomach is a soft bag that adds liquid chemicals to food to break it down into tiny pieces. It churns the food around to make a soupy liquid.

Quick quiz

1. How do the intestines move food along?
2. What foods give our body a quick release of energy, but can be bad for us if we eat too much of them?
3. How long does it take for food to pass all the way through our bodies?

See pages 132–133 for the answers

Small intestine

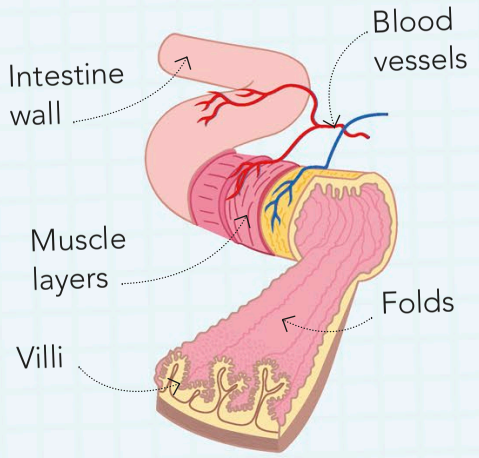
The mushed-up food and liquid travels through the small intestine. Goodness from the food travels through the walls of the intestine and into our blood.

Large intestine

Waste food that we don't need goes into the large intestine. It stays there until we push it out as poop.

Inside the small intestine

The walls of the small intestines have lots of wiggly folds. These increase the area that is able to absorb (take in) food. Tiny hair-like villi absorb the goodness from the food and transfer it to the blood.



The small intestine

How does food help our bodies?

Proteins

Proteins are found in meat, fish, beans, nuts, and eggs. They help our bodies to grow and to repair.

Carbohydrates

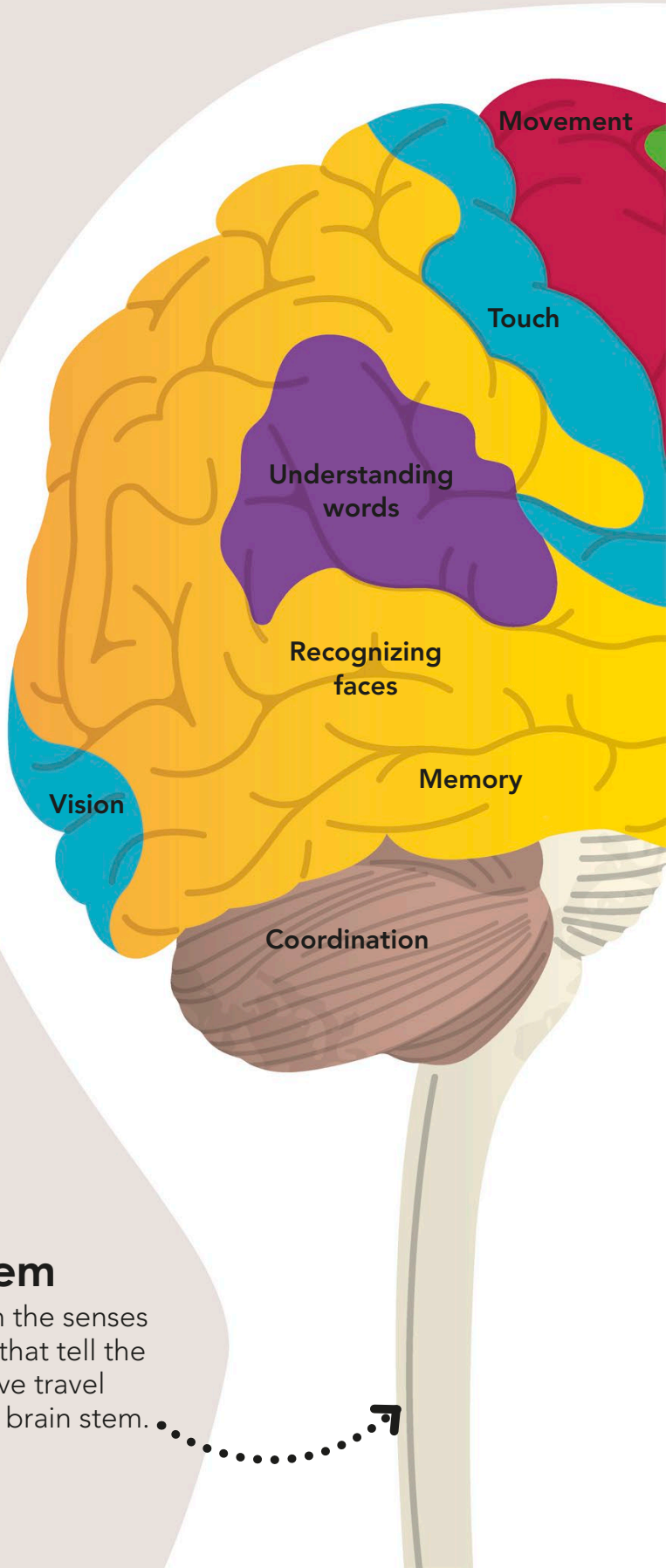
Carbohydrates are found in pasta, potatoes, rice, and bread. They give our bodies the energy that they need.

Fruits and vegetables

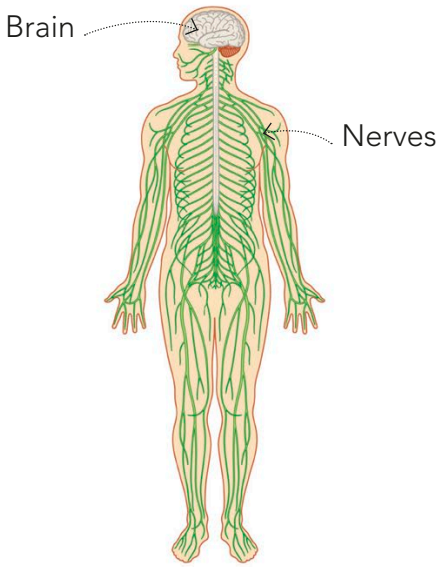
Fruits and vegetables contain fiber that helps us digest food. They also contain vitamins and minerals that keep our body parts working.

What controls my body?

The brain is the control center for the body. It is connected to the senses by a network of tiny paths called nerves. Signals for things such as hunger and thirst also travel along nerves. Every time we move, breathe, or think, our brains are at work.



How is the brain connected to the body?

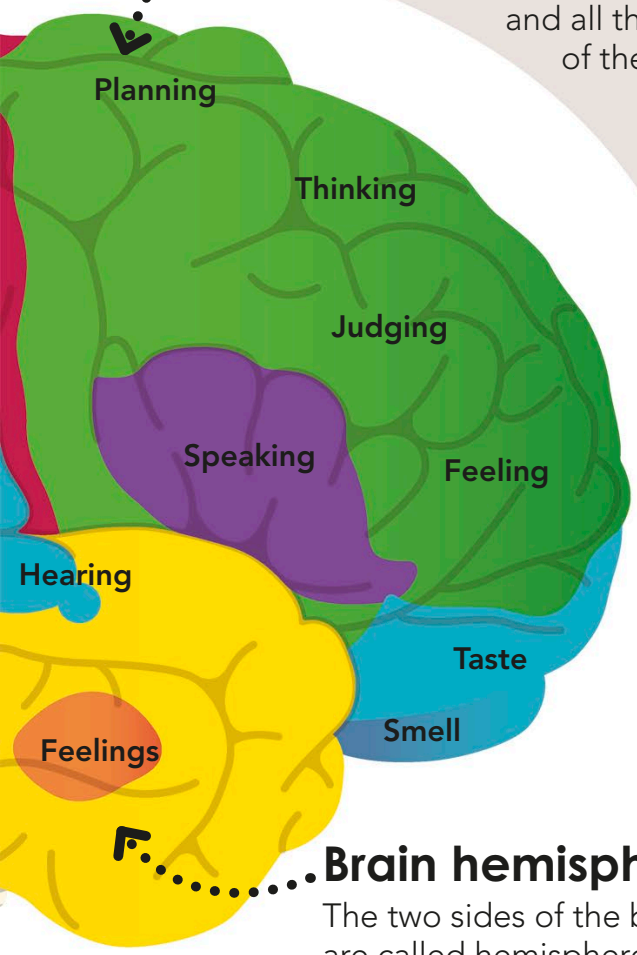


Central nervous system
A network of nerve cells carry messages between the different parts of the body and the brain.

Brain stem
Signals from the senses and signals that tell the body to move travel through the brain stem.

Different jobs

Different parts of the brain are responsible for different jobs in the body. Signals travel between these areas and all the parts of the body.



Brain hemispheres

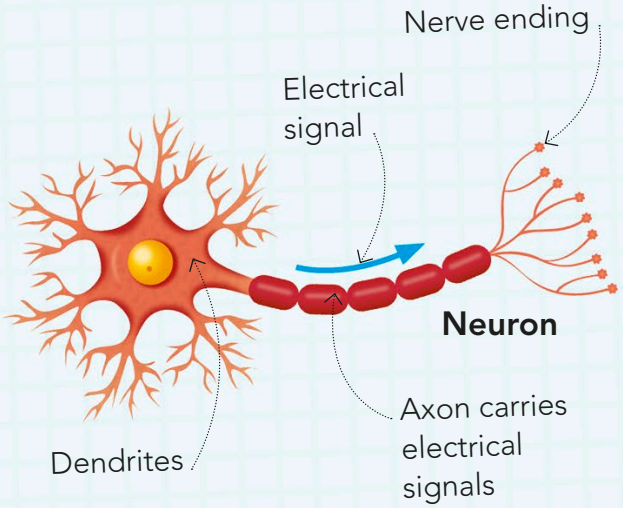
The two sides of the brain are called hemispheres. The right hemisphere controls the left side of the body and the left hemisphere controls the right.

Key

- Senses
- Thoughts
- Language
- Movement
- Understanding the world
- Feelings
- Coordination

Nerve cells

Thoughts travel as electrical signals along dendrites to the nerve ending. Chemicals pass the thought on to the next nerve.



Quick quiz

1. What happens in the brain during sleep?
2. How many hemispheres does the brain have?
3. How did the ancient Egyptians remove the brain when they were making a mummy?

See pages 132–133 for the answers

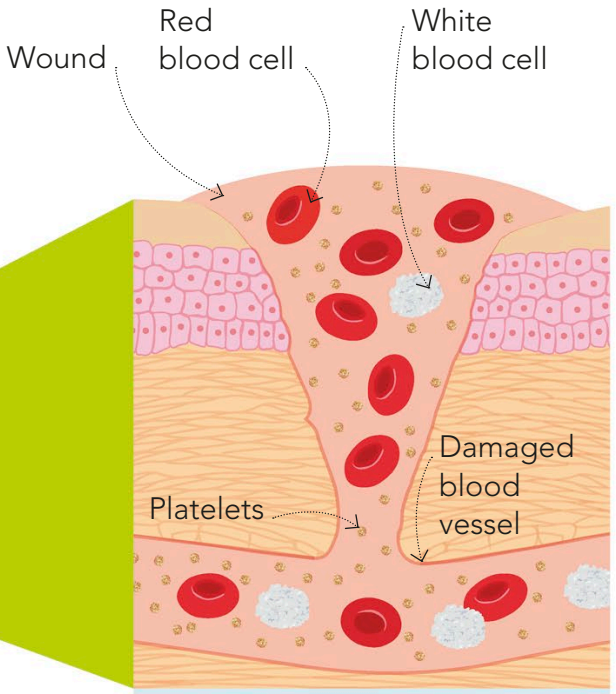
How do cuts heal?

When we get a cut, blood comes out of the break in our skin and repairs the damage. It sticks together and changes from a liquid to a solid called a clot. A hard scab forms on top and new skin cells are made underneath. When the wound has healed, the scab falls off.

The top layer of your skin is completely replaced every month.

Cuts and scrapes

When you get a cut, blood leaks out and starts to clot. A clot is solid blood that seals a wound. Three types of blood cells work together to heal the cut.



Wound

When something breaks through the top layer of skin into a blood vessel, blood leaks out. White blood cells fight germs by squirting killer chemicals at them and swallowing them.

How do bones mend?

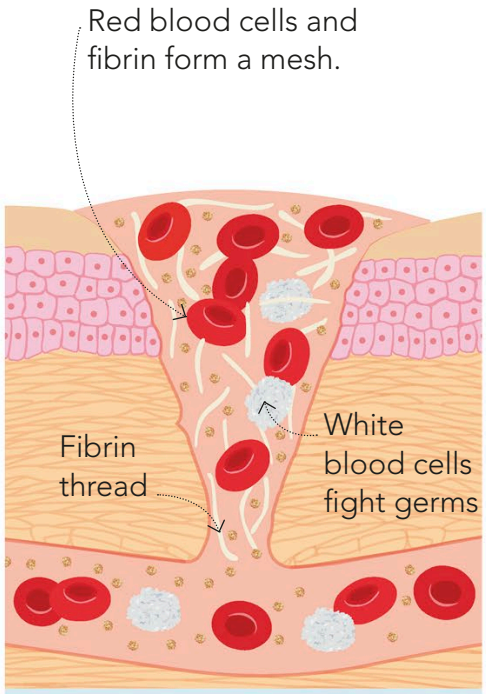
Healing fractures

If a bone breaks, it can heal itself if it is kept still. Blood fills the gap with a clot, which then turns into a body tissue called cartilage. Finally, new bone is created by the body's cells.

True or false?

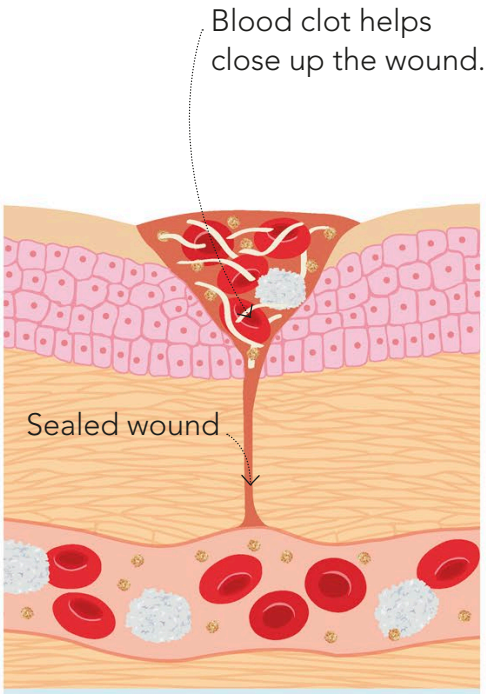
1. The top layer of your skin is replaced every year.
2. Leeches can stop blood from clotting.
3. A group of tiny cuts is called a blister.

See pages 132–133 for the answers



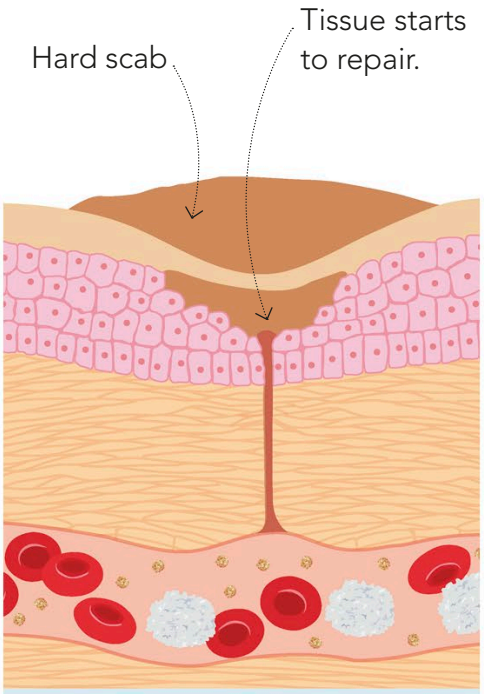
Closing up

Cells called platelets change shape and make strands called fibrin. These strands act like a net to trap red blood cells and gather them together.



Clot

When enough red blood cells are trapped by the fibrin net, they make a clot. Liquid blood can turn into solid blood in just a few minutes.



Healed skin

A hard layer called a scab forms at the top of the clot. New skin cells are made under the clot. The scab falls off after a few days, leaving new skin.

How does my body fight sickness?

Germs can enter our bodies and make us sick. The body has a system in place to stop germs from getting into the body and to fight those that do get in.

Ears

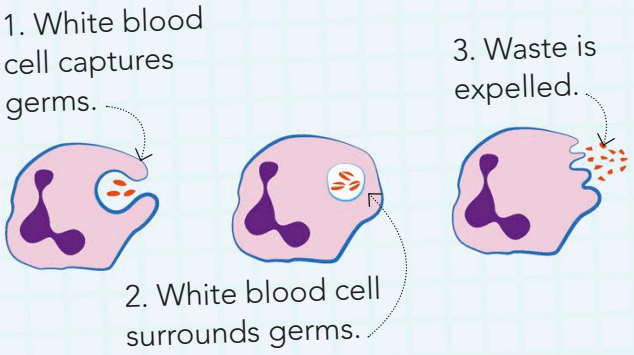
Ears produce a yellowish, waxy fluid that fights germs by pushing them out.

Skin

The skin is a waterproof layer that covers and protects the inner parts of our body, keeping germs on the outside.

White blood cells

White blood cells kill germs in the body. They travel around in the blood. When they find germs, the white blood cells squirt killer chemicals at them or swallow them up.

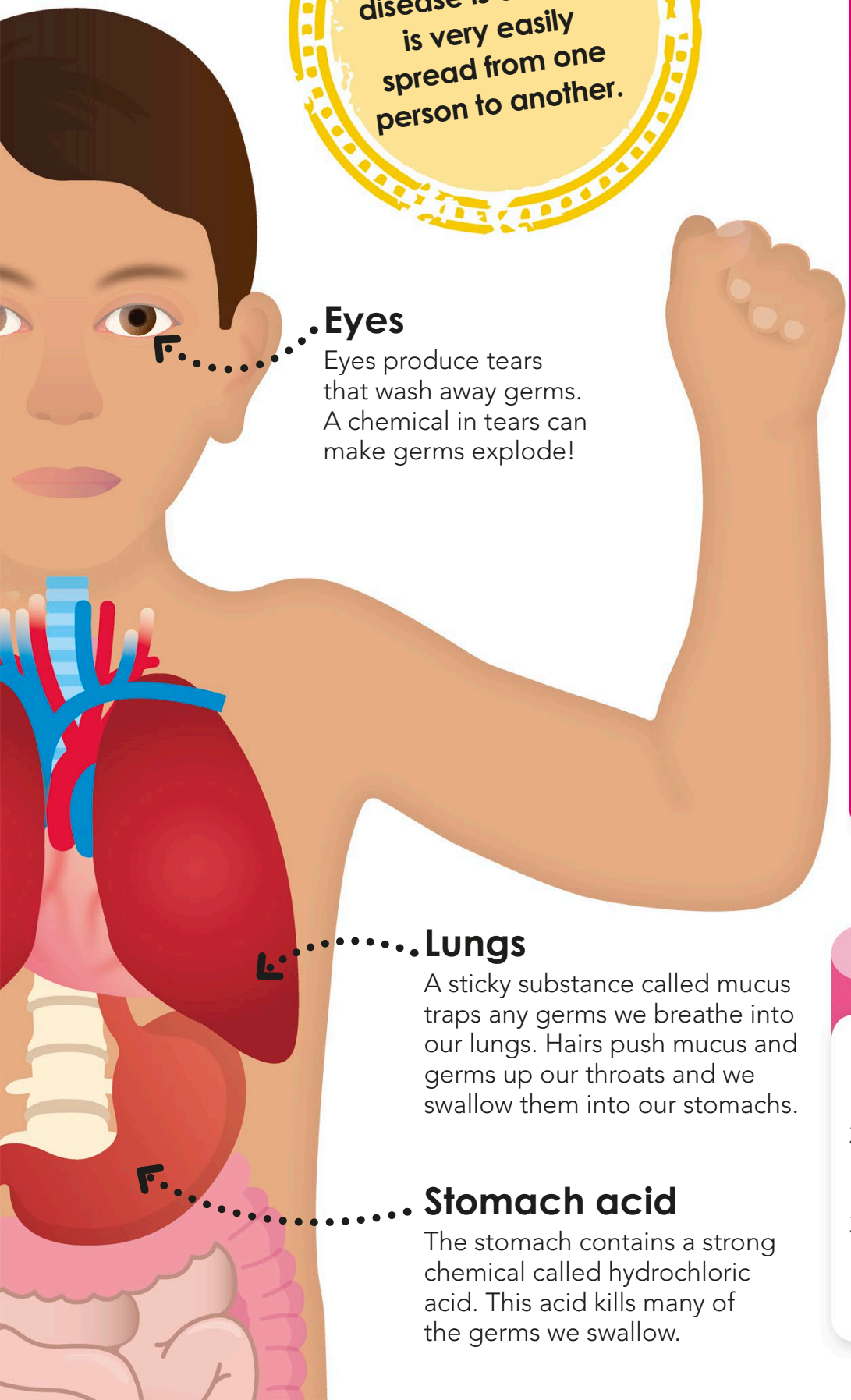


Some white blood cells surround germs and then destroy them

Intestines

Mucus in the intestines catches germs and stops them from getting into the blood. Friendly bacteria help food digestion and stop germs from growing.

A "contagious" disease is one that is very easily spread from one person to another.



Eyes

Eyes produce tears that wash away germs. A chemical in tears can make germs explode!

Lungs

A sticky substance called mucus traps any germs we breathe into our lungs. Hairs push mucus and germs up our throats and we swallow them into our stomachs.

Stomach acid

The stomach contains a strong chemical called hydrochloric acid. This acid kills many of the germs we swallow.

What else helps us fight sicknesses?

Vaccines

Vaccines give our body a tiny amount of a disease, so our bodies can learn how to fight it off.

Medicine

Medicines are used to cure sickness or make us feel better. They come in many different forms.

Quick quiz

1. Which types of blood cells fight germs?
2. What do tonsils do for the body?
3. How does saliva (spit) protect our bodies?

See pages 132–133 for the answers

The Material World

Materials can change shape and be used to make things. They can be mixed together and separated, or they can react together to make new things.

What is everything made of?

From the smallest insects to massive stars, everything in the universe is built from tiny particles called atoms. Atoms are so small we can't even see them. They contain even smaller particles called protons, neutrons, and electrons.

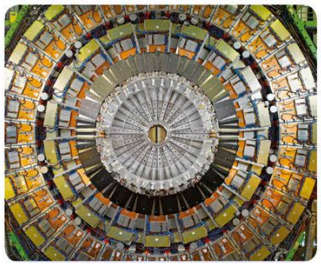
What happens when you split an atom?

Nuclear energy

Splitting atoms releases large amounts of energy. This can be used to create electricity in a nuclear power station.

Nuclear explosion

When atoms split, neutrons ping into other atoms, making them split, too. This can create a huge explosion of heat and energy.



Particle accelerator

Scientists speed atomic particles along tracks and crash them into each other in order to learn more about atoms.

Electrons

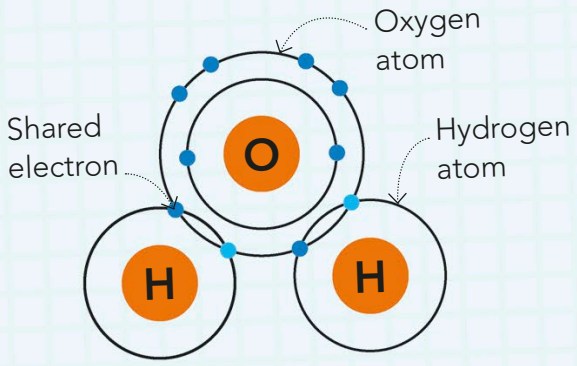
Electrons are negatively charged particles that move around. They are attracted to the atom by protons.

Nucleus

The nucleus is at the center of the atom. It is made up of protons and neutrons.

Molecules

Atoms stick together in groups called molecules. The shells of atoms overlap and they share electrons between them. For example, water is made from two hydrogen atoms and one oxygen atom.



Structure of a water molecule

Protons

Protons are positively charged particles. They attract electrons to the atom. The number of protons in an atom is called the atomic number.

Neutrons

Neutrons are particles that have no electric charge. All atoms have equal numbers of neutrons and protons, apart from hydrogen, which has one proton and no neutrons.

Quick quiz

1. Which atomic particle has no charge?
2. What do we call electricity made by the heat released by splitting atoms?
3. What do we call atoms that are joined together in a group?

See pages 132–133 for the answers

Why does chocolate melt?

Materials can be solid, liquid, or gas, depending on the temperature and how squashed they are. Chocolate is solid at room temperature. When we heat it up, the tiny particles inside the chocolate start to move past each other. This makes the chocolate melt and change into a liquid.

Solid
A solid keeps its shape. If you stack solids they make a pile not a pool.

Quick quiz

1. What do we call the process of changing from a liquid to a solid?
2. Which state of matter has the most tightly packed particles?
3. What metal is liquid at room temperature?

See pages 132–133 for the answers

Water is the only substance found naturally in all three forms on Earth—solid, liquid, and gas.

What melts in nature?

Glaciers

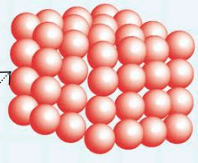
Big sheets of ice, known as glaciers, start to melt as the temperature increases. Sometimes huge chunks of ice fall into the sea as a result.

Volcanoes

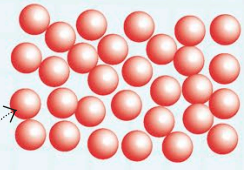
Rock melts when it is very hot and lots of weight pushes down on it. This hot, melted rock explodes out of volcanoes as lava.

Changing states

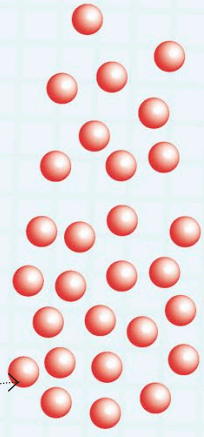
Materials can sometimes change from being solid to liquid, and then to gas. This happens if we add heat or squash them. Materials can then change back as they cool or if we stop squashing them.



Solids have particles packed close together and in straight lines.



Liquids have particles in small groups that move past each other.



Gases have particles that move away from each other in all directions.

Liquid

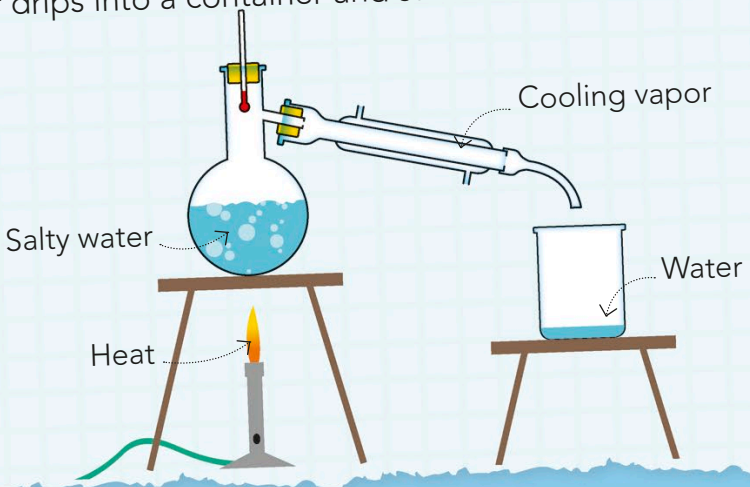
A liquid can be poured. It makes a pool not a pile.

How can I get salt out of saltwater?

Saltwater is a mixture of water and salt. The salt has dissolved into the water so we can no longer see the individual grains. We can get salt out of saltwater by letting the water evaporate, or through a process called distillation.

What is distillation?

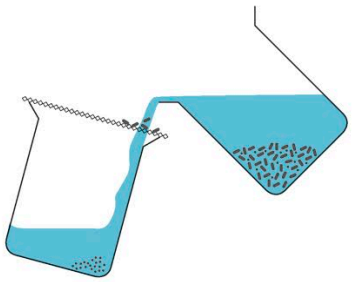
Distillation is when liquid is separated from a mixture. Boiling salt water turns the water into a gas called water vapor. The gas goes into a tube, cools, and turns back into liquid. The water drips into a container and salt is left behind.



Mining for minerals

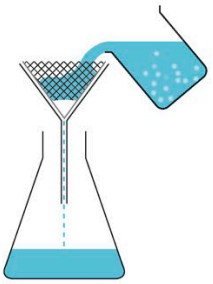
People collect the salt by raking it up into piles. These are transported to factories to be turned into the salt we eat.

How else can mixtures be separated?



Sieving

A sieve collects larger solids but allows smaller solids through. For example, it could separate pebbles from sand.



Filtering

A filter is a material that works like a net to trap solid materials and let only liquids through.

Quick quiz

1. Can you drink saltwater?
2. Is the water in rivers and lakes salty?
3. What is it called when a liquid is warmed up and turns into a gas?

See pages 132–133 for the answers

What is a metal?

Metals are useful materials. They can be used for making different things depending on how they behave. They can be strong, shiny, or malleable, which means they can be shaped easily. Metals also let electricity move through them.

Mercury is the only metal that is a liquid at room temperature.

Aluminum

Aluminum is a light, strong metal that does not rust easily. It can be shaped into lots of different things, such as bicycles, drink cans, and airplanes.

Malleable (easily shaped)

Iron

Iron is hard, strong, and long-lasting. When iron is left in the open air for too long, it rusts, and so is often coated in paint to protect against this.

Hard and strong

What do we get by mixing two metals?

Brass

A mix of two or more metals is called an alloy. Brass is a mixture of copper and zinc. It is used to make musical instruments and coins.

Steel

Steel is iron with other things added to make it less likely to rust, or to make it stronger. It is used to make cutlery, ships, and tools.

Picture quiz

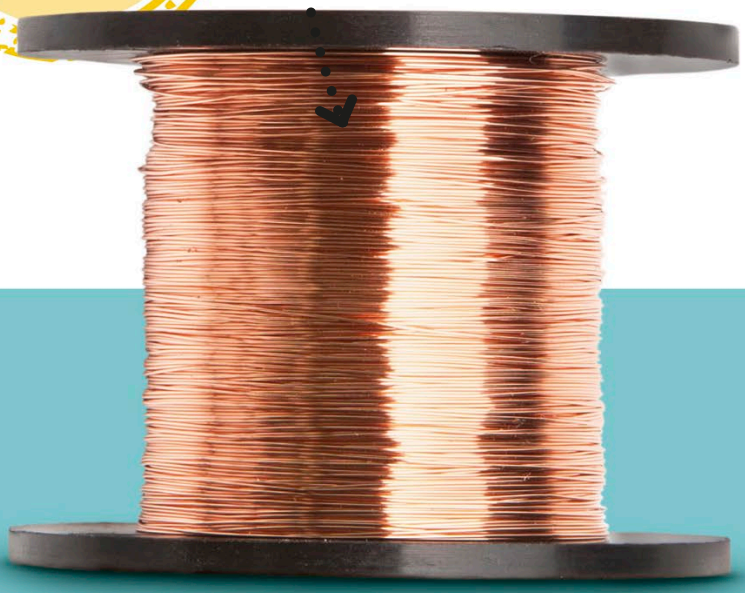
What happens when iron is left exposed to the air?

See pages 132–133 for the answer

Copper

Copper can be easily shaped into wire or flattened into sheets. Copper is a good conductor, which means electricity passes through it easily.

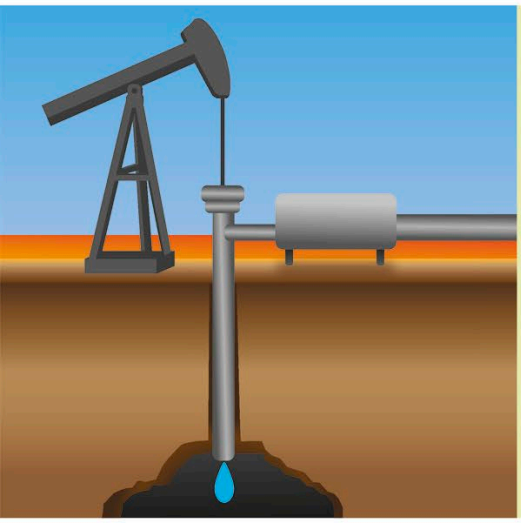
Conducts electricity and heat



Gold

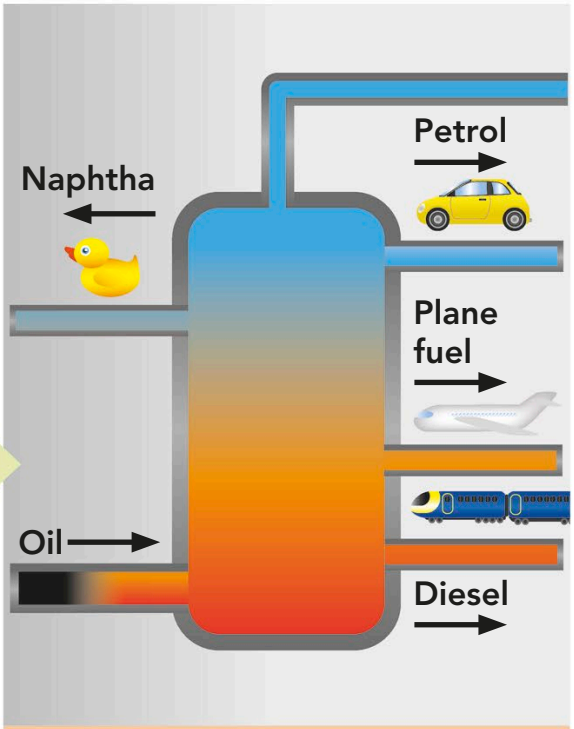
Gold is a shiny, beautiful soft metal. It can be easily melted and shaped. Gold is rare and expensive.

Shiny



Extracting oil

Engineers drill into the ground to find oil. They pump water down the hole to where the oil is. Oil floats on water, so it rises up and comes out of the ground.



Refining oil

Oil is made from various liquids that all boil at different temperatures. When it is heated up, the oil separates into different things, such as gasoline and naphtha. Naphtha is used to make plastic.

How is plastic made?

Most plastics are made from crude oil. Crude oil was made when tiny plants and animals called plankton got squashed underground millions of years ago. It takes many steps to turn oil into plastic.

What can plastic be used for?

Shopping bags

Plastic is used for shopping bags because they need to be light and strong. Plastic bags should be reused because they take a long time to break down if you throw them away.

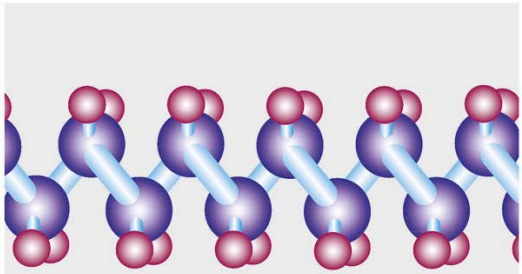
Toys

Plastic toys come in bright colors, and will last a long time even if you play with them a lot. Plastic can easily be turned into different shapes to create any toy the inventors come up with.

True or false?

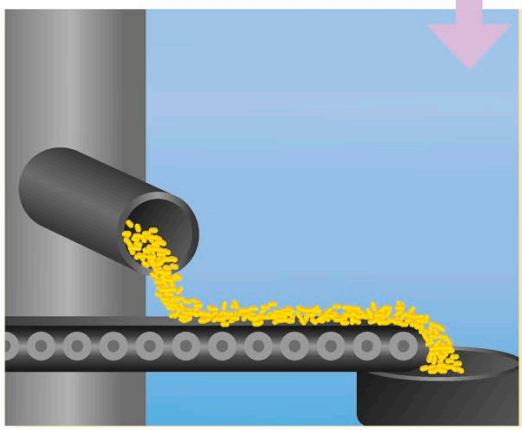
1. Plastic is made from oil.
2. 80 percent of our plastic worldwide is recycled.
3. It takes around 500 years for a plastic bottle to decompose.

See pages 132–133 for the answers



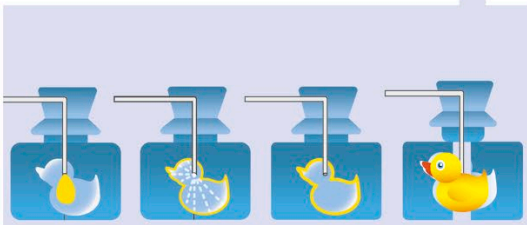
Chemical process

Naphtha is heated and chemicals are added. This makes the tiny particles it is made from into long chains. The chains are then broken down into solid plastic pellets.



Melting down

The pellets are melted into liquid plastic. Other chemicals and colors are added to make different types of plastic.



Shaping objects

The plastic is poured into a hollow mold and air is blown in to make the plastic stick to the walls. It cools to become a solid plastic duck.

Finished product

The final product is a bright plastic toy duck that floats and will last for many years.

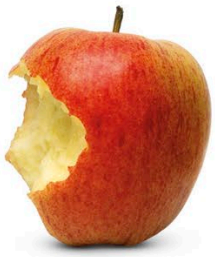
What makes fireworks explode?

When two substances meet they sometimes react—they might start to fizz or change to create something new. This is called a chemical reaction. Some chemical reactions produce explosions. The beautiful explosions of color we see in fireworks are made by chemical reactions.

Colors

Fireworks have metal chemicals added to them so they glow different colors. Lithium produces red fireworks and sodium salts create yellow ones.

Where else do we see chemical reactions?



Apple turning brown

The insides of an apple start to turn brown in a chemical reaction with oxygen in the air.

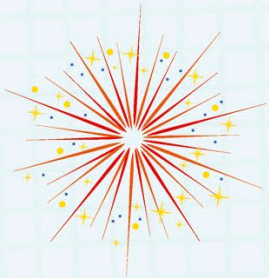
Metal rusting

Iron reacts with water and oxygen in the air to make a reddish-brown substance called rust.

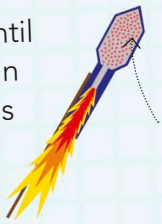
Making a bang

Fire traveling through a firework causes chemical reactions inside it. These reactions create the explosions people enjoy watching.

4. When the fire reaches the gunpowder, there is a huge explosion of heat, light, and color.



3. The firework burns until the fire reaches the main chamber, which contains gunpowder mixed with metal chemicals.



2. The gunpowder explodes, releasing enough energy to launch the firework into the air.

1. The fuse is lit. It burns slowly until it reaches a first, small amount of gunpowder.

? True or false?

1. When you bake a cake, a chemical reaction takes place.
2. Burning fuel is a type of chemical reaction.
3. Not all fireworks use chemical reactions.

See pages 132–133 for the answers

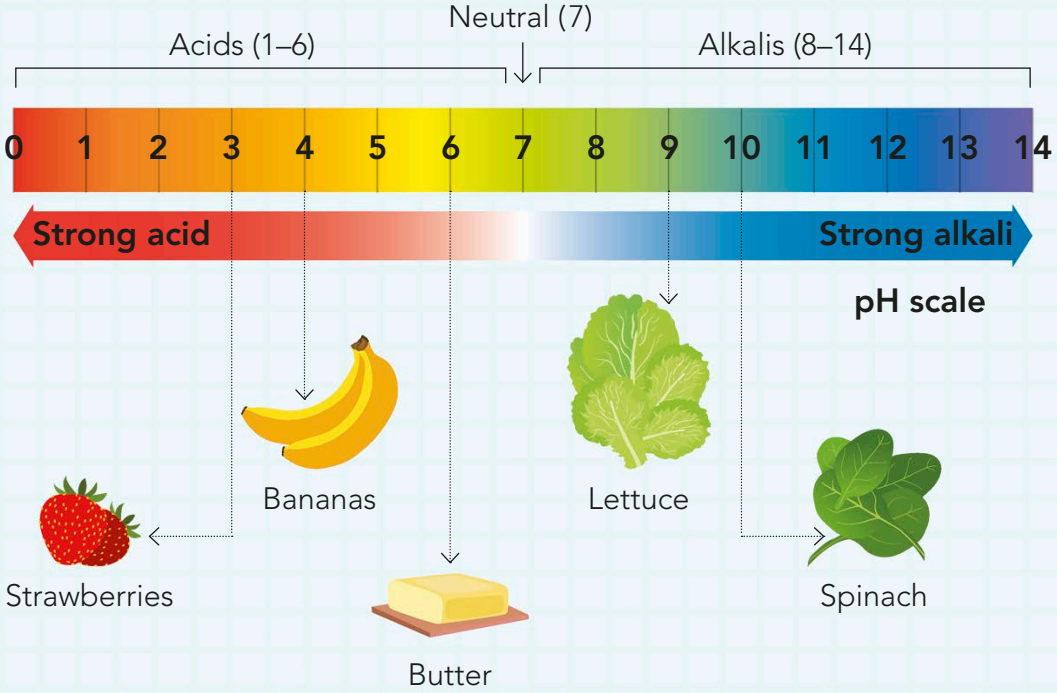
Why is lemon juice sour?

Lemon juice tastes sour because it contains citric acid. Acids make things taste sharp or sour. Strong acids are dangerous and can burn through metal. Weak acids are safe to eat and drink.

The sourest food in the natural world is the gooseberry.

What is a pH scale?

We measure acid on a scale called the pH scale. The lower the number, the more strongly acidic it is. At the other end of the scale are alkalis. If the number is higher than seven, the liquid is an alkali.



Sharp taste

Lemon juice contains high levels of citric acid, which has a pH value of 2. This gives lemons their strong, sharp taste.

What other foods are acidic?

Canned tomatoes

Canned tomatoes have a pH level of 3.5. Tomatoes contain a mixture of weak acids, which are safe to eat.

Vinegar

Vinegar contains acetic acid, which gives it a pH level of 3. It is used to add a sour flavor to food.

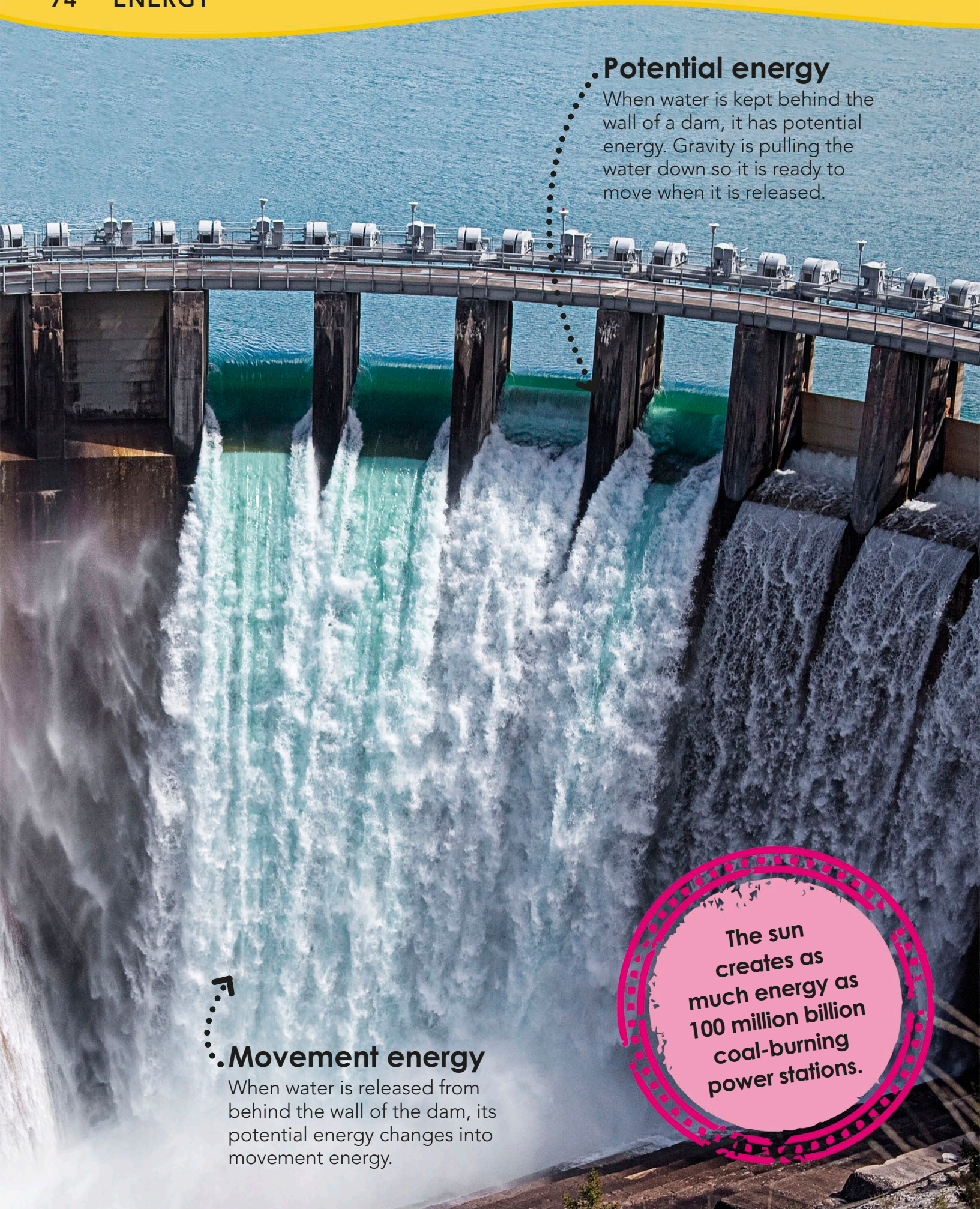
? True or false?

1. Lemons are more acidic than vinegar.
2. If we add an alkali to an acid we can make salt.
3. We can check if something is acid or alkali using litmus paper.

See pages 132–133 for the answers

Energy

Anything that moves has energy. It is power to make work happen. Energy can change from movement to electricity, and then to heat and light.



Potential energy

When water is kept behind the wall of a dam, it has potential energy. Gravity is pulling the water down so it is ready to move when it is released.

Movement energy

When water is released from behind the wall of the dam, its potential energy changes into movement energy.

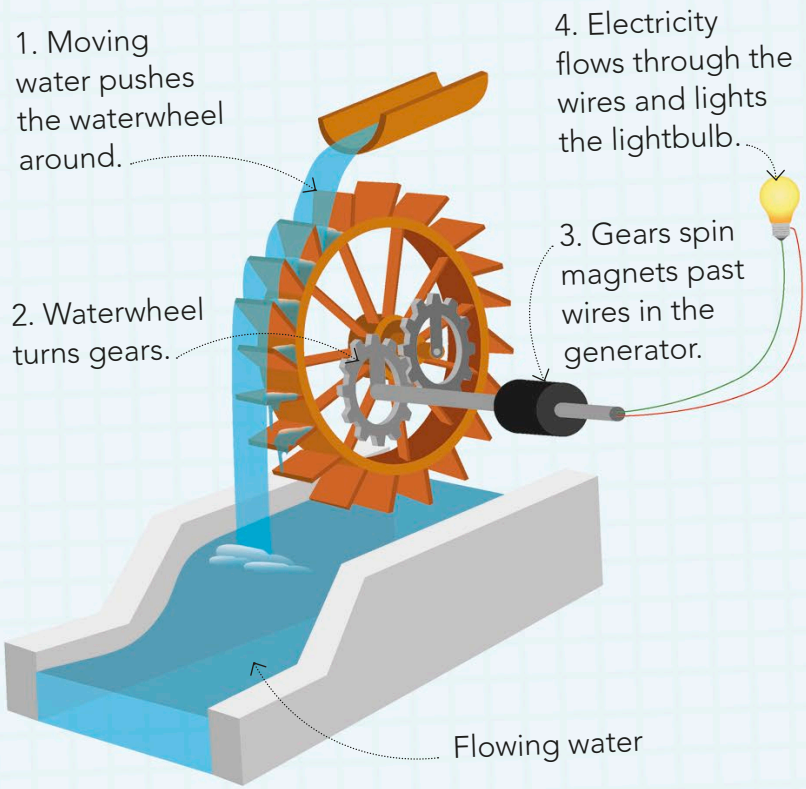
The sun creates as much energy as 100 million billion coal-burning power stations.

Where does energy go?

Energy cannot be created or destroyed—it just changes from one type of energy to another. Stored energy in the food we eat changes into movement energy in our bodies. Movement energy in water can change into electrical energy in a light bulb.

Changing energy

Movement energy can be converted into electricity using a generator. Electrical energy then changes into heat and light energy in a light bulb.



What other forms of energy exist?

Chemical energy

Energy can be released during a chemical reaction. The energy stored in wood is released by burning it.

Nuclear energy

Nuclear energy is made when tiny particles called atoms are split apart in machines called nuclear reactors.

Quick quiz

1. Where does most of the energy on planet Earth come from?
2. What do we call energy made from fuel that won't run out?
3. What type of energy is created when atoms are split apart?

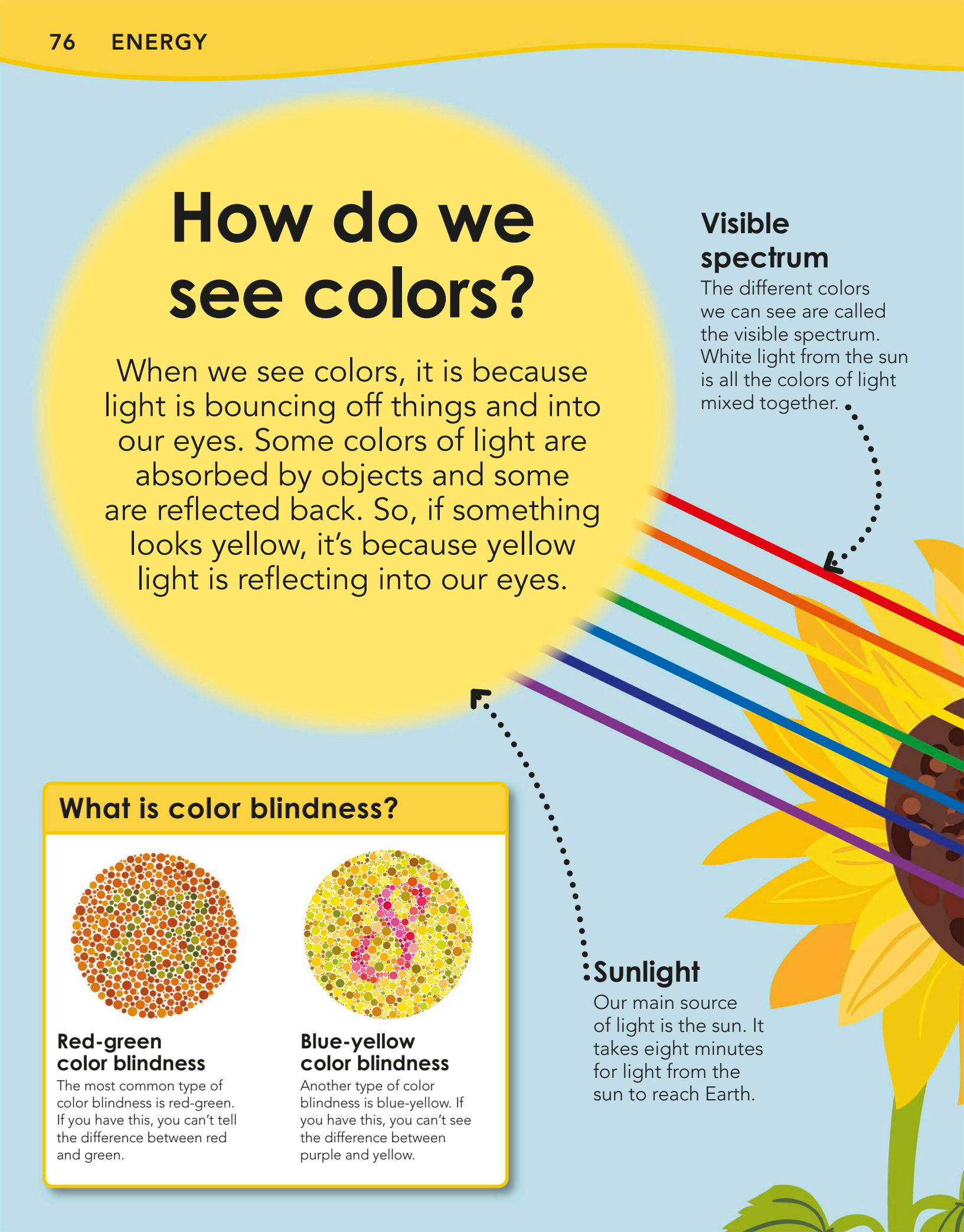
See pages 132–133 for the answers

How do we see colors?

When we see colors, it is because light is bouncing off things and into our eyes. Some colors of light are absorbed by objects and some are reflected back. So, if something looks yellow, it's because yellow light is reflecting into our eyes.

Visible spectrum

The different colors we can see are called the visible spectrum. White light from the sun is all the colors of light mixed together.



Sunlight

Our main source of light is the sun. It takes eight minutes for light from the sun to reach Earth.

What is color blindness?

Red-green color blindness

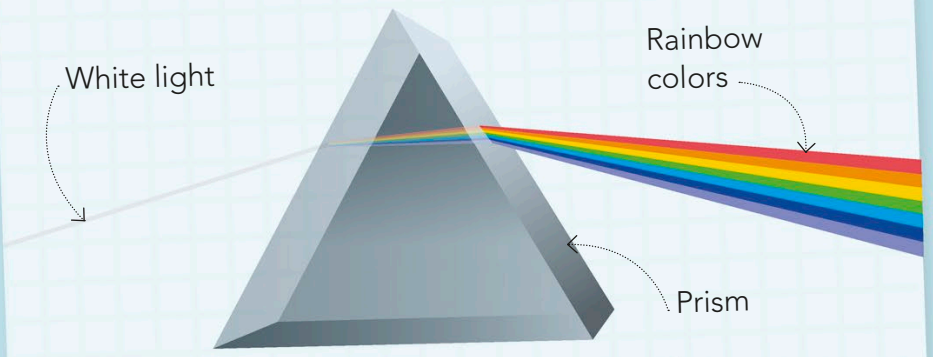
The most common type of color blindness is red-green. If you have this, you can't tell the difference between red and green.

Blue-yellow color blindness

Another type of color blindness is blue-yellow. If you have this, you can't see the difference between purple and yellow.

Splitting light

If we pass white light through a prism, it splits into all the colors of the rainbow. Colors come from light—all the colors are already inside the "white" light.



Reflection

Yellow light is reflected into the eye by the flower petals. Sensors in the eye tell the brain that the object is yellow.

Absorption

All the colors from the sun except yellow have been absorbed by the petals. Only the yellow reflects back toward the eye.

Picture quiz

What is a shadow?

See pages 132–133 for the answer

Sound
When we make a sound, it makes the air vibrate.

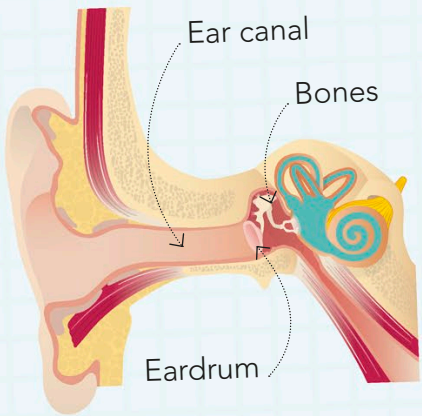
There is no sound in space because there is no air for it to travel through!

How does sound move?

Sound is a vibration. It can travel through a solid, liquid, or gas. When we hear a sound, it is because vibrations have traveled through the air in waves called sound waves. These vibrations are picked up by our ears.

How humans hear

Sound waves travel into your ear. They vibrate a part of the ear called the eardrum. It passes vibrations through tiny bones, and then through a liquid. Sensors send the sound to the brain.



Inside of the ear

Sound waves

As sound travels, it vibrates the air by squashing and un-squashing it. This moving air is called a sound wave.

Sensing sounds

Our ears collect sound waves. They change sound vibrations into electrical signals that travel to the brain. Then the brain tells us what the sound is.

Quick quiz

1. Can sound travel through solid materials?
2. Why does a bee buzz when it flies?
3. When we speak, what part of the body vibrates to make the sound?

See pages 132–133 for the answers

How do animals use echoes?

Underwater

Dolphins send clicking sounds through the water. The sounds bounce off things and help the dolphins find potential food.

In the dark

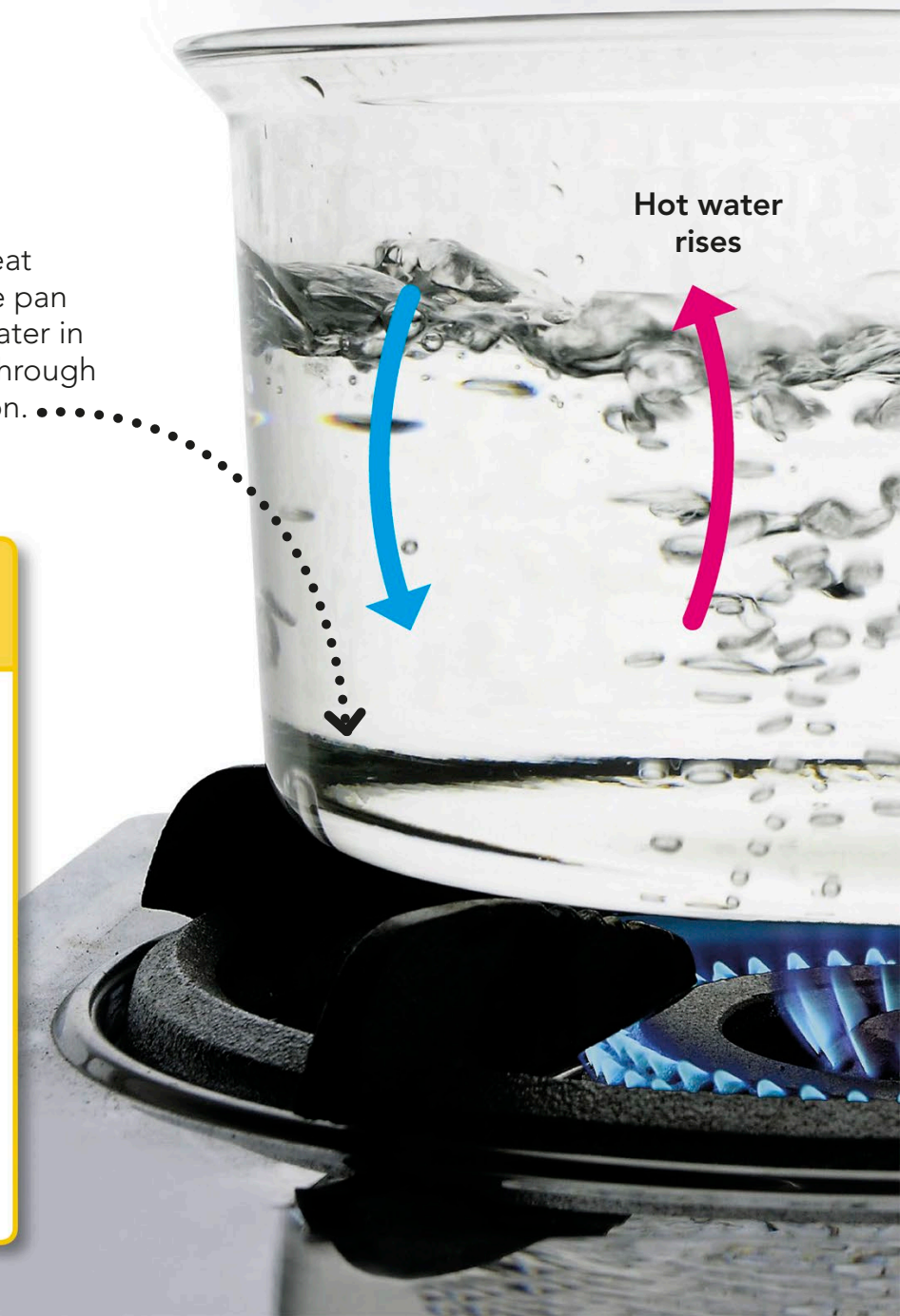
Bats send out pulses of sound, which bounce off objects. This stops bats from flying into walls, and helps them catch insects in the dark.

How does heat move?

Heat is always moving in one direction, from warm to cold. When we touch a warm object, heat moves into our skin. When we touch a cold object, heat moves out of our skin and into the object.

Conduction

When we heat a pan of water, heat moves from the lower part of the pan to the upper part, heating the water in the process. When heat moves through solid objects we call it conduction.



What happens when lava (liquid rock) cools?

Lava bombs

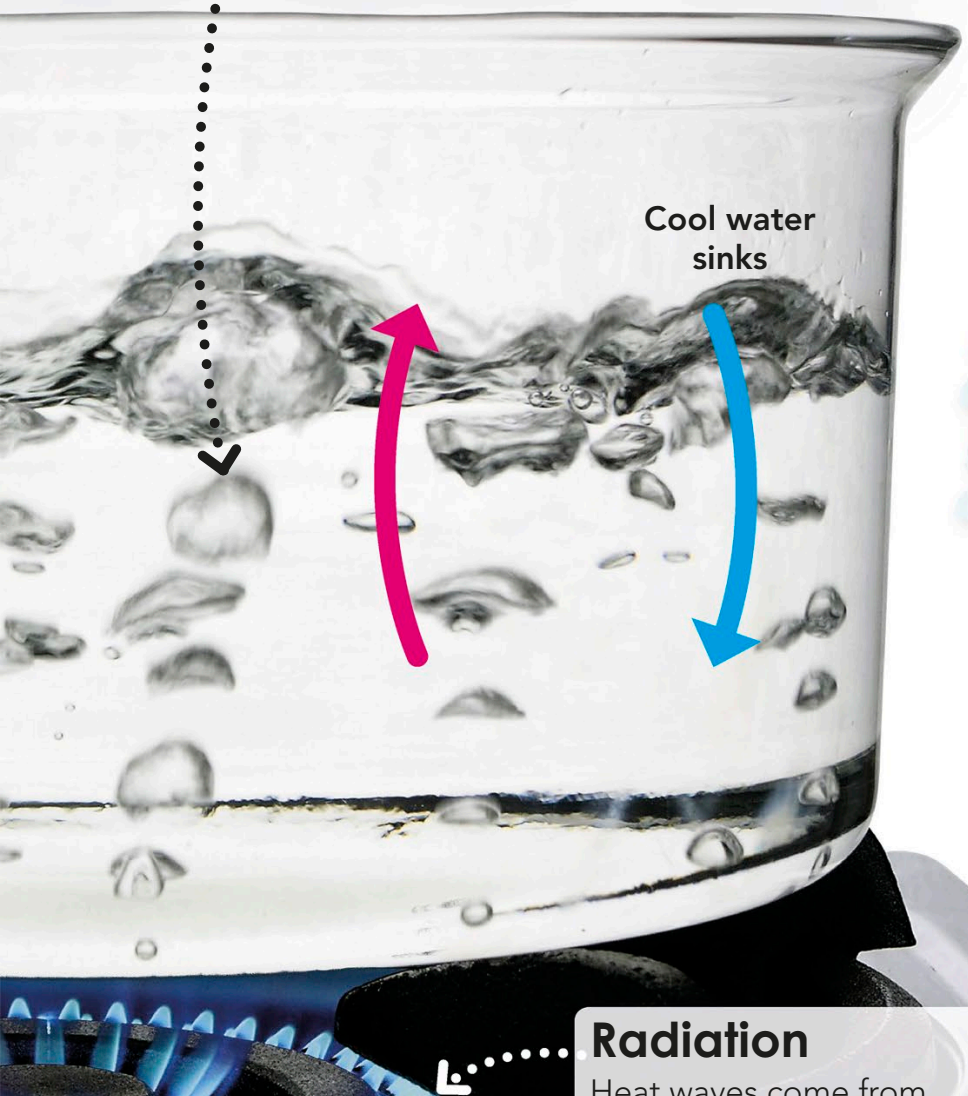
Volcanoes throw out blobs of lava that cool as they move through the air. They become solid, making rocks.

Pillow lava

When lava enters the cold ocean it sometimes cools to make pillow-like shapes.

Convection

The water at the bottom of the pan heats up and rises and the colder water sinks. This heat movement in liquid or air is called convection.

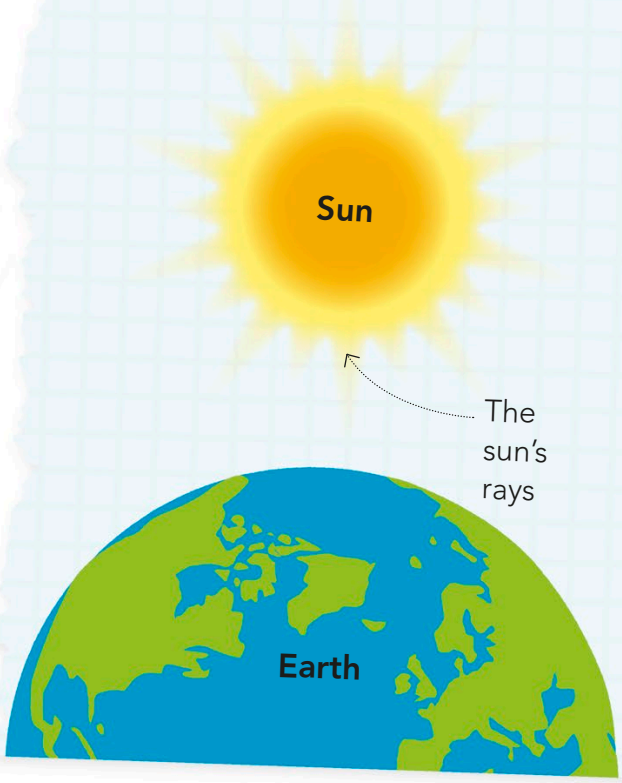


Radiation

Heat waves come from burning objects, heating the things they reach. This is called radiation.

The sun

The sun is our main source of heat. It warms the planet with invisible rays called radiation. When these rays shine on an object, they warm it up.



Quick quiz

1. What type of heat travels through the air from a fire?
2. What is the name for the way that heat travels through solid objects?
3. What happens when a solid is heated and becomes a liquid?

See pages 132–133 for the answers

What is electricity?

Electricity is a movement of energy—a flow of tiny, charged particles called electrons. Electrons can be charged up naturally in something called static electricity. Or we can make electricity from heat, light, wind, and other forms of energy.

Lightning

Lightning is a giant spark of electric charge that moves between the clouds and the ground, or between the clouds in the sky.

How can we make electricity?

Solar energy

Solar panels use energy from the Sun to make electricity. They are often placed on house roofs.

Wind energy

Wind turbines use the movement of the wind to make electricity. A group of wind turbines is called a wind farm.

Water energy

Dams use the movement of water to turn turbines that make electricity.

100 lightning bolts strike the ground every second.

Charged particles

All electricity is made from moving charged particles called electrons. These electrons flow as an electric current.

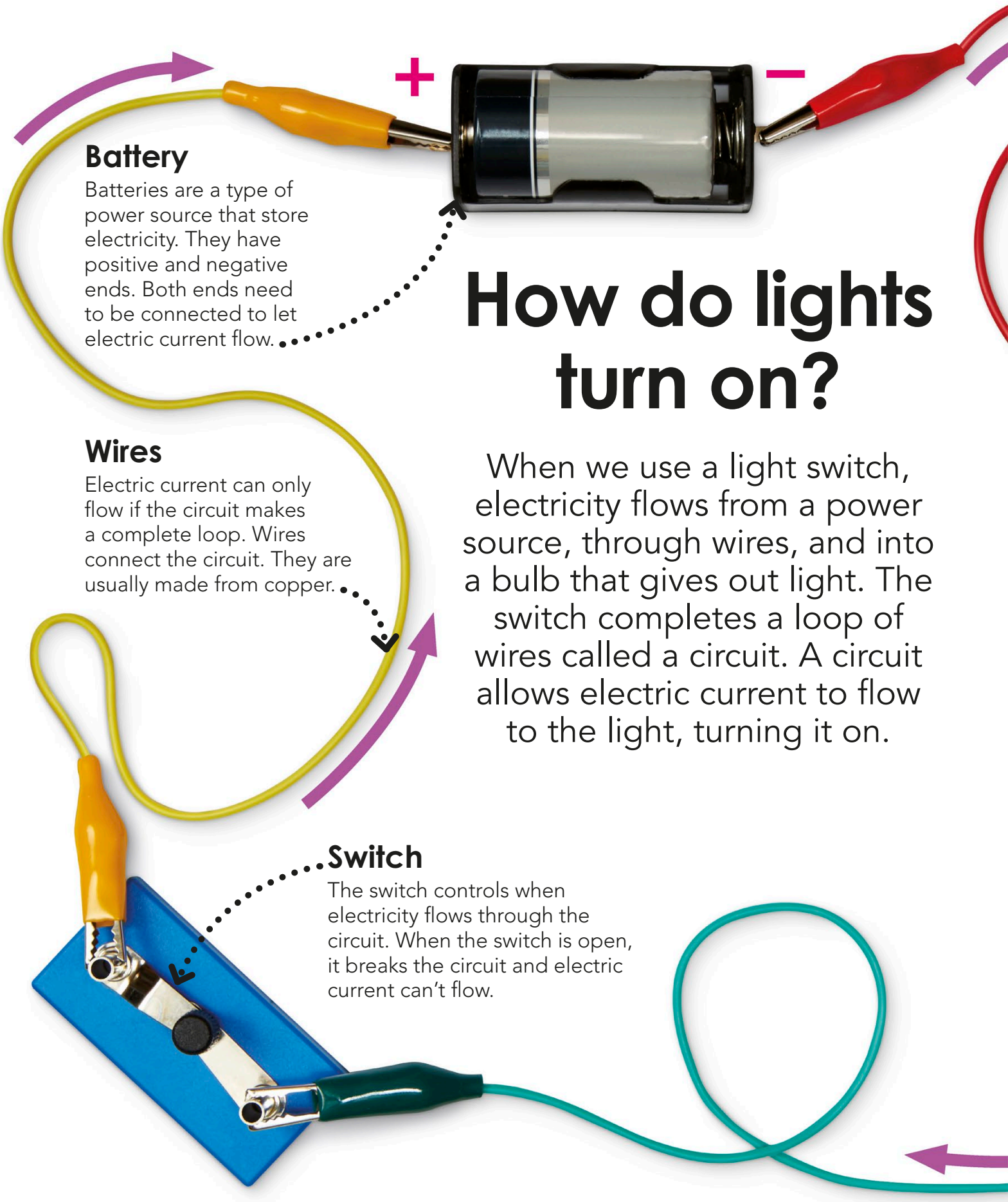
Clouds

Tiny pieces of ice, rain, or snow in the clouds rub against each other, charging up static electricity. Eventually the charge leaps as lightning.

Quick quiz

1. What are materials called that let electricity flow through them?
2. What is a lightning strike made from?
3. What type of electricity do you make by rubbing a balloon on your head?

See pages 132–133 for the answers



How do lights turn on?

When we use a light switch, electricity flows from a power source, through wires, and into a bulb that gives out light. The switch completes a loop of wires called a circuit. A circuit allows electric current to flow to the light, turning it on.

Battery

Batteries are a type of power source that store electricity. They have positive and negative ends. Both ends need to be connected to let electric current flow.

Wires

Electric current can only flow if the circuit makes a complete loop. Wires connect the circuit. They are usually made from copper.

Switch

The switch controls when electricity flows through the circuit. When the switch is open, it breaks the circuit and electric current can't flow.

Electricity flows around the circuit.

Electricity moves at 200,000 km (125,000 miles) per second. That's two-thirds as fast as the fastest thing ever—light.

Lightbulb

The lightbulb glows when electric current passes through it. This is only a small lightbulb, but all lightbulbs everywhere are lit up in the same way.

Circuit diagram

Every component (object) in the circuit can be shown with a symbol. The wires are shown with straight lines.

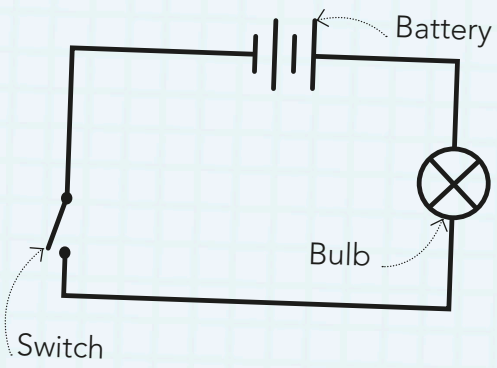
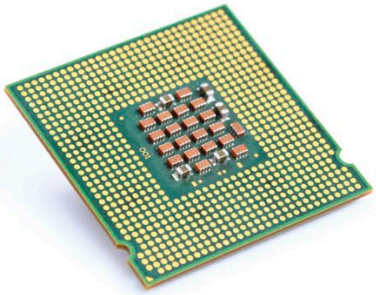


Diagram of a simple circuit

What are circuits used for?

Television sets

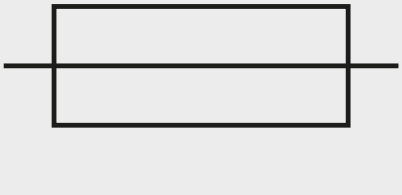
Tiny circuits inside television sets allow us to control things like brightness and volume.



Mobile phones

Miniature circuits smaller than a fingernail are found in mobile phones and other electronic devices. These circuits are called microchips.

Picture quiz



This symbol shows a part of a circuit that breaks when too much electricity flows through the wires. What is it?

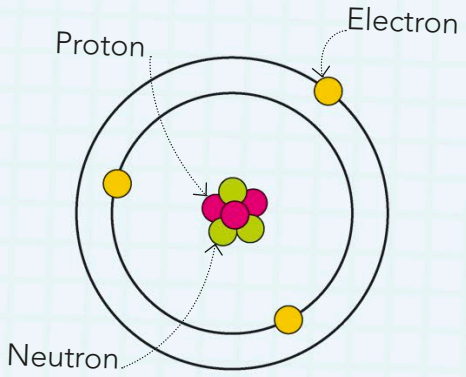
See pages 132–133 for the answer

How can I make my hair stand on end?

If you rub a balloon on your hair, you can charge it with a safe amount of a type of electricity called static electricity. Tiny particles called electrons move from your hair to the balloon, charging it and attracting your hair toward the balloon.

Electrons

Electrons are tiny, negatively charged particles. They are part of the atoms that everything is made of. When electrons flow, they make electricity.



Atom

Giant sparks of static electricity that leap from the clouds are called lightning.

How is static electricity useful?

Photocopier

Photocopiers use static electricity to stick negatively charged black ink onto positively charged areas of the page.

Defibrillator

Machines called defibrillators use static electricity to restart hearts that have stopped beating.

Negatively charged

The balloon becomes negatively charged when it is rubbed on the hair. This is because electrons are rubbed off the hair and onto the balloon.

Positively charged

If something loses electrons it becomes positively charged. As electrons leave the hair and move onto the balloon, the hair becomes positively charged.

Opposites attract

Opposite charges attract. The negatively charged balloon is attracted to the positively charged hair and they stick to each other.

True or false?

1. Socks from the dryer stick together because of static electricity.
2. Static electricity is used to make paint stick to cars.
3. Positive charges stick together.

See pages 132–133 for the answers

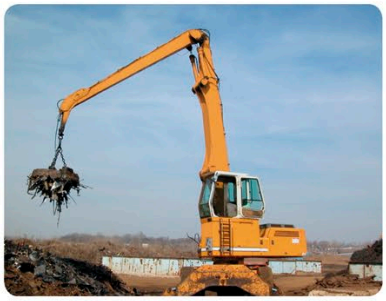
Can you make electricity from a magnet?

If you move a magnet past a coil of wire, it makes electricity flow in the wire. Generators are machines that spin coils of wires past magnets, or magnets past coils of wire, to create electricity.

Powering up

As the rider pushes the pedals, the bike wheels turn. The front wheel turns the cog on the dynamo generator.

What else are magnets used for?

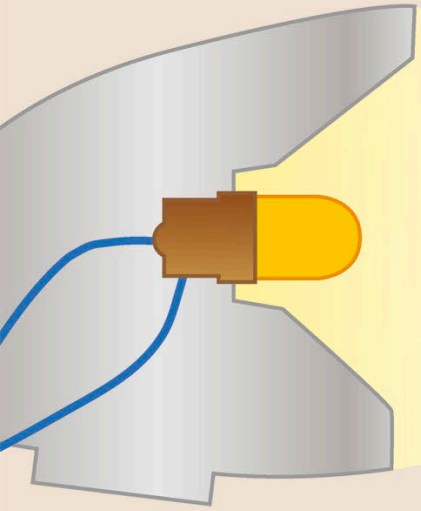


Scrap metal

Cranes with magnets on them can pick up magnetic metals such as iron from piles of garbage.

MRI

MRI stands for magnetic resonance imaging. MRI scanners can take pictures of the human brain.



Lighting up

The dynamo generator makes enough electricity to power the light.

True or false?

1. Magnets can be used to power bicycle lights.
2. A turbine is a big fan that turns a generator.
3. Hamster wheels are often connected to generators.

See pages 132–133 for the answers

Cog

The turning cog rotates the magnet.

Magnet

N S

Coil of wire

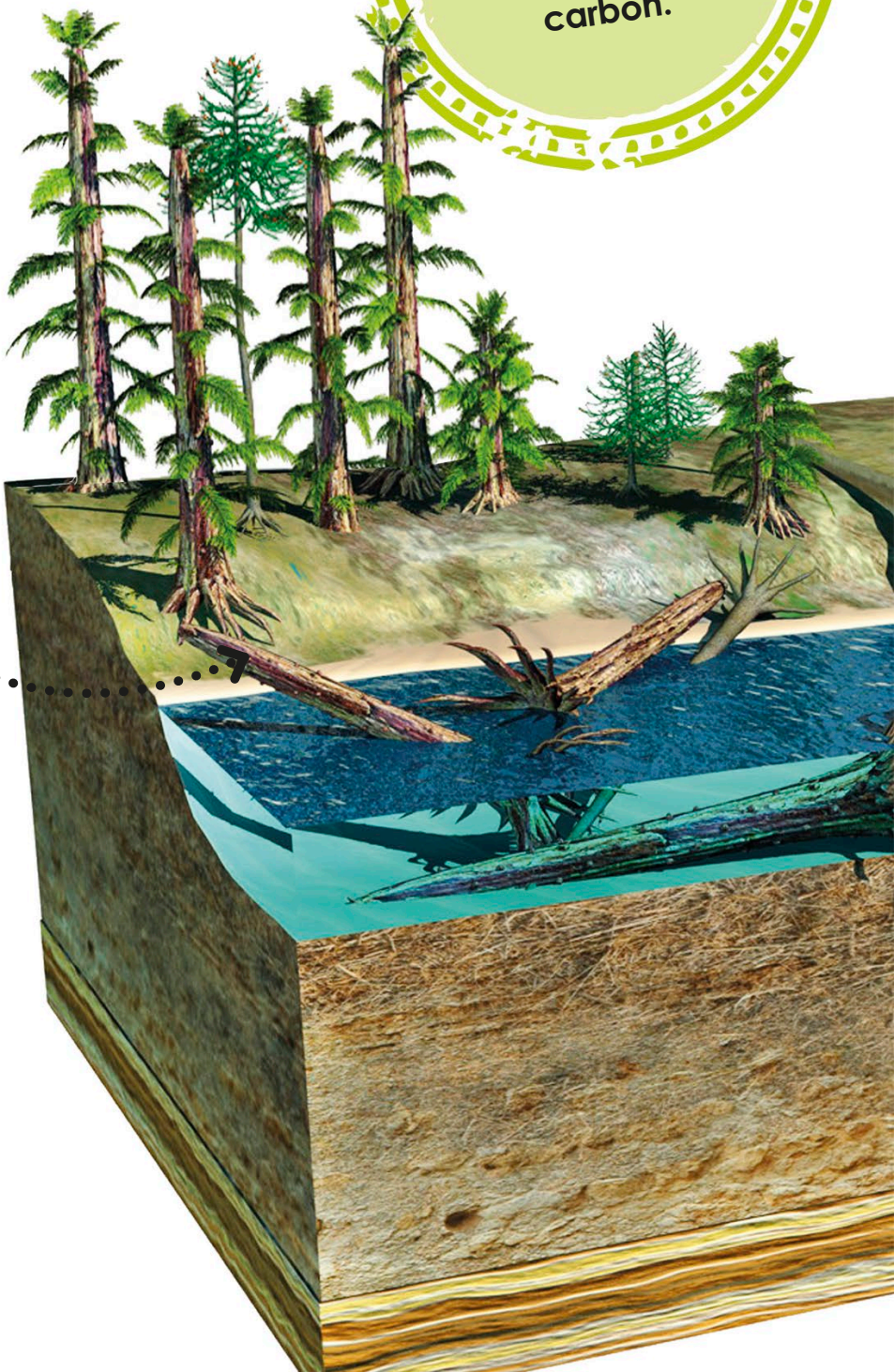
Dynamo generator

The bicycle wheel turns the cog. The cog moves a magnet past a coil of wire. Electricity flows in the wire when the magnet is spinning.

Where does coal come from?

Coal is a fuel made from the remains of ancient plants that have been squashed underground. Coal burns easily and releases energy as heat and light. It can be burned in a power station to make electricity.

Coal and diamonds are made from the same thing—carbon.



1. Swamp

Trees, ferns, and moss die and sink into the swamp. New plants grow and die, and the layers pile into the swamp.

Quick quiz

1. What is the group name for coal, oil, and gas?
2. Where is coal formed?
3. What is the name of a place where we dig out coal?

See pages 132–133 for the answers

What other fuels form underground?

Crude oil

Oil is made from tiny plants and animals called plankton that lived in the oceans millions of years ago. They died and got buried under mud and squashed into oil.

Natural gas

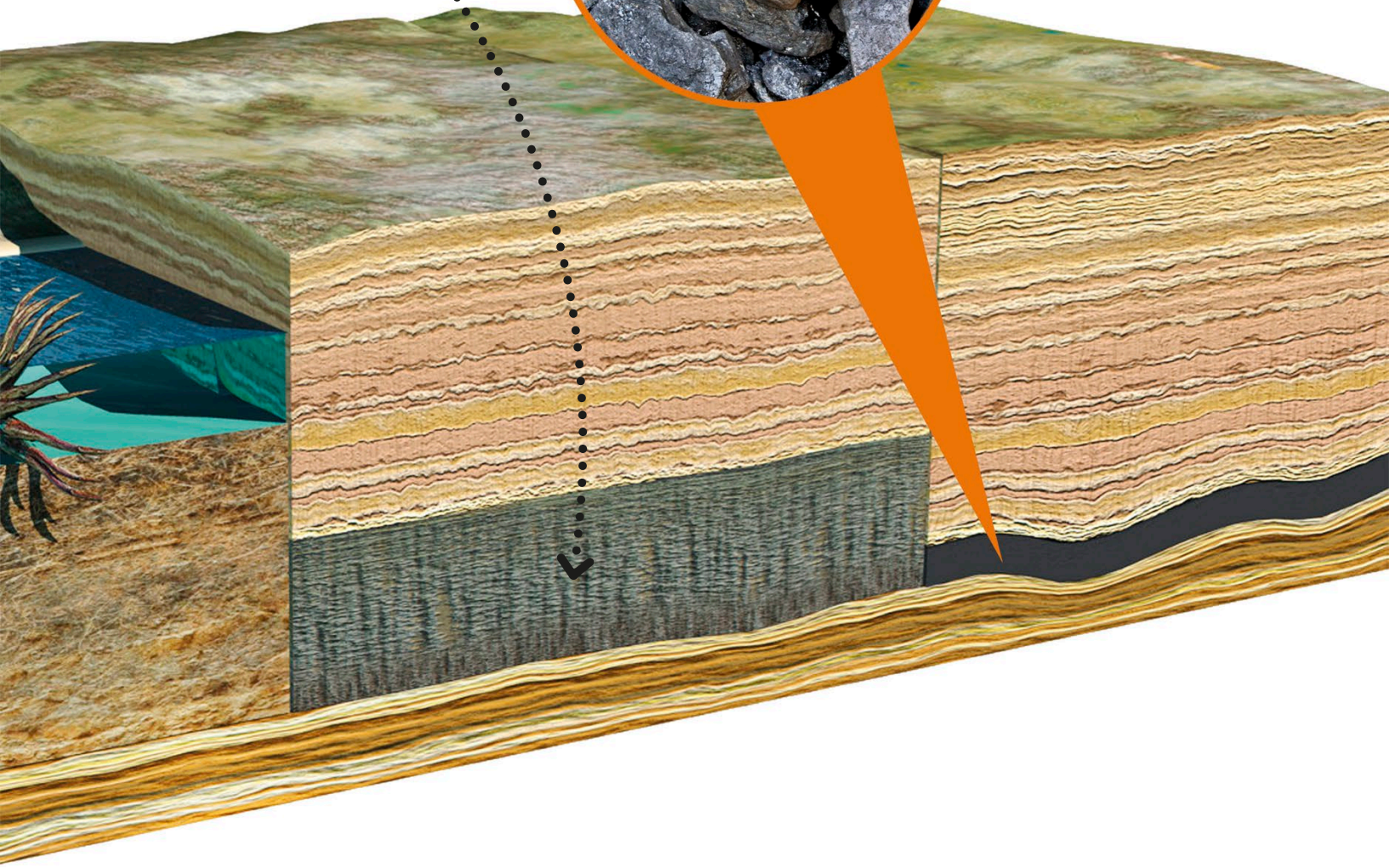
Natural gas was formed in the same way and at the same time in the past as oil. It also comes from plankton. Natural gas and crude oil are often found together underground.

2. Burial

Earth builds up over the swamp, pushing down and squeezing the plant layer. As it gets squashed it heats up.

3. Coal

Over time, the layers get squashed and heat up further. Gases are forced out and the plants become layers of coal.



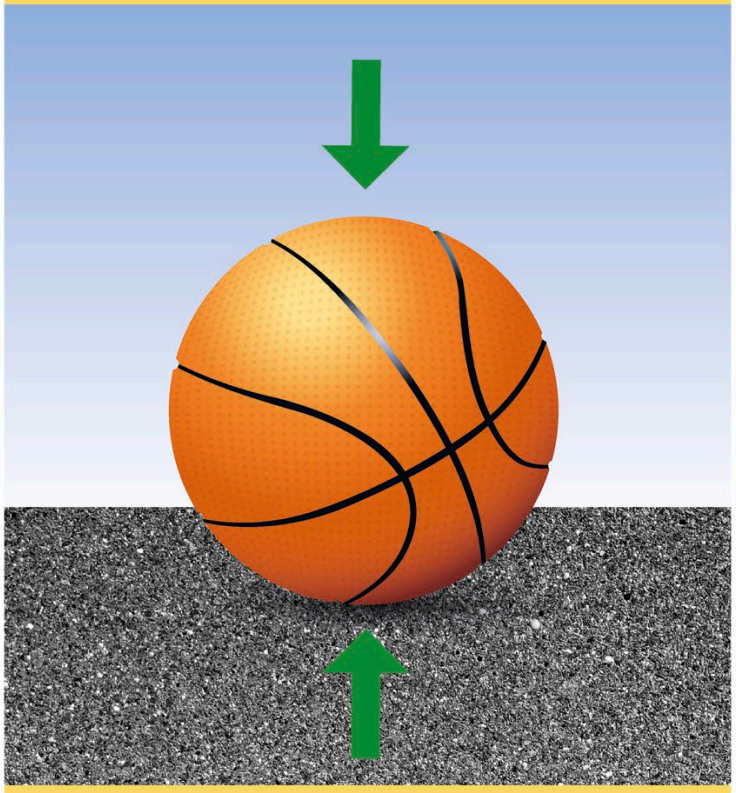
Forces and movement

Forces are pushes and pulls that act on objects. They make things speed up or slow down. They can lift things into the air or move them around.

What makes things speed up or slow down?

A British scientist named Isaac Newton discovered three laws of motion that help us understand how objects behave when forces push or pull on them. Forces make things speed up or slow down.

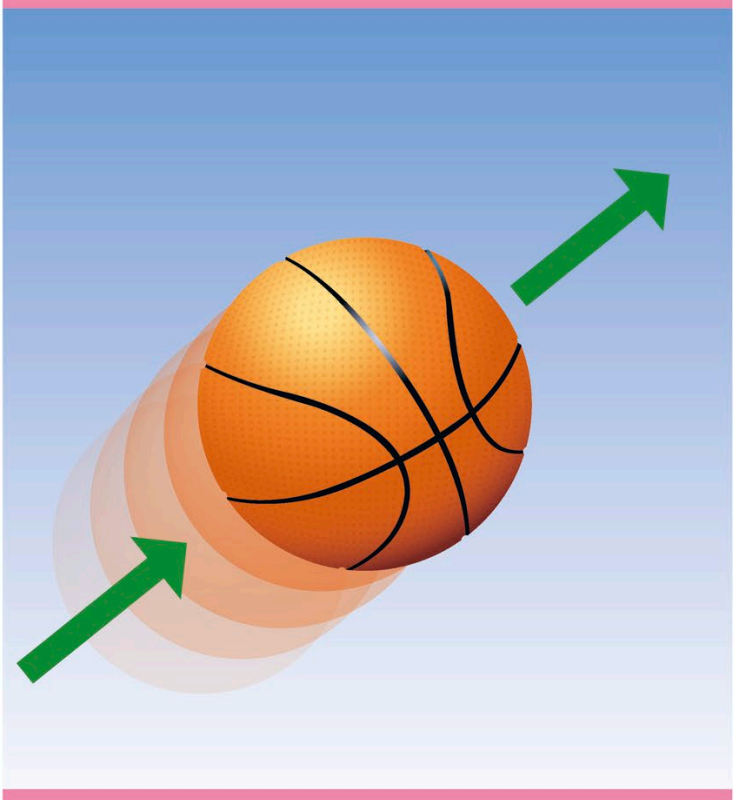
FIRST LAW



Stationary ball

When forces are balanced, an object stays at rest or, if it is moving, it keeps moving at a constant speed. Objects only change speed when extra force is added.

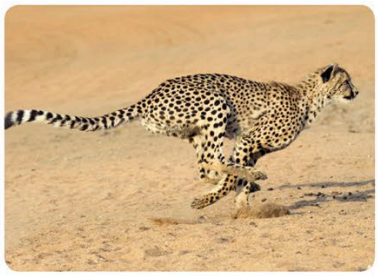
SECOND LAW



Getting faster

If we push the basketball forward with our hands, the extra force we give it makes it speed up and move in the direction we pushed it in.

What helps animals move fast?



Strength

A cheetah is fast because it is light with strong, powerful legs. Its feet have good grips, which let it push off from the ground as it runs.

Smooth shape

A penguin moves quickly through the water because its body is shaped like a lemon, allowing it to move through water easily. This is called streamlining.

THIRD LAW

Bouncing back

For every action there is an equal and opposite reaction. If the ball pushes into a wall at speed, the wall will push the ball back the opposite way.

Acceleration means to speed up.

? True or false?

1. In space, moving objects can keep moving forever since there is no air to slow them down.
2. An object moving through air is slowed down by air pushing it back.
3. When forces are balanced an object moves slowly.

See pages 132–133 for the answers

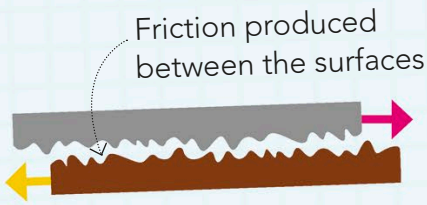
What stops things from slipping?

Friction is a force that acts between two surfaces that are moving or trying to move. It slows things down. For example, there is friction between the soles of our shoes and the ground when we walk.

If you rub your hands together, the friction between them will start to produce heat.

How friction works

As two surfaces move past each other they rub, slowing each other down. Friction always acts in the opposite direction to movement.



Two surfaces moving past each other

Which shoes are supposed to slip?

Skis

The bottom surfaces of skis are smooth, reducing friction, so they glide easily over the snow. The snow and ice below each ski melt to reduce friction even more, making traveling faster.

Tap shoes

The soles of tap-dancing shoes are made of polished metal. This means that there is much less friction between the shoe and the ground, so tap dancers can glide around when dancing.

Rough surface

Rough surfaces increase friction. Wet, icy, or muddy surfaces reduce it, so cars are more likely to skid in these conditions.

Great grip

Tires have treads on the bottom of them to increase friction, so they can grip the road or track.

? True or false?

1. Friction helps a soccer player kick the ball in the right direction.
2. Friction between the air and an airplane is called air resistance.
3. Rough surfaces produce more friction than smooth surfaces.

See pages 132–133 for the answers

How do magnets pull?

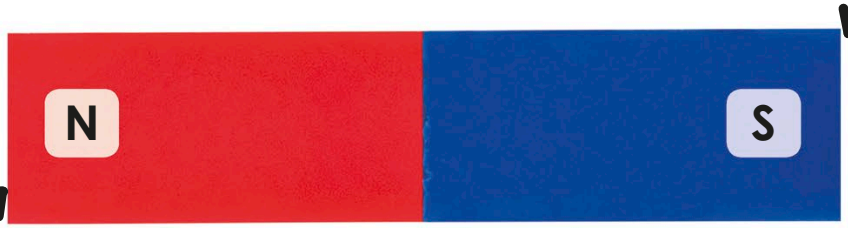
Magnets have two poles, a north and south pole. There is an invisible force field between the poles called the magnetic field. Magnetic metals and other magnets are attracted toward a magnet when they enter its magnetic field.

South pole

South poles pull north poles toward them and push other south poles away.

North pole

North poles pull south poles toward them and push other north poles away.



What are magnets used for?

Transportation

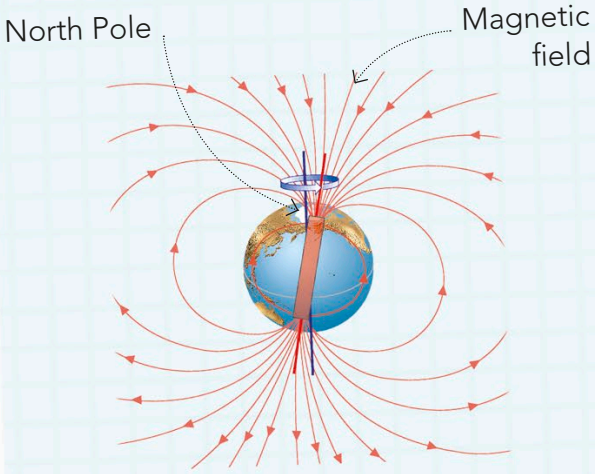
Maglev, short for magnetic levitation, trains are one of the fastest train services on Earth. Powerful magnets on the tracks let the trains hover a fraction of an inch above the rails.

Navigation

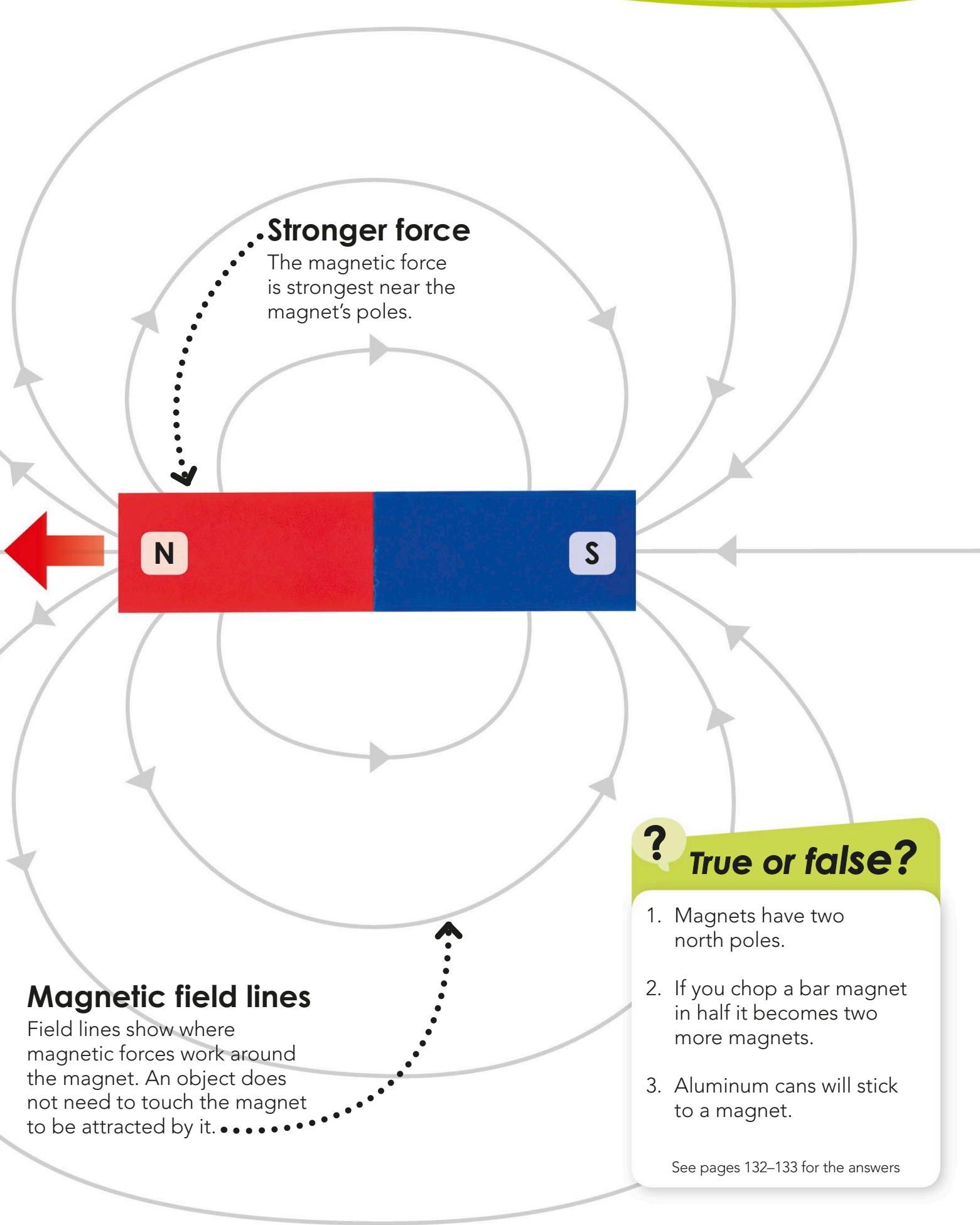
A compass is used to find the way using the Earth's magnetic field. The magnetic needle in the compass always points in the direction of north.

Earth's magnetic field

The Earth has a magnetic field that protects us from harmful rays from outer space. The Earth's North and South Poles are where the Earth's magnetic field is strongest.



Magnetic fields



True or false?

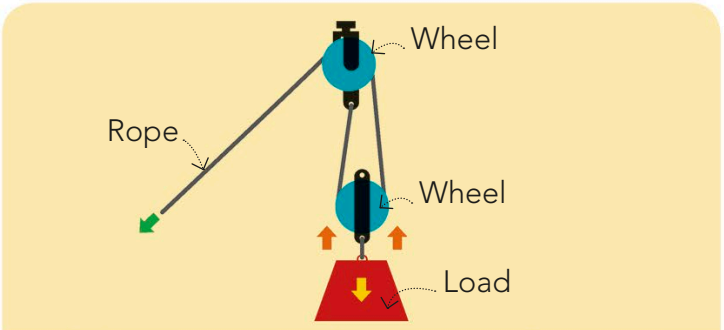
1. Magnets have two north poles.
2. If you chop a bar magnet in half it becomes two more magnets.
3. Aluminum cans will stick to a magnet.

See pages 132–133 for the answers

How can I move something more easily?

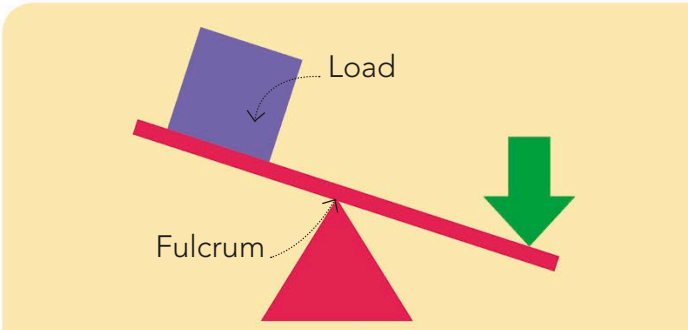
Machines help us to move things more easily. A machine is something that makes a push or pull bigger, or helps to change the direction that it acts in. Levers, pulleys, and gears are simple machines.

The first ever machine was a wedge-shaped ax from the Stone Age.



Pulley

A pulley cuts down the effort it takes to lift a heavy weight. The more pulleys you add, the easier it gets to lift.



Lever

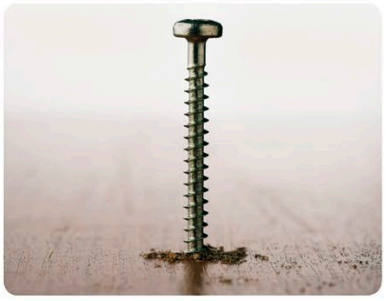
Levers make it easier to move things. A small push force has a bigger impact at the other end of the lever than just lifting would.

True or false?

1. A door handle is an example of a lever.
2. Crows can use levers.
3. A screw is a simple machine.

See pages 132–133 for the answers

What are some other types of simple machines?

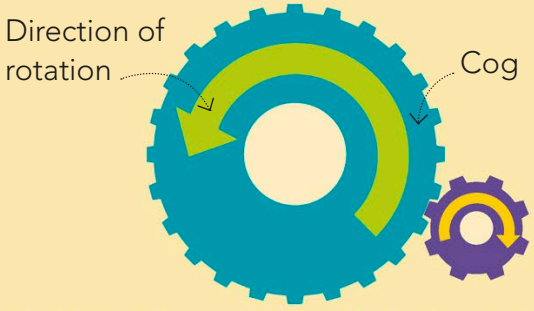


Screw

A screw changes the direction of a force. It changes a turning movement into a forward push. As you turn the screw, it pushes down.

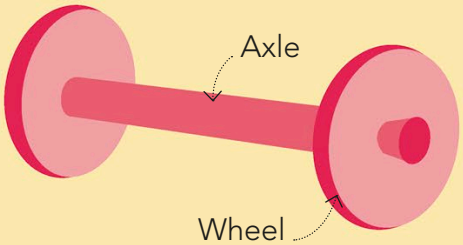
Wheelbarrow

Most of a wheelbarrow's load is carried by the wheel and axle. This makes carrying heavy loads easier.



Gears

Gears can change the direction and speed of a rotation. Turning pedals on a bicycle moves the wheels around using gears.



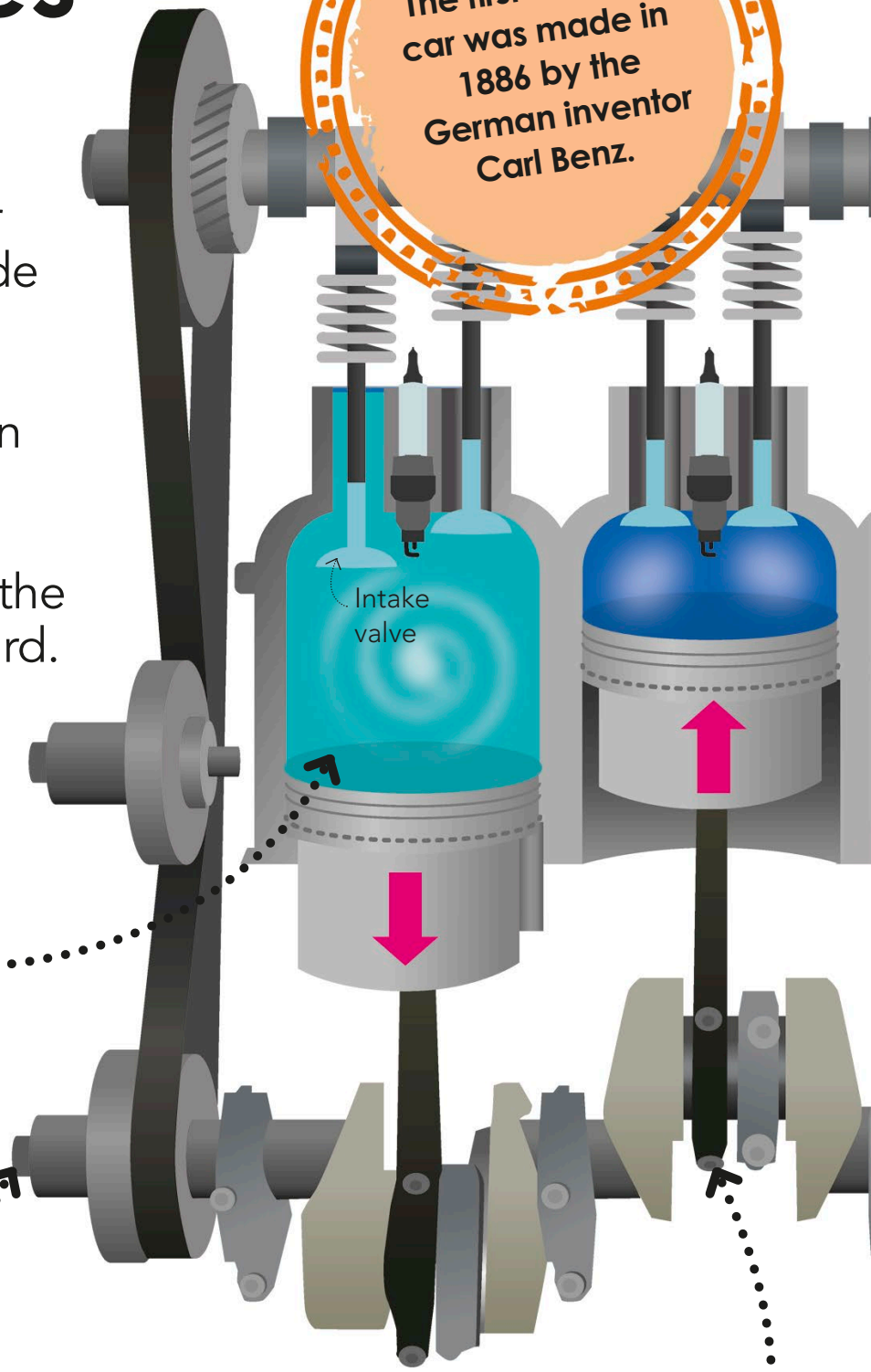
Wheel and axle

A wheel is a turning machine that makes moving objects along the ground easier. Axles join pairs of wheels together.

What makes cars go?

Most cars use gasoline for fuel. This is squashed inside a chamber in the engine. The fuel is lit and then explodes, pushing a piston that rotates a long pole called a crankshaft. As the crankshaft turns, it makes the wheels drive the car forward.

The first modern car was made in 1886 by the German inventor Carl Benz.



Fuel in

This piston moves down and fuel and air are sucked in. This happens once every time the crankshaft turns.

Crankshaft

The crankshaft uses the up-and-down movement of the pistons to turn the wheels around.

Squeeze

This piston rises, squashing the fuel and air into a really small space. The air and fuel heat up as they get squashed.

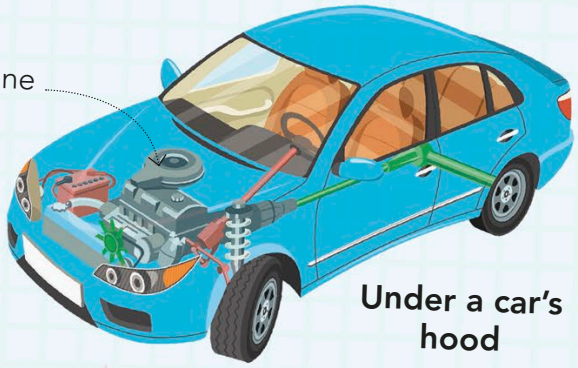
Quick quiz

1. How many cars currently exist in the world?
2. What happens to air and fuel when it gets squashed into a small space?
3. What are gasoline and diesel made from?

See pages 132–133 for the answers

Inside a car

Engines are usually at the front of a car. They move the front wheels to propel the car forward and backward. Four-wheel drive cars turn both sets of wheels.



Under a car's hood

Waste out

When fuel burns, it releases waste products. They are carbon dioxide gas, steam, and pollution. This piston pushes the waste out into the exhaust pipe.

Spark

A tiny electrical signal makes a spark light the squashed fuel and air. It explodes, pushing this piston down and turning the crankshaft.

How else can we power cars?

Diesel

Many older cars and some modern cars use a fuel called diesel to power the engine.

Electric car

Some modern cars use a combination of fuel and electricity, while others run completely on electricity.

What stops us from floating away?

We move at a constant speed or stay still until a force slows us down or speeds us up.

There is an invisible force constantly pulling us down toward the Earth. This force is called gravity. When we throw a ball up, it comes down because of gravity. Gravity stops us from floating into space.

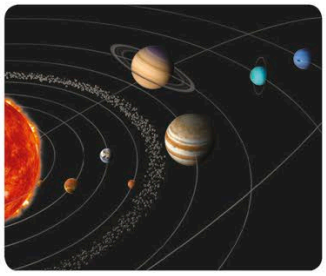
Liftoff

The skateboarder pushes away from the ground, pushing against the force of gravity to lift off.

Going up

As the skateboarder moves into the air, the force of gravity slows him down until he stops moving upward.

Where else do we see gravity at work?



Solar system

The planets move in circles around our star, the Sun. They are kept in place by the force of gravity. Large objects, such as stars, pull smaller objects, such as planets, toward them.

Landslides

Landslides happen on slopes. When earth or rocks become unstable, they start to slip and move down the slope. This happens because of the pulling force of gravity.

Falling down

The skateboarder begins to move downward, speeding up as gravity pulls him down. This is called acceleration.

Safe landing

The ground stops the downward acceleration and the skateboarder lands. He bends his legs to cushion the upward force from the ground.

Quick quiz

1. How does the force of gravity change between takeoff and landing?
2. What is it called when something speeds up?
3. If forces are balanced on an object, what will it do?

See pages 132–133 for the answers

Propeller engine

As the propeller spins, it pushes air out backward, faster than when it comes in. This creates a force called thrust that pushes the airplane forward.

How do planes stay in the air?

As a plane moves forward, air rushes over its wings and down toward the ground. As the plane gets faster, the downward push of the air is strong enough to lift the whole airplane up.

Quick quiz

1. How does wing shape make airplanes lift up?
2. What force acts the opposite way to lift?
3. What is the job of the tail plane?

See pages 132–133 for the answers

Tail

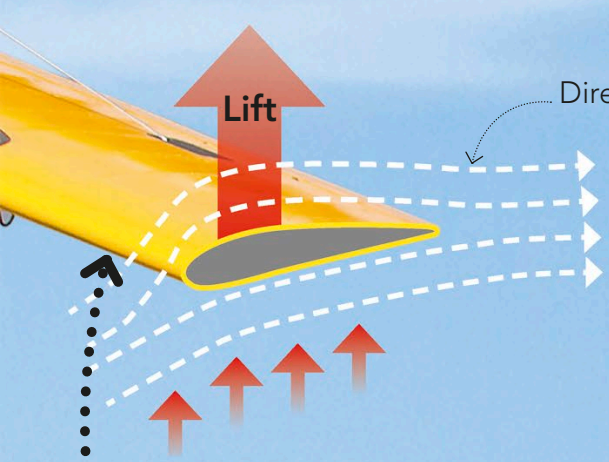
The tail plane works like a mini wing. It stops the airplane from rotating, keeping it stable in the air.

How do rockets fly through the air?

Jet propulsion

When a rocket takes off, air rushes out of the bottom of the rocket. This pushes it upward, in the opposite direction to the air's movement.

A plane's wings are shaped to push air down. This shape is called an airfoil.



Pressure exerted by slow-moving air

Wings

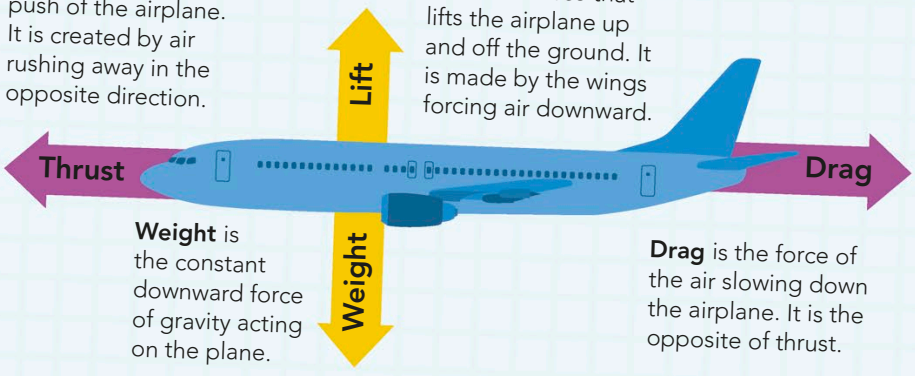
The wing shape pushes the air rushing past downward. The force of air going down pushes the plane up in the opposite direction. This is called lift.

Flying forces

There are four main forces acting on a flying plane: drag, lift, thrust, and weight.

Thrust is the forward push of the airplane. It is created by air rushing away in the opposite direction.

Lift is the force that lifts the airplane up and off the ground. It is made by the wings forcing air downward.



Weight is the constant downward force of gravity acting on the plane.

Drag is the force of the air slowing down the airplane. It is the opposite of thrust.


СОЮЗ
ТМА

Our planet

We live on a rocky planet, orbiting a star, in a universe mostly made of empty space. Earth is the only planet known to have the perfect conditions for life.

Life below ground

Animals such as centipedes live in soil in the crust. They burrow in the soil, mixing it around.

? True or false?

1. The Earth's crust is split into giant jigsaw pieces that move around.
2. You could dig a hole into the Earth's core.
3. The Earth's core is hotter than the sun.

See pages 132–133 for the answers

Crust

The crust is the solid rock layer that makes up the surface of the Earth on land and at the bottom of the oceans.

Mantle

The thickest layer is the mantle. It is made from hot rock. The upper part is liquid called magma. The lower part is solid rock.

If the Earth were the size of an apple, the crust would be as thick as an apple's skin.

Outer core

The outer core is made from liquid nickel and iron metal.

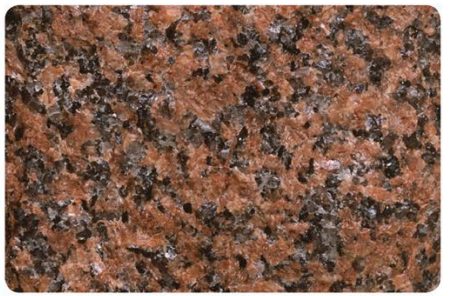
How deep can a hole get?

We can only dig into the top layer of the Earth—the crust. If we could dig through the planet's layers, we'd travel through soil, solid rock, hot rock, liquid metal, then finally arrive at the solid metal core at the center of the Earth.

Inner core

The inner core is made from hot, solid iron and nickel. It is squashed into a solid by all the layers above it.

What rock is the crust made from?



Granite

The crust under land is mostly made from granite. It has mountains, soil, and buildings on top of it.

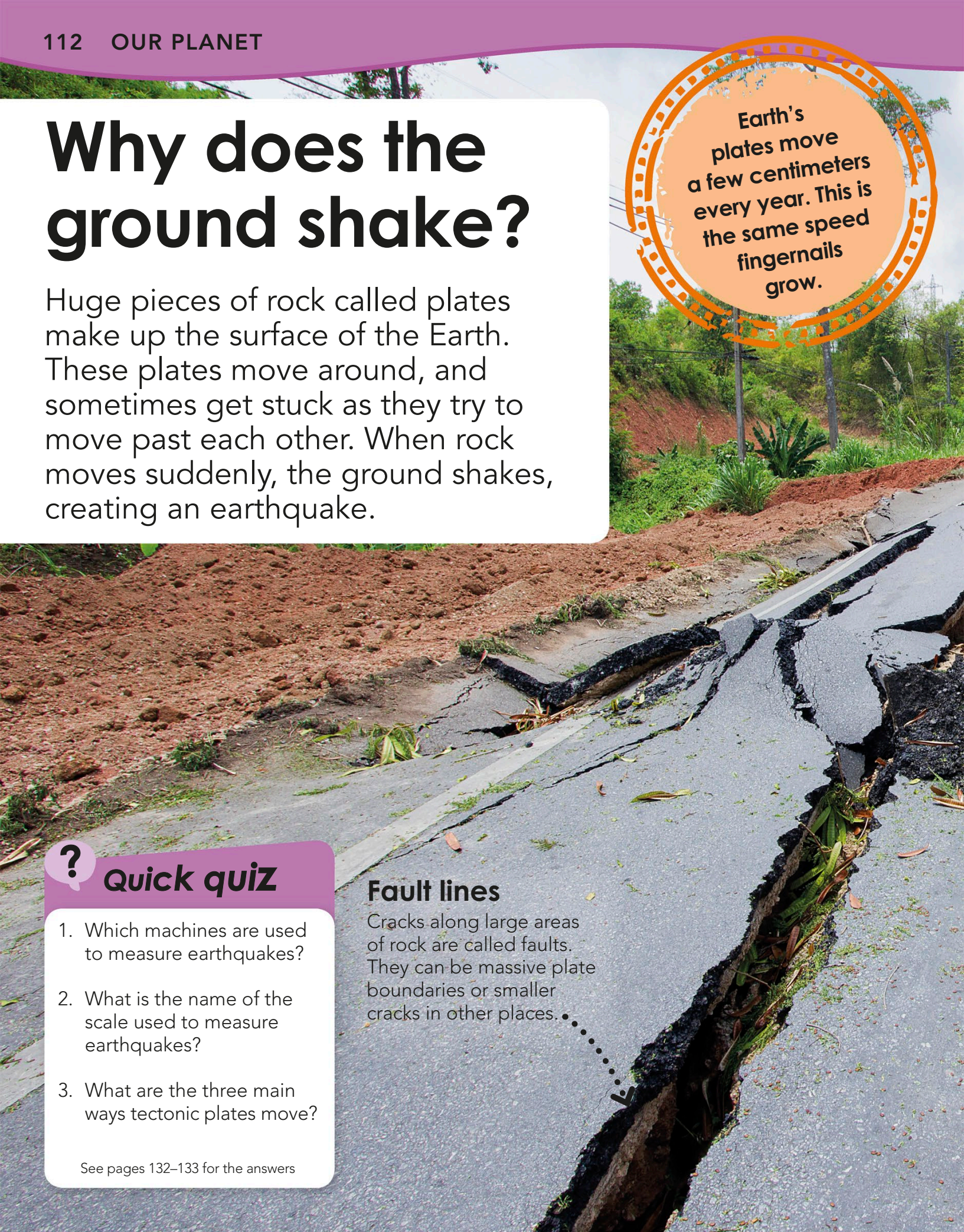
Basalt

The thinner crust of the ocean floor is mostly made from basalt. It has sand and sea water on top of it.

Why does the ground shake?

Huge pieces of rock called plates make up the surface of the Earth. These plates move around, and sometimes get stuck as they try to move past each other. When rock moves suddenly, the ground shakes, creating an earthquake.

Earth's plates move a few centimeters every year. This is the same speed fingernails grow.



Fault lines

Cracks along large areas of rock are called faults. They can be massive plate boundaries or smaller cracks in other places.

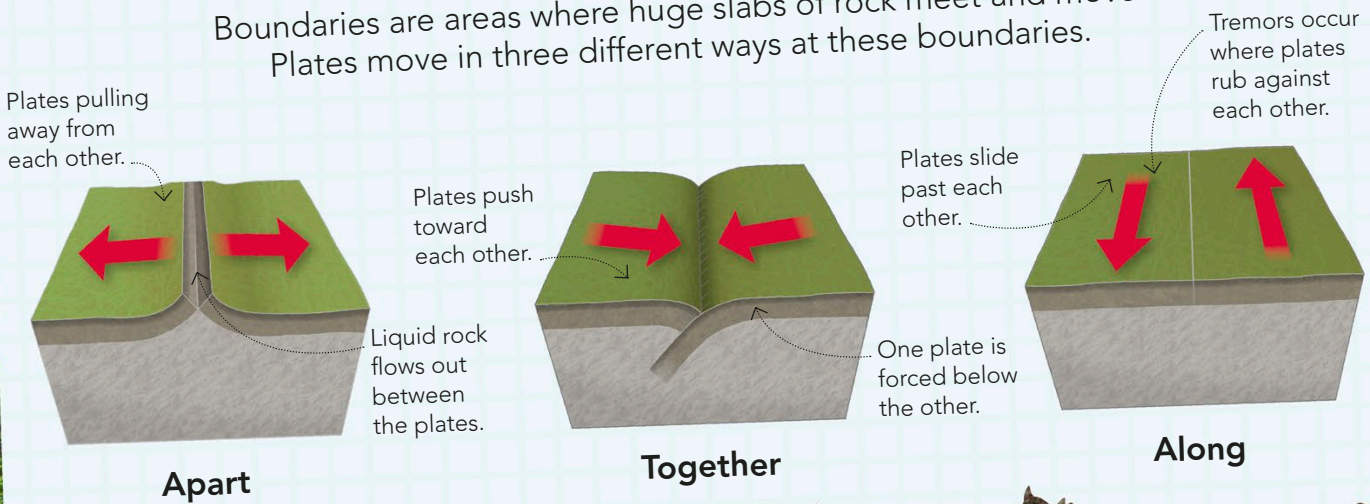
Quick quiz

1. Which machines are used to measure earthquakes?
2. What is the name of the scale used to measure earthquakes?
3. What are the three main ways tectonic plates move?

See pages 132–133 for the answers

Types of plate boundaries

Boundaries are areas where huge slabs of rock meet and move. Plates move in three different ways at these boundaries.



Flexible rock

Rock can stretch and bend as it moves. Sometimes it springs back into place, making the Earth shake.

Where do earthquakes happen?

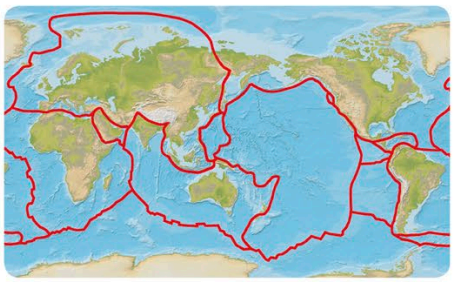


Plate boundaries

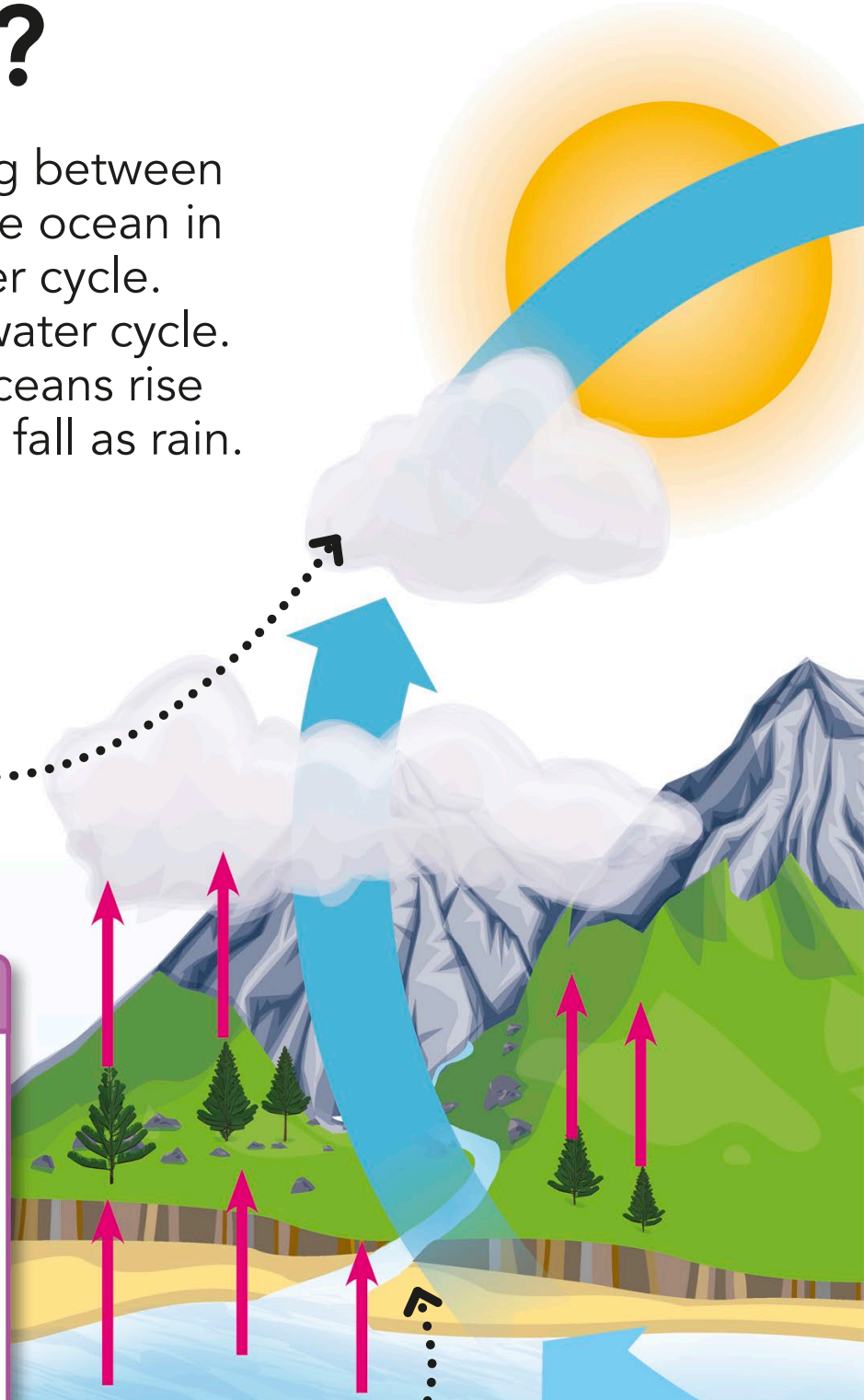
Earth's surface is broken into huge chunks of rock called tectonic plates. Most earthquakes happen in places where the tectonic plates rub together.

Where does rain come from?

Water is constantly moving between the land, rivers, air, and the ocean in something called the water cycle. The sun's heat drives the water cycle. It makes water from the oceans rise into the air and eventually fall as rain.

2. Condensation

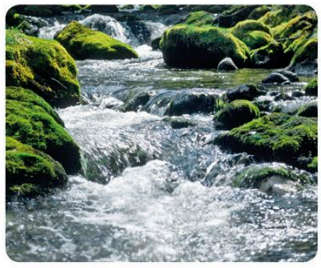
As it rises, water vapor starts to cool and begins to turn back into tiny water droplets and make clouds. This is called condensation.



1. Evaporation

When the sun heats up the water, it starts to evaporate. This means it changes from a liquid to a gas. The gas is called water vapor.

Is all water the same?



Fresh water

Fresh water is the water we drink. Rain is fresh water. We find it in lakes, streams, rivers, underground, and in ice.

Salt water

Salt water is found in oceans and seas. It tastes salty compared to fresh water. Salt water makes up 97.5 percent of the water on planet Earth.

3. Precipitation

Rain, snow, or hail fall from the clouds when the tiny droplets get heavier than the air around them. This is called precipitation.

Picture quiz

What happens when there is a shortage of water?

See pages 132–133 for the answer

4. Runoff

Rainwater trickles into streams that flow into rivers, which then carry the rain toward the sea.

5. Back to the sea

The water returns to the sea, or is collected in lakes, where the sun heats it and the whole cycle begins again.

Why is planet Earth blue?

More than two-thirds of the Earth's surface is covered in water, making our planet look blue from space. The huge oceans hide deep trenches, volcanoes, and mountain ranges. They are home to a great variety of living things.

Clouds

Images of Earth taken from space show swirling white clouds in the atmosphere.

Oceans of the world

There are five oceans on Earth. Smaller seas, gulfs, and bays are parts of the oceans, usually near the land. The Earth's oceans produce more than two-thirds of the oxygen we breathe, through tiny plants called phytoplankton.

We have mapped more of the surface of Venus than we have the oceans of Earth.

Pacific Ocean

The Pacific is the largest ocean on Earth, coving one-third of the planet's surface.

True or false?

1. The largest ocean is the Atlantic.
2. The deepest part of the ocean is 7 miles (11 km) below the surface.
3. During the winter, the Arctic Ocean is almost completely covered in ice.

See pages 132–133 for the answers

How deep is the ocean?

Sunlight zone

The sunlight zone goes from the surface to around 650 ft (200 m) deep. It's a bright area where we find coral reefs and colorful fish.

Twilight zone

The twilight zone goes from around 650 ft (200 m) to 3,300 ft (1,000 m) deep. It's darker than the sunlight zone.

Midnight zone

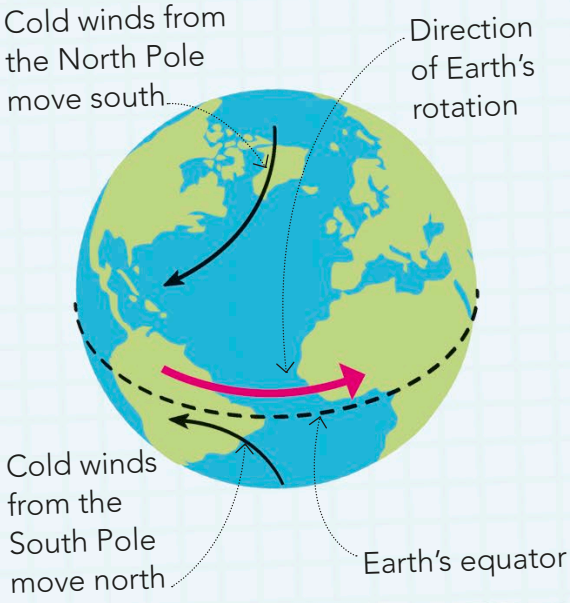
The midnight zone goes from 3,300 ft (1,000 m) to 13,000 ft (4,000 m) deep. It is completely dark apart from tiny lights made by sea creatures.

Where does wind come from?

The sun heats up the surface of planet Earth. The land heats up faster than water so the air above land is warmer than the air above the sea. Warm air rises and cooler air sinks. This movement of air is called wind.

Weather patterns

Cold air from the North and South Poles sinks toward the warm equator, the imaginary line around the center of the Earth. The Earth's surface near the equator is spun faster than the poles so the wind ends up moving toward the west.



Land air

The warm air above the land rises because it is less squashed together than colder air. Warm air floats above colder air.

Quick quiz

1. Why is the air above land warmer than the air above the sea?
2. What is the name we give to the fastest type of wind?
3. What is the scale we measure wind on?

See pages 132–133 for the answers

How can we keep track of the wind?

Wind sock

A wind sock is an instrument that shows the direction the wind is blowing toward. The hollow tube is lifted as the wind blows through it. Wind socks are used at airports.

Anemometer

An anemometer is a machine that measures wind speed. Little cups catch the wind and spin around. The faster the wind moves, the faster they turn.

Flow of air

As the warm air rises, it starts to cool and form clouds, which move out to sea.

Sinking air

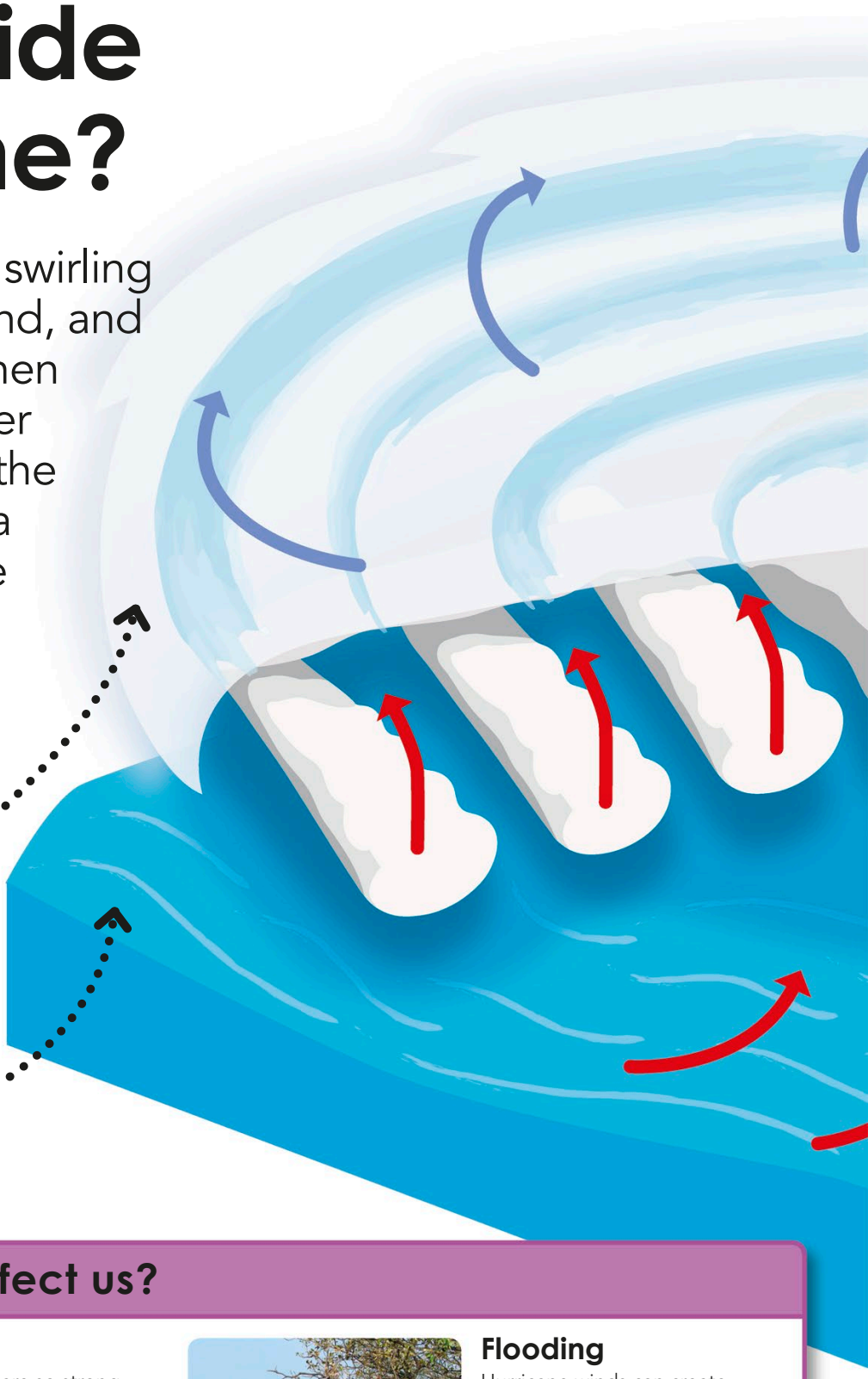
Cold, wet air sinks because it is heavier and closer together than warmer air. When it meets the sea it stops sinking.

Sea breeze

Cool air is sucked toward the land where the warm air has risen up. This movement is called the onshore breeze.

What's inside a hurricane?

Hurricanes are massive, swirling storms full of clouds, wind, and rain. Hurricanes form when thunderstorms meet over warm ocean waters. At the center of a hurricane is a calm area called the eye of the storm.



Icy clouds

Clouds overflow from the center to make a layer of thin, icy clouds on top. It moves in the opposite direction to the clouds underneath.

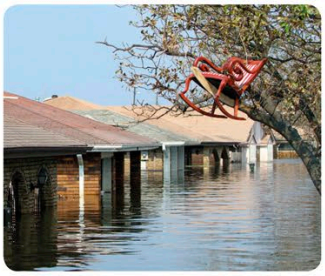
Ocean waters

Hurricanes occur where seas are at least 200 ft (60 m) deep and at least 80°F (27°C) warm.

How do hurricanes affect us?

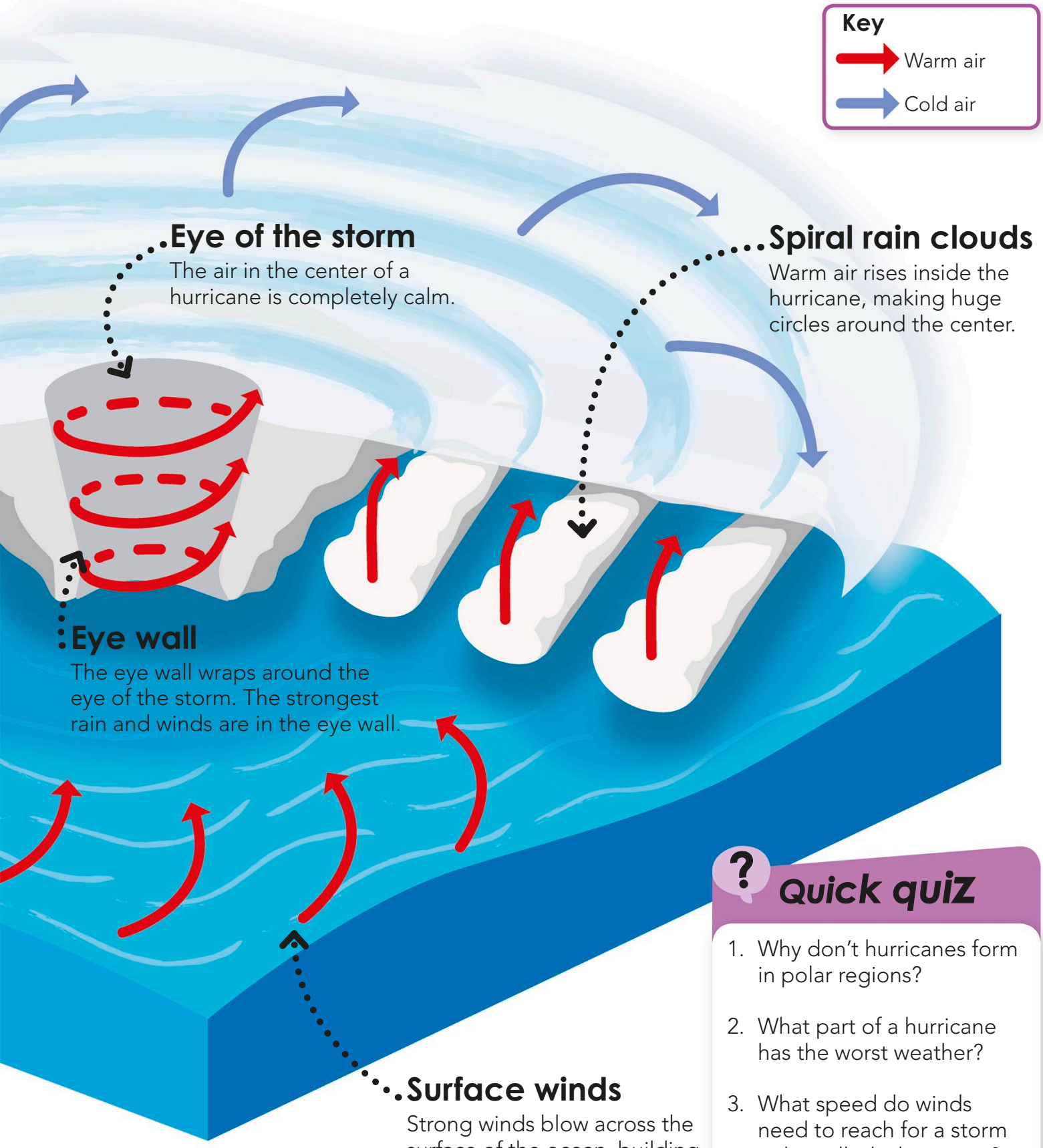
Damage

Hurricane winds are so strong they can blow down buildings and destroy electricity and water supplies. This can leave people without homes, schools, and places to go to work.



Flooding

Hurricane winds can create massive waves that flood towns on the coast. During a hurricane, a month's worth of rain can fall in a few hours.



Quick quiz

1. Why don't hurricanes form in polar regions?
2. What part of a hurricane has the worst weather?
3. What speed do winds need to reach for a storm to be called a hurricane?

See pages 132–133 for the answers

Where does planet Earth end?

Planet Earth is protected by layers of gases called the atmosphere. At around 62 miles (100 km) above sea level, the Earth's atmosphere ends and space begins. This is called the Karman line.

Orbiting satellite

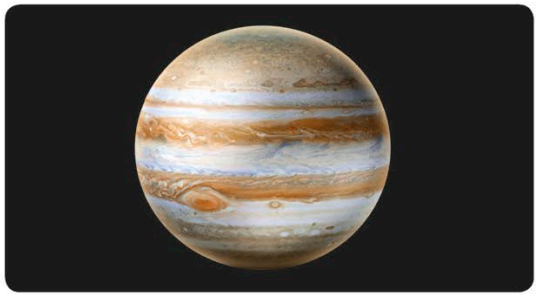
Exosphere

This is the final layer of the atmosphere, where air completely runs out to become airless outer space.

Thermosphere

This layer is the last one before the atmosphere fades into space. The Karman line is in this layer. Temperatures can reach 3,600°F (2,000°C).

Do other planets have atmospheres?



Jupiter

Jupiter is a planet made from gas. It has a thick atmosphere made up of hydrogen, helium, methane, and ammonia gases.

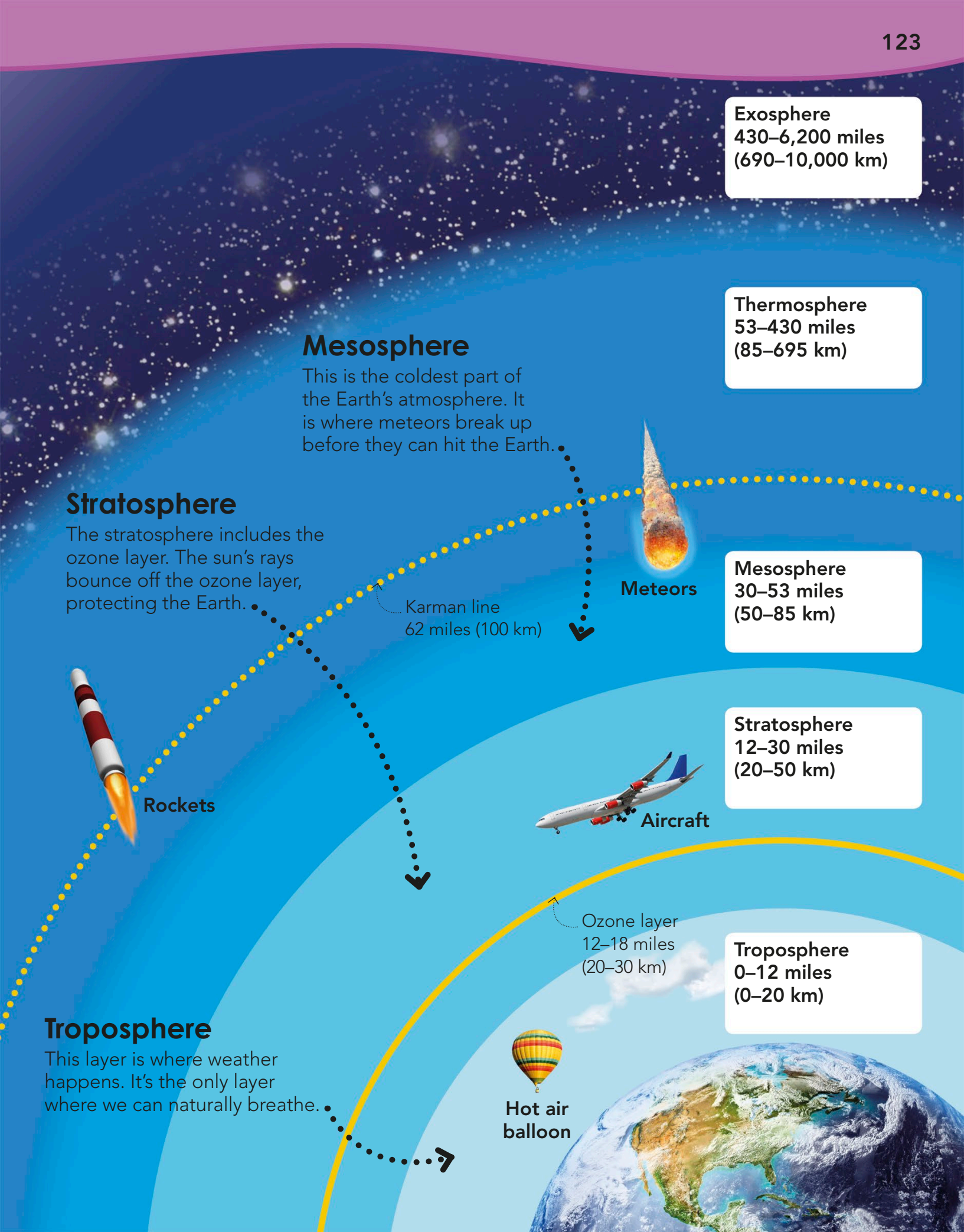
Mercury

Mercury is a rocky planet with low gravity and almost no atmosphere. Gases around Mercury are blown away by the sun's solar wind.

? True or false?

1. The atmosphere is held in place by gravity.
2. Earth is the only planet with an atmosphere.
3. The stratosphere has warmer layers higher up and cooler layers lower down.

See pages 132–133 for the answers


Exosphere
430–6,200 miles
(690–10,000 km)
Thermosphere
53–430 miles
(85–695 km)
Mesosphere
This is the coldest part of the Earth's atmosphere. It is where meteors break up before they can hit the Earth.
Stratosphere
The stratosphere includes the ozone layer. The sun's rays bounce off the ozone layer, protecting the Earth.
Karman line
62 miles (100 km)
Meteors
Mesosphere
30–53 miles
(50–85 km)
Rockets
Aircraft
Stratosphere
12–30 miles
(20–50 km)
Ozone layer
12–18 miles
(20–30 km)
Troposphere
0–12 miles
(0–20 km)
Troposphere
This layer is where weather happens. It's the only layer where we can naturally breathe.
Hot air balloon

Where does the moon go?

The moon takes a month to travel around the Earth. Depending on where it is on that journey, different amounts of sunlight are reflected off the moon's surface. Sometimes it seems to disappear altogether. In reality, though, the moon is always there—we just can't always see sunlight reflecting off it.

Which other planets have moons?

Jupiter

Jupiter has 53 moons. One moon, Io, has many active volcanoes on it. Another, called Europa, is covered in ice!

Saturn

Saturn has at least 53 moons. One of its moons, called Titan, is made from ice and rock and has a layer of gases around it.

Light and dark

The side of the moon facing the sun is lit up, while the other side facing away from the sun is in shadow.

Lunar phases

The moon appears to change shape during its monthly journey when seen from Earth.

Waning crescent

Last quarter

Waning gibbous

From Earth, we only ever see the same side of the moon.

Sunlight

Reflected light

The moon doesn't make light of its own. It only reflects the sun's light.

New moon

Waxing crescent

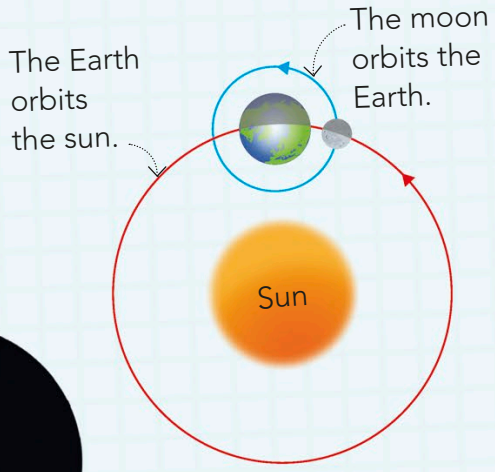
First quarter

Waxing gibbous

Full moon

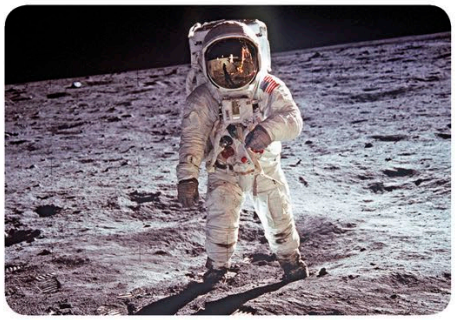
Orbits

The Earth moves around the sun in a loop called an orbit. At the same time, the moon orbits around the Earth.



Earth and moon orbits

Picture quiz



Who was the first person on the moon?

See pages 132–133 for the answer

Can we live on other planets?

A planet needs the perfect ingredients and conditions for life to survive. Ingredients include liquid water, oxygen gas, and food. Conditions include the right temperature, protection from harmful rays, and the right amount of gravity.

Too hot

The thick, toxic atmosphere on Venus has trapped a lot of heat, making this the hottest planet in the solar system.

Venus

Hot and cold

Mercury is too hot for life on the side that faces the sun and too cold the other side. It has no atmosphere.

Mercury

Sun

Earth

Mars

The red planet

Mars has very little atmosphere so the sun's heat isn't trapped by gases. Instead, it just bounces back into space, making Mars too cold for life.

An atmosphere is a layer of gases around a planet.

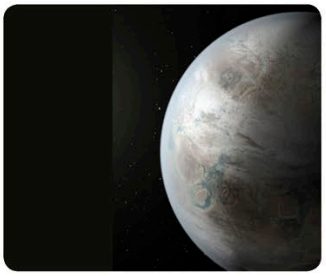
Perfect conditions

Earth has an atmosphere, liquid water, and the right level of gravity. It's in the "Goldilocks zone," which means it's not too hot and not too cold, but just right for life.

Can distant planets support life?

Kepler 186f

This Earthlike planet has a rocky surface and may have water on it. But it would take 500 years to get to Kepler 186f, even if we could travel at the speed of light.

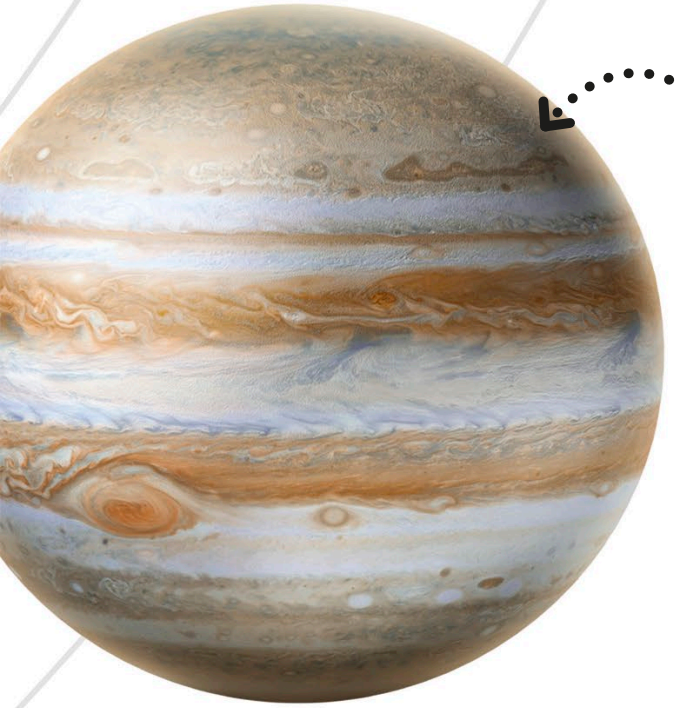


Kepler 452b

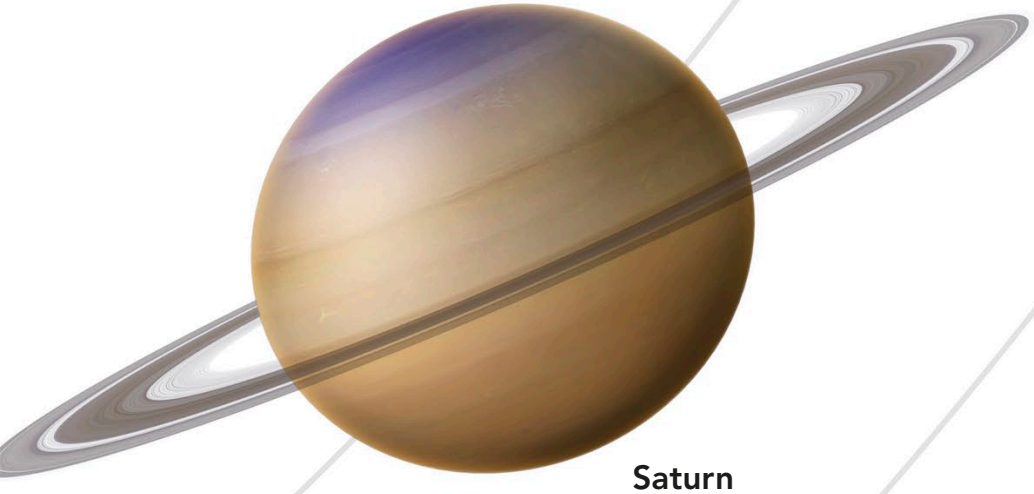
This planet is close in size to Earth and orbits a star similar to our sun. It is in the "Goldilocks zone" of its solar system, but scientists do not yet know if it has water.

Gas giants

The four outer planets are made from gas so they don't have a solid surface. They are so massive that their gravity would squash us.



Jupiter



Saturn

Uranus

Neptune

Quick quiz

1. Which planet used to be similar to Earth?
2. Why don't we travel to planets outside of our solar system?
3. What are planets from outside our own solar system called?

See pages 132–133 for the answers

What is space made from?

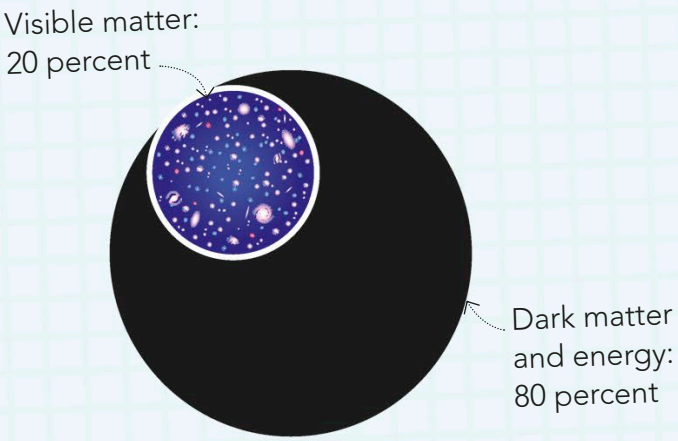
Space is mostly a vast, silent, empty space. It looks dark because of huge gaps between objects that give off light, such as stars. Space is expanding all the time. We don't know where it ends or if it even has an end.

Galaxies

Groups of billions of stars are called galaxies. Galaxies have collapsed stars called black holes at their center.

Dark matter

Scientists believe an invisible substance called dark matter and an invisible force called dark energy exist in space. Most of the universe is made up of dark matter and energy.



If you could drive a car straight up in the air, it would take about an hour to reach space.

True or false?

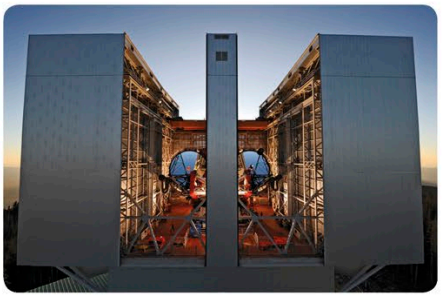
1. There are more galaxies in the universe then people on planet Earth.
2. Our star, the sun, is about halfway through its life.
3. Space is mainly full of stars.

See pages 132–133 for the answers

Stars

There are lots of different types of star. Some are just being born and some are exploding at the end of their lives. They shine because they burn gases at hot temperatures.

How do we take photos of space?



Land-based telescopes

It is easier to build and fix telescopes on land than in space. Huge telescopes take detailed images of space.

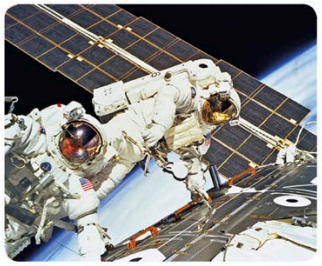
Hubble Space Telescope

The Hubble Telescope floats in space. It takes pictures of the universe away from the light pollution found on Earth.

How do people travel into space?

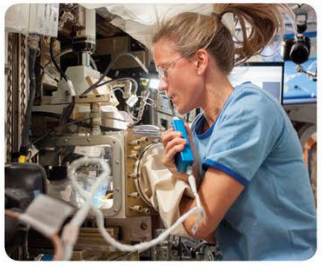
People first started traveling into space in the 1960s. They traveled in space rockets and later space shuttles. Earth's gravity pulls things down, so a space rocket needs to be powerful enough to escape gravity.

What do people do in space?



Fix satellites

There are thousands of satellites traveling around the Earth. They help us to predict the weather and send phone, TV, and GPS signals.



Experiments

Astronauts visit the International Space Station, a huge space craft that was built in space. They live there for months and do science experiments.

Inside the capsule

The rocket takes up to three astronauts and supplies to the International Space Station. Astronauts need to take food, water, and air with them.

Capsule

The Soyuz capsule protects astronauts from the sun's rays and from heat that is made when the rocket passes quickly through the Earth's atmosphere.

Rocket power

The rocket lifts the capsule into space and then separates from it and returns to Earth. Meanwhile, the capsule keeps traveling in space.

Gantry arms

Gantry arms support the rocket and hold it upright before launch. They release the rocket during liftoff.

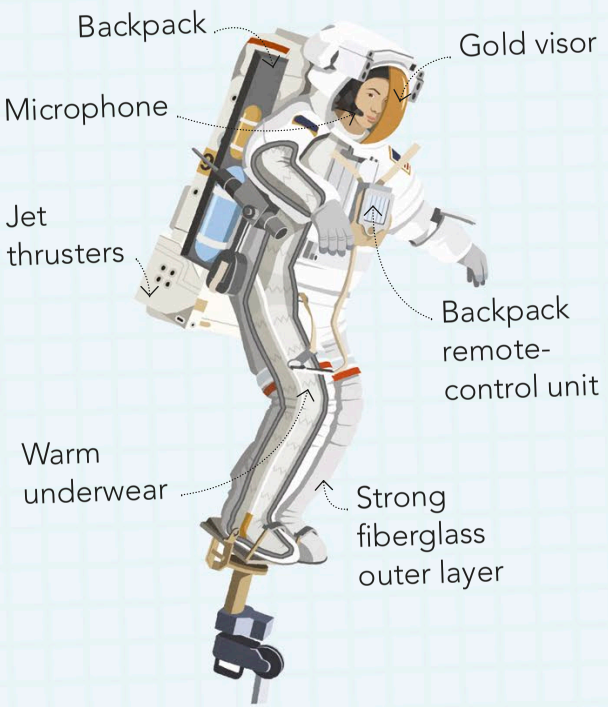
Boosters

Strap-on boosters power the rocket for liftoff. Gas shoots out of the bottom and the rocket is propelled upward. The boosters fall away later.

The word astronaut means "star sailor."

Space suits

Space has no air in it, so people who travel outside a spacecraft need to take air with them. A space suit carries oxygen and protects the body from harmful space rays. It keeps the body at the right temperature in the extreme cold of space.



Quick quiz

1. Why is space food usually dry?
2. What was the first animal in space?
3. Why do rockets have to be so powerful?

See pages 132–133 for the answers

Answers

Page 7 1) False. Biology is the study of living things. 2) True.

Page 10 1) False. Giant tortoises can live for over 200 years, but ocean quahogs, (a type of shellfish) can live for 500 years. 2) True. 3) True.

Page 13 Invertebrates.

Page 15 1) True. 2) False. Bacteria come in three shapes. 3) False. There are 100,000 bacteria on every 0.15 sq in (sq cm) of your skin.

Page 17 1) True. 2) False. Plants need light to grow. 3) True.

Page 19 1) True. 2) True. 3) False. Spiders have tiny hairlike hooks on their feet.

Page 21 1) False. Most adult insects have wings, spiders don't. 2) True. 3) True.

Page 23 The ostrich.

Page 25 1) False. Some mammals live in the sea. 2) False. Mammals are the only animals that have fur on their bodies. 3) True.

Page 27 1) False. Female lions do most of the hunting. 2) True. 3) False. There are no wild lions in Australia—most live in Africa.

Page 29 1) True. 2) True. 3) True.

Page 31 1) False. Penguins live in the Antarctic, not the Arctic. 2) True. 3) False. Polar bears live in the Arctic.

Page 32 1) Fossils are very rare because most dead dinosaurs were eaten or rotted away. 2) Yes, they can be preserved inside amber, which comes from tree sap. 3) Coprolites.

Page 37 1) Red blood cells. 2) The digestive system. 3) The skin.

Page 39 1) True. 2) True. 3) True.

Page 41 1) 22 bones. 2) The hands. 3) Over 400 joints.

Page 43 1) True. 2) True. 3) False. Muscles only pull, they can't push.

Page 45 1) The oxygen we need comes from plants. 2) 23,000. 3) The trachea.

Page 47 1) True. 2) False. Blood cells are made inside bones. 3) True.

Page 48 1) Muscles in the intestines move the food along by squeezing it. 2) Sugar. 3) It takes one-to-three days for food to pass all the way through the body.

Page 51 1) Memories are stored and useless information is deleted. 2) Two hemispheres. 3) Ancient Egyptians removed the brain by pulling it out through the nose.

Page 53 1) False. The top layer of your skin is replaced every month. 2) True. 3) False. A group of tiny cuts is called a graze.

Page 55 1) White blood cells. 2) Tonsils catch and fight germs that enter the mouth. 3) Saliva kills germs.

Page 59 1) The neutron. 2) Nuclear energy. 3) Molecules.

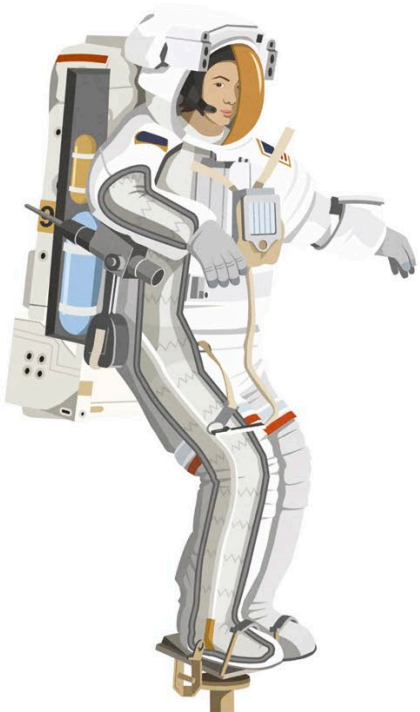
Page 60 1) Solidifying. 2) A solid. 3) Mercury.

Page 63 1) No, salt water can be deadly for humans to drink. 2) No, the water in rivers and lakes is fresh water. 3) Evaporation.

Page 65 Rust is formed.

Page 66 1) True. 2) False. Under 20 percent of our plastic is recycled. 3) True.

Page 69 1) True. 2) True. 3) False. All fireworks use chemical reactions.



Page 71 1) True. 2) True. 3) True.

Page 75 1) The sun. 2) Renewable energy. 3) Nuclear energy.

Page 77 A shadow is an area where light is blocked from reflecting off a surface by an object in the way of the light.

Page 79 1) Yes, sound can travel through solids, liquids, and gases. 2) The bee's wings are vibrating, making a buzzing sound. 3) The voice box.

Page 81 1) Radiation. 2) Conduction. 3) It has melted.

Page 83 1) Conductors. 2) Moving charged particles called electrons. 3) Static electricity.

Page 85 A fuse.

Page 87 1) True. 2) True. 3) False. Positive charges stick to negative charges.

Page 88 1) True. 2) True. 3) False. Hamster wheels are not connected to generators.

Page 90 1) Fossil fuels. 2) Deep underground. 3) A mine.

Page 95 1) True. 2) True. 3) False. When forces are balanced, an object stays at rest, or if it is moving, it keeps moving at a constant speed.

Page 97 1) True. 2) True. 3) True.

Page 99 1) False. Magnets have one north pole and one south pole. 2) True. 3) False. Aluminum is not magnetic.

Page 101 1) True. 2) False. Crows cannot use levers. 3) True.

Page 102 1) Over a billion. 2) An internal combustion engine. 3) Gasoline and diesel.

Page 105 1) It doesn't change—gravity is a constant force. 2) Acceleration. 3) The object will move at a constant speed or stay still.

Page 106 1) The wing shape pushes the air downward. 2) Weight. 3) The tail plane keeps the plane stable.

Page 110 1) True. 2) False. We can only dig into the top layer of the Earth—the crust. 3) True.

Page 112 1) Seismometers. 2) The Richter scale. 3) Apart, together, and along.

Page 115 A drought.

Page 117 1) False. The largest ocean is the Pacific. 2) True. 3) True.

Page 119 1) Land heats up quicker than water. 2) A hurricane. 3) The Beaufort scale.

Page 121 1) Hurricanes need warm, moist air to develop. 2) The eye wall. 3) Winds need to reach at least 73 mph (120 kph) to be called a hurricane.

Page 122 1) True. 2) False. Other planets, such as Jupiter and Mercury, have an atmosphere. 3) True.

Page 125 Neil Armstrong.

Page 127 1) Venus. 2) Other planets outside of our solar system are too far away for us to travel to. 3) Exoplanets.

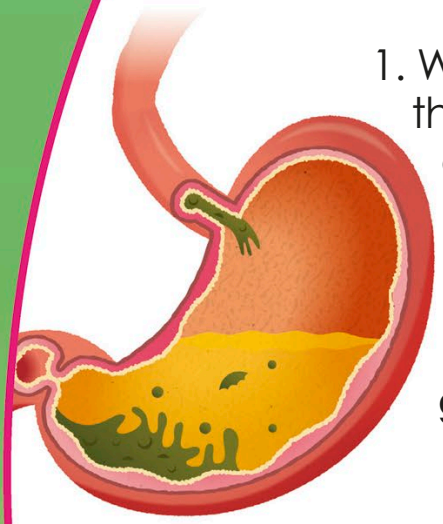
Page 129 1) True. 2) True. 3) False. Space is mainly empty.

Page 131 1) Space food is dry so it can last a long time. The water is added back into it in space. 2) The Russian space dog, Laika. 3) Rockets have to be powerful so they can escape the Earth's gravity.

Quiz your friends!

Who knows the most about science? Test your friends and family with these tricky questions. See pages 136–137 for the answers.

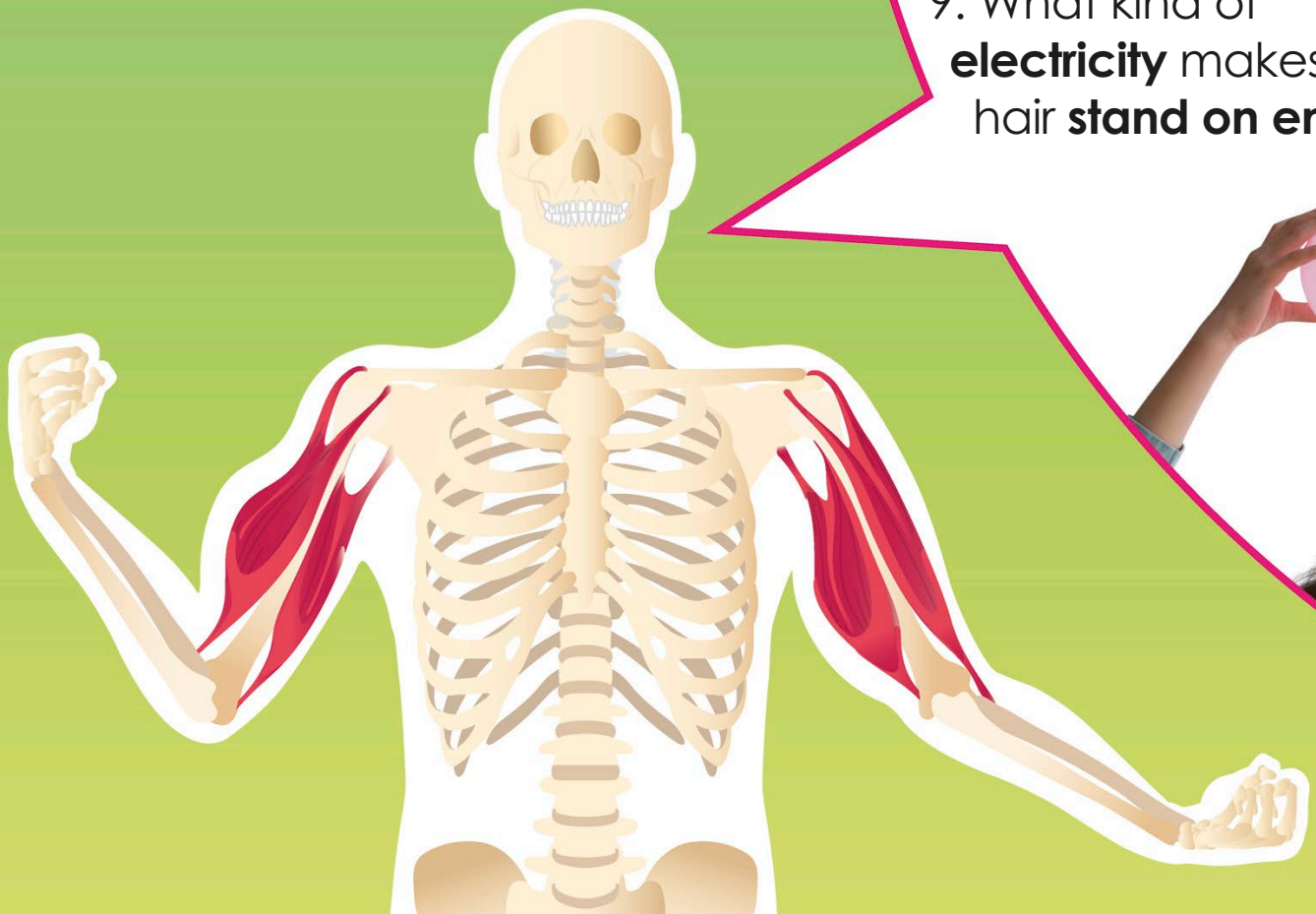
Questions

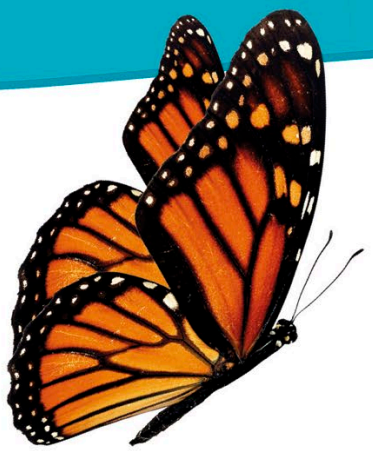


1. What is the name of the **chemical** in our **stomach** that **kills germs**?

6. In which state do materials have particles that are close together and in straight lines?

9. What kind of **electricity** makes our hair **stand on end?**



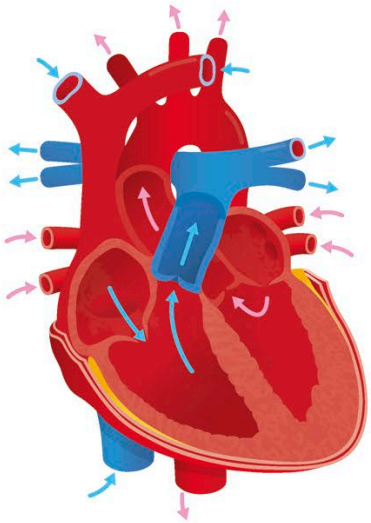


2. How many different life stages does a **butterfly** go through?

3. What is the **top layer of the skin** called?

4. What is the **smallest** living thing on Earth?

5. What are **feathers** made of?



7. What is the force that pulls us toward the Earth?

8. What is **litmus paper** used for?

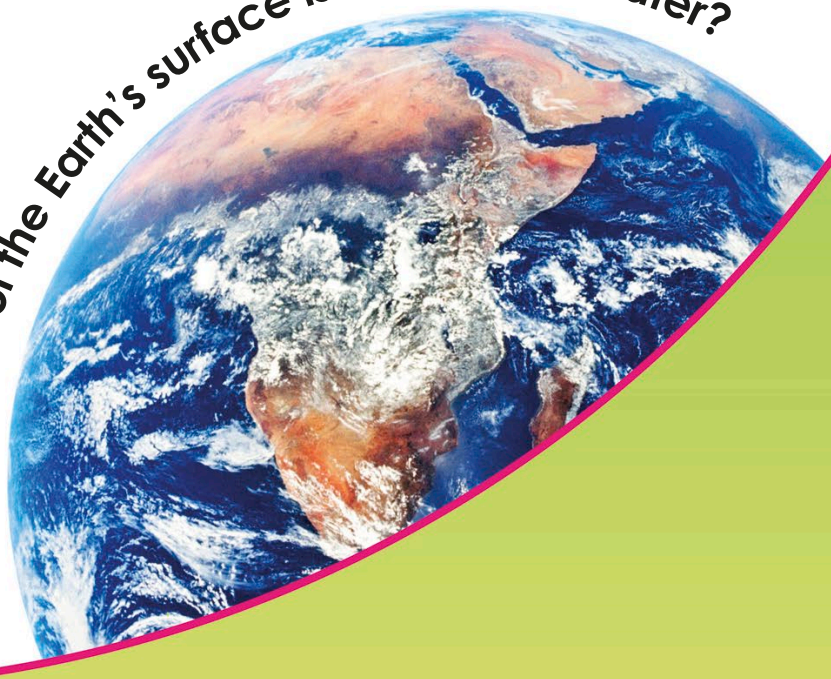
10. How many times does the heart pump per minute?

11. What is the name for a **mixture** of two or more **metals**?

12. How **fast** must a rocket travel to **escape Earth's gravity?**

13. Where does **air** enter our **body**?

14. How much of the Earth's surface is covered in water?

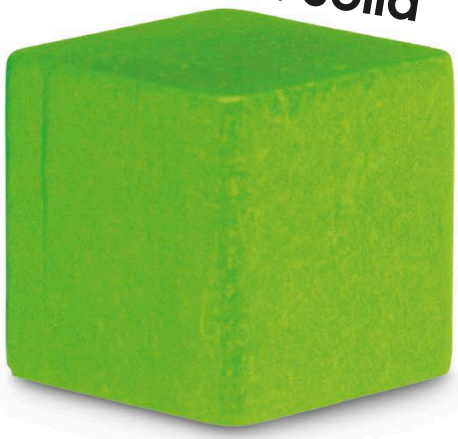


Answers

1. Hydrochloric acid

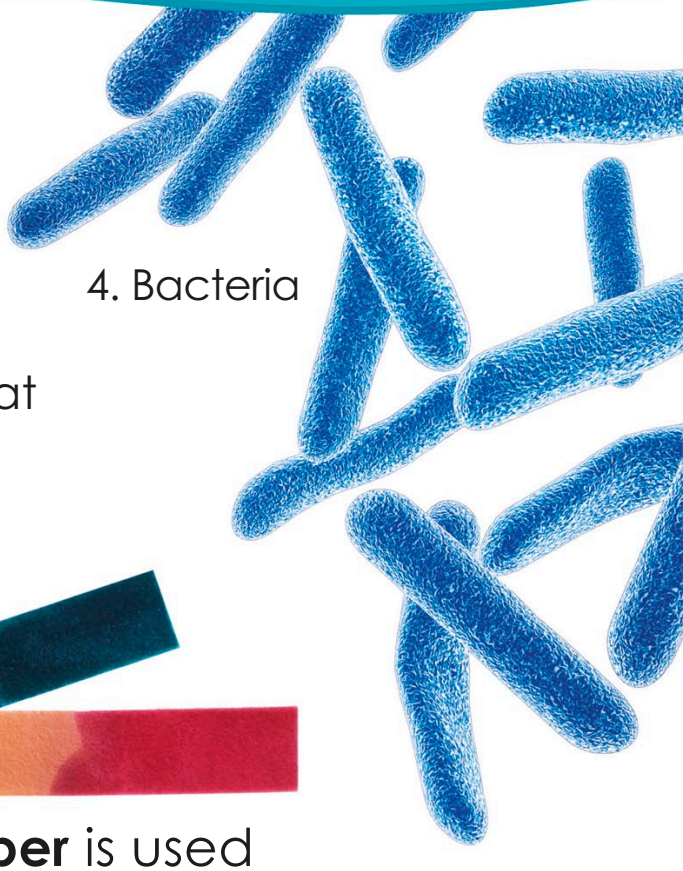
2. **Four**: egg, chrysalis, pupa, butterfly

6. *Solid*



12. 25,000 mph (40,000 kph)— that's 125 times faster than a race car!

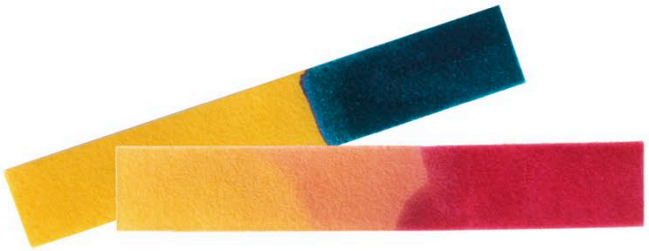
3. The **epidermis**



4. Bacteria

5. Keratin—the same material that **fingernails** are made of.

7. Gravity

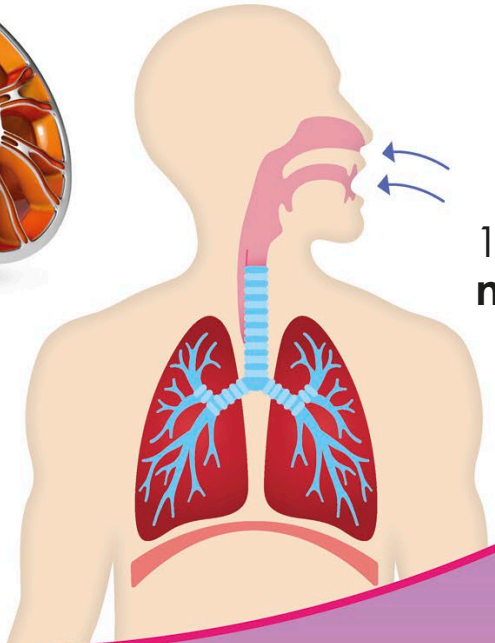


8. Litmus paper is used to test how **acid** or **alkaline** a liquid is.

9. **Static electricity**

10. The heart pumps blood around 80 times per minute.

11. An alloy



14. Over **two-thirds**

13. Through our **mouth** and **nose**

Glossary

Absorption
When something takes in another substance, for example, when a sponge absorbs liquid

Adaption
Way in which an animal or plant becomes better suited to its habitat

Amphibians
Cold-blooded vertebrates that start life in water before moving between land and water when grown

Archaeologist
Someone who looks for and studies ancient places and objects

Arteries
Tubes that carry blood rich in oxygen from the heart to the tissues

Arthropods
Group of vertebrates with a tough outer skeleton and a body divided into segments

Atoms
Smallest part of something that can take part in a chemical reaction

Bacteria
Tiny living things that can be found everywhere on Earth

Boundary
The point where one area ends and another begins

Camouflage
Colors or patterns that help something appear to blend in with its environment

Capillaries
Tiny blood vessel carrying blood through the tissues from arteries to veins

Cardiac
Of, or near, the heart

Cells
Tiny parts of the body that carry out different jobs, such as fighting infection

Cerebrum
Part of the brain involved in activities such as thinking, memory, movement, and sensation

Chrysalis
Hard casing a butterfly wraps itself in during metamorphosis

Circulatory
The system in the body made up of the heart and blood vessels

Conduction
When heat transfers between two things

Convection
When heat is transfered by the movement of fluids

Diaphragm
Muscle that moves up and down to control how much air is in your lungs

Evaporation
When a liquid is heated and changes into a gas or vapor

Exhale
To breathe out

Extracting
To take something away from something else

Filtration
When a liquid or gas is passed through something to remove small particles

Fluid
A gas or liquid

Force
Push or pull that causes things to start moving, to move faster, change direction, slow down, or stop moving

Fracture
A broken bone

Friction
Force created when two surfaces rub or slide against each other

Fuel
Substance that is burned to create heat or power

Inhale
To breathe in

Invertebrate
Animal that does not have a backbone

Keratin
A substance found in shells, claws, and skin

Lunar
Of the moon

Malleable
An object or material that can be shaped without breaking

Mammals
Warm-blooded vertebrate animals that have skin covered in hair and feed their young milk

Material
Substance that can be used to make things. It can be natural or made by humans

Metamorphosis
Process by which some animals transform themselves into a different form from birth to adulthood

Minerals
Natural substances that grow in crystals, such as salt. All rocks are made from minerals

Molecules
Group of atoms bonded together

Mucus
A thick, sticky substance that protects the nose, lungs, and intestines

Muscle
Material in the body that contracts (shortens) to allow movement

Nerve
Long string of neurons carrying impulses between the brain, the spinal cord, and parts of the body

Neutron
A particle that has no charge

Nuclear
Being, or talking about, the nucleus of an atom

Nucleus
The central and most important part of an atom or cell

Orbit
Path an object takes when traveling around another object when pulled by its gravity

Oxygen
Gas in the atmosphere that supports life

Particles
Extremely small parts of a solid, liquid, or gas

Photosynthesis
Process that green plants use to make food from sunlight

Pressure
Weight or force that is created when something is pressed against something else

Radiation
The transfer of energy through waves or particles. For example, heat from the sun warming our faces

Reptiles
Cold-blooded vertebrates with scaly skin that usually reproduce by laying eggs

Solar
Word used to relate to the sun and its energy

Spectrum
Range of something, for example, the range of colors in a rainbow

Streamlined
Something smooth that air can easily pass over

Telescope
Instrument used to look at distant objects

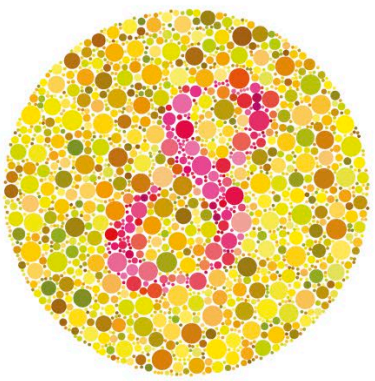
Vapor
Extremely small drops of liquid

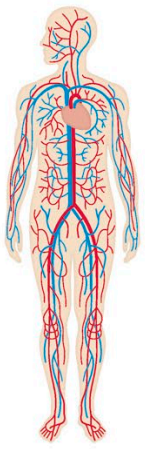
Veins
Blood vessels that carry blood from the tissues toward the heart

Vertebrate
Animal that has a backbone

Vibration
Moving backward and forward small amounts very quickly

Index





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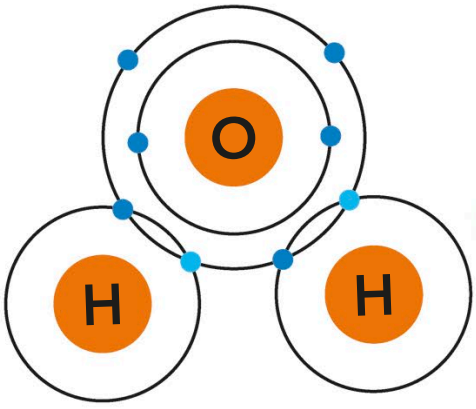

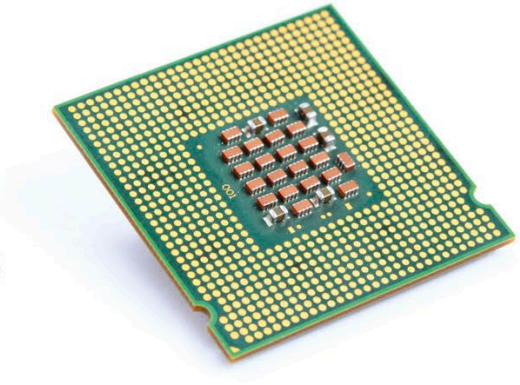

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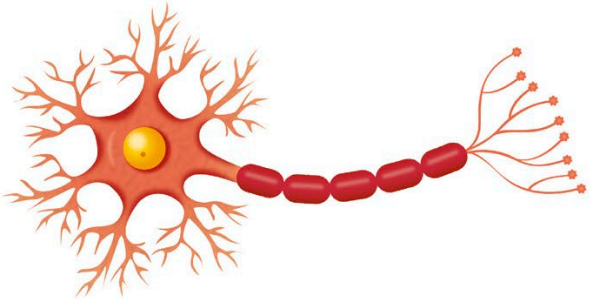

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