WEATHER SCIENCE

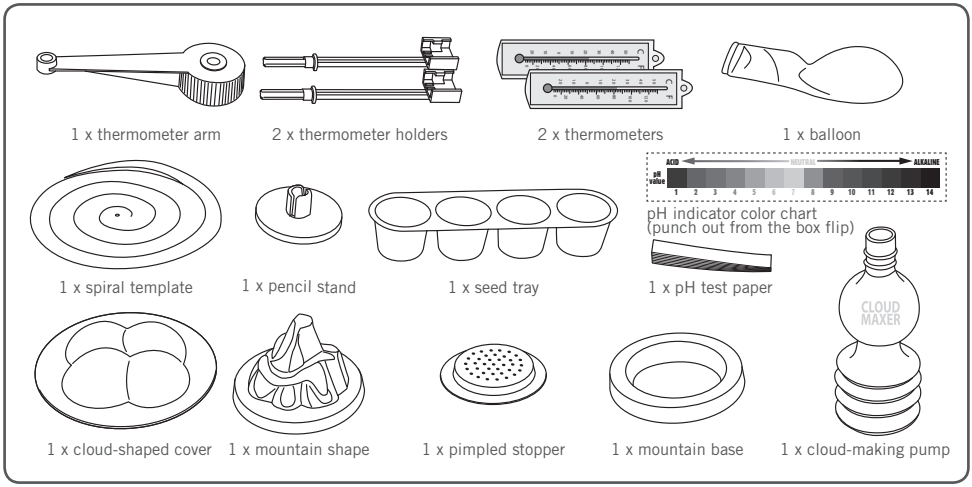
⚠ WARNING:
CHOKING HAZARD - Small parts.
Not for Children under 3 years.

To Parents: Please read through these instructions before giving gudiance to your children.

A. SAFETY MESSAGES

1. Read carefully through all these instructions before you start. Adult supervision is always required.
2. Children can choke on flat or broken balloons. Adult supervision is necessary when using balloons. Flat and broken balloons must be discarded immediately.
3. This kit and its finished product contain small parts which may cause choking if misused. Keep away from children under 3 years old.
4. This kit is intended for children aged over 8.
5. Adult assistance and supervision are recommended when using scissors.
6. Adult supervision is required throughout, and especially where alcohol and desk lamps are used.
7. Always wash your hands after handling soil or compost.

B. CONTENTS



Also required, but not included in this kit: a glass, some potting soil, some beans, a pencil, a plastic bottle, a desk lamp (in case there is no sunshine) and alcoholic drink. Adult supervision is required when getting all these materials from home.

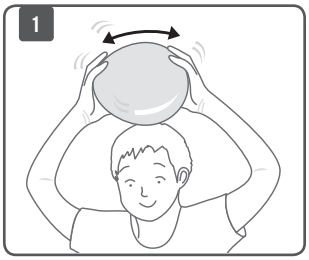
QUESTIONS & COMMENTS

We treasure you as a customer and your satisfaction with this product is important to us. In case you have any comments or questions, or you find any parts of this kit missing or defective, please do not hesitate to contact our distributor in your country, whose address is printed on the package. You are also welcome to contact our marketing support team at Email: infodesk@4M-IND.com, Fax (852) 25911566, Tel (852) 28936241, Web site: WWW.4M-IND.COM

C. LIGHTNING BALLOON

A flash of lightning is a giant spark of electricity. Lightning happens when electric charge builds up inside a storm cloud. When the charge becomes large enough, it jumps from the cloud to another cloud, from one part of the cloud to another, or from the cloud to the ground. The electric charge in a cloud is made when ice particles and water drops in the cloud bump into each other. The charge sits on the particles and drops. There are two types of charge: positive and negative. In a thunder cloud, positive charge builds up in the top of the cloud, and negative charge builds up in the bottom.

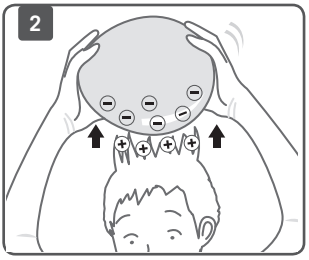
This activity will show you how electric charge is made when you rub a balloon on your hair. This is similar to how a charge is made when particles collide in a storm cloud.



Materials required from kit: balloon

STAND UP HAIR

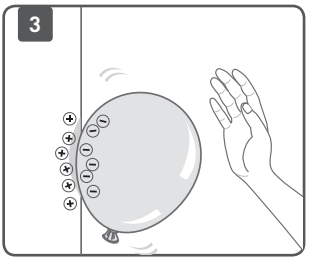
1. Inflate the balloon and tie a knot in its neck (ask an adult to help you with this). Rub your hair lots of times with the balloon.



2. Hold the balloon over your head. Your hair will stand on end! Try it on members of your family or friends. They will be amazed.

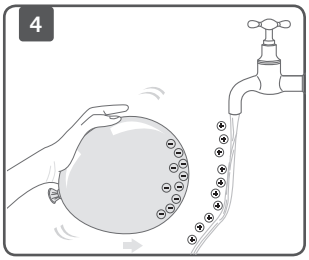
STICKY BALLOON

3. Rub your hair lots of times with the balloon. Carefully put the balloon on a wall. It will stick to the wall!



BENDY WATER

4. Turn on a tap and adjust it so that you have very thin stream of water. Rub your hair lots of times with the balloon. Slowly move the balloon towards the stream of water. The stream of water will bend around the balloon.



HOW IT WORKS

The sort of electricity you made in the activities is called static electricity because it stays on objects instead of flowing through them. You can make static electricity by rubbing certain combinations of materials together, such as the balloon and your hair. When you rub them together, tiny particles called electrons jump from one material to the other. Electrons carry a negative electric charge. The material that gains the electrons gains a negative charge, and the material that lost them is left with a positive charge. In this case, electrons jump from your hair to the balloon, so the balloon gets a negative charge.

Two like charges (two positive or two negative) repel each other, and two opposite charges attract each other. When you put the balloon near an object, its negative charge pushes electrons in the object away, leaving a positive charge on the surface of the object. Then the charge in the balloon and in the surface of the object attract, so the balloon attracts the object. This makes the balloon stick to the wall, or pull up your hair, or attract paper. The particles in water have a positive end and a negative end. When the balloon is close to the stream of water, the balloon attracts the positive ends of the particles, which makes the stream bend.

FUN FACTS

- A bolt of lightning contains about 5 billion joules of energy — enough to power an energy-saving light bulb for 20,000 years!
- Mountaineers caught in thunderstorms sometimes feel the hairs on their heads standing on end because of the electric charge in the thunderclouds.
- Lightning conductors on buildings are designed to carry the electricity in a lightning bolt safely to the ground.
- The tiny electric shocks you sometimes get when you touch metal objects indoors are made by static electricity jumping off your body. The electricity is made when your shoes rub on nylon carpets.

D. CLOUD MAKER

Clouds are made up of millions upon millions of tiny water droplets or ice crystals. Water droplets are made when water vapour (the gas form of water) in the air turns to liquid water. This happens when air pressure and temperature fall.

Materials required from kit: cloud-making pump
Materials required from home: a drink containing alcohol (such as cooking wine or brandy)

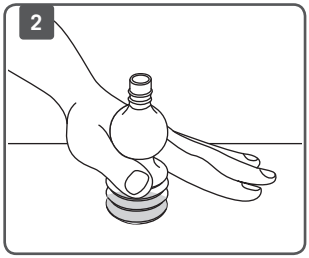
Important: you must ask an adult before using alcohol in this activity, and an adult must supervise you when you carry out the experiment.

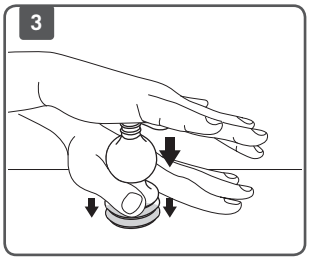
1. Very carefully pour a little of the alcoholic drink into the cloud-making pump. You only need enough to cover the bottom of the pump. Swirl the liquid around inside the pump.

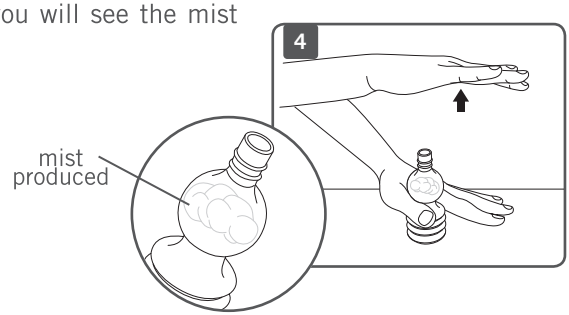
2. Stand the pump on a table. Put the first two fingers of one hand either side of the pump, halfway down.

3. Press the palm of other other hand firmly onto the neck of the pump. Squash down the bottom section of the pump, while keeping your palm firmly on top of the neck.

4. Wait a few seconds. Now very quickly take your palm off the neck of pump. You should see mist suddenly appear in the top of the pump. Cover the opening before the mist disappears. Squash down the bottom section of the pump again, and you will see the mist clear up like magic.







HOW IT WORKS

Some of the alcohol in the drink evaporates into the air in the pump. That means it turns into alcohol vapour. When you squash the pump, the pressure inside the bottle rises, and so does the temperature. When you take your finger off the neck, the pressure drops, and this makes the temperature drop too. The sudden drop in pressure and temperature makes some of the alcohol vapour condense to form tiny droplets that you see as mist. When you press down the pump again, you increase the pressure and temperature. This makes the alcohol in the tiny droplets evaporate again, so the droplets disappear.

This is exactly what happens in the Earth's atmosphere. When air that contains water vapour rises into the atmosphere, its pressure falls and its temperature falls. This makes the water vapour condense into the tiny water droplets that make clouds.

FUN FACTS

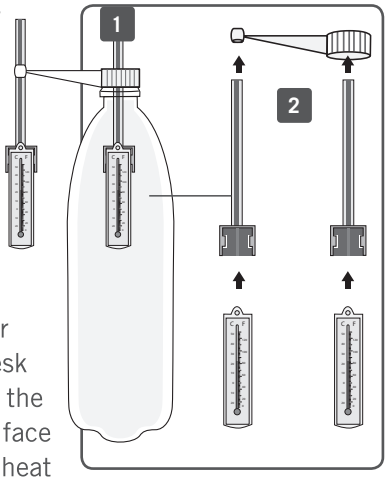
- You can see the cloud-making effect in a bathroom. Warm air over a bath or from inside a shower contains lots of water vapour. When this air hits a cold mirror, the water vapour condenses, making the mirror misty.
- The biggest clouds are giant cumulonimbus clouds, which can be more than 10 kilometres tall.
- Lenticular clouds are flying-saucer-shaped clouds that form when damp air rises over mountains and cools.

E. THE GREEN HOUSE EFFECT & GLOBAL WARMING

The greenhouse effect is a way in which the Earth's atmosphere traps heat from the Sun. This makes the atmosphere warm. Without the greenhouse effect, the Earth would be a much colder place. Certain gases in the atmosphere are better at trapping heat than others. A gas called carbon dioxide is one of the best.

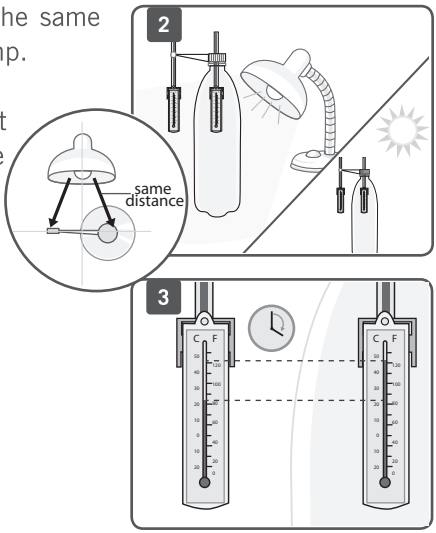
Materials required from kit: thermometers, thermometer arm, thermometer holder
Materials required from home: a small, clear plastic drinks bottle, a desk lamp, baking soda, vinegar
Important: ask an adult before using a desk lamp, as the lamp could get very hot.

1. Slot a thermometer into each thermometer holder. Push a thermometer holder into each hole at the end of the thermometer arm. Remove the top from a small, clear plastic drinks bottle. Wash out the bottle with water. Write down the temperature on both thermometers. Carefully put the bottle over the thermometer attached to the screw cap, and screw it into place in the cap.



2. Place the set up outdoors under sunshine or alternatively stand the bottle on a desk. Put a desk lamp (a 60-watt incandescent light bulb) next to the bottle and switch it on. The thermometers should face away from the lamp so that the lamp does not heat the thermometer bulb, and both should be the same distance about 15 cm (6 inches) from the lamp.

3. Wait for about 20 minutes. Then look at the thermometers again and write down the readings. How much has the temperature risen inside and outside the bottle?



HOW IT WORKS

The lamp warms the bottle itself, and this warms the air inside the bottle, which makes the temperature of the air trapped inside the bottle rise. The lamp also heats the air around the thermometer outside the bottle, but this time, the warm air can escape and be replaced by cooler air, so the temperature does not rise as high as the temperature inside the bottle. The bottle acts like the Earth atmosphere. It demonstrates how the Earth's atmosphere traps heat.

NOW DO THE SECOND PART OF THE EXPERIMENT:

4. Take the thermometer arm off the bottle, with its thermometers, and put it to one side to allows the thermometers to return to room temperature.

5. Put a teaspoon of baking soda and two teaspoons of vinegar into the bottle, and shake the bottle gently. Wait ten seconds and then put the bottle back onto the thermometer arm.

6. Now repeat steps 1 and 2 above. This time, has the temperature in the bottle risen more than it did the first time?

The baking soda and the vinegar react together to make a gas called carbon dioxide, and this mixes with the air in the bottle. Carbon dioxide is good at trapping heat. It traps some of the heat that passes through the bottle. So this time the temperature in the bottle rises higher. This shows that adding carbon dioxide to the air in the bottle makes the air trap more heat. This is what is happening in the Earth's atmosphere. We are adding carbon dioxide to the atmosphere, which is causing the phenomenon of global warming.

FUN FACTS

- Carbon dioxide is known as a greenhouse gas. Other greenhouse gases include water vapour and methane.
- Global warming is the slow warming of the atmosphere. It is happening because we are adding carbon dioxide to the atmosphere.
- The carbon dioxide comes from burning fossil fuels (oil, gas and coal), and from cutting down forests.
- The average temperature of the atmosphere has risen by about half a degree Celsius since the year 1900.
- Melting glaciers and retreating ice around the North Pole are visible signs of global warming.

F. MINI WATER-CYCLE MODEL

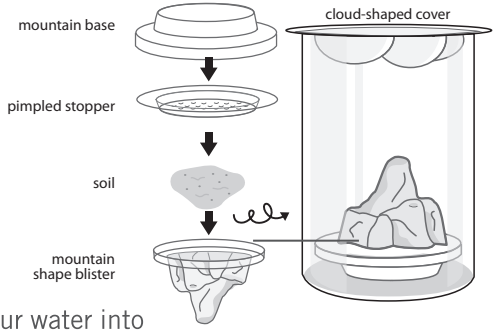
All the time, water is moving between the oceans, the atmosphere, the land, lakes and rivers and vegetation. Water evaporates from the oceans, condenses in the air to make clouds, water from clouds falls as rain, and runs down rivers into the ocean. This movement of water is called the water cycle. In this activity, you can make a mini model of the water cycle.

Materials required from kit: cloud-shaped cover, mountain shape, pimpled stopper, mountain base
Materials required from home: drinking glass, ice, some potting soil, desk lamp

1. Find the mountain shape, then find the hole in the mountain side. Hold the shape upside down in one hand, keeping a finger over the hole.

2. Pour the soil into the mountain shape. Add a few drops of water to dampen the soil.

3. Put the pimpled stopper on top of the soil, then clip the mountain base into place.

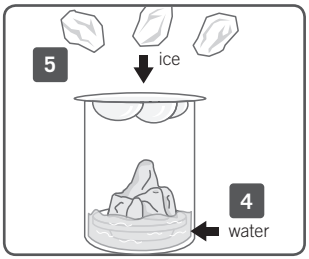


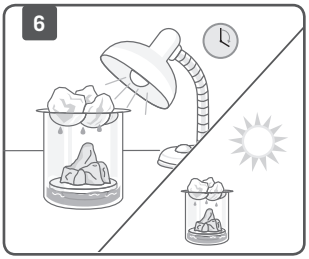
4. Put the mountain shape into a glass. Pour water into the base of the glass until the water is about 1 cm (0.5 inches) deep so that it covers the base. Now put the cloud shaped cover on top of the glass.

5. Put a few ice cubes in the top of the cloud cover.

6. Place the model outdoors under sunshine or alternatively put a desk lamp (a 60-watt incandescent light bulb) about 15 cm (6 inches) away from the glass and switch it on. Ask and adult to help you with the desk lamp, as it could get hot.

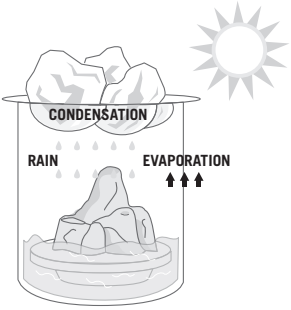
7. Watch the cloud blister for a couple of 10 minutes. What happens? You will see drops of water condensed underneath of the cover. These are ‘rain’.

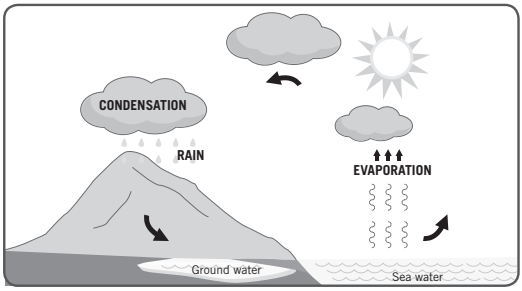




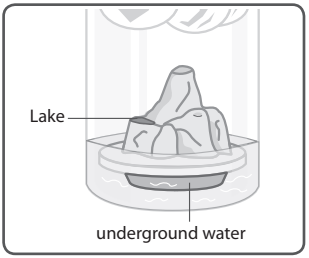
HOW IT WORKS

The heat from the desk lamp makes the water in the glass warm. This makes some water evaporate into the air in the glass. The warm air rises to the top of the glass, where the ice in the cloud blister cools it down. The water vapour in the air condenses, forming water droplets on the bottom of the cloud. When there's enough water, it drips down onto the mountain, then runs back into the water at the bottom of the glass. This is a mini model of the water cycle. The water in the glass represents the ocean, the cloud blister represents a cloud, and the dripping water represents rain.

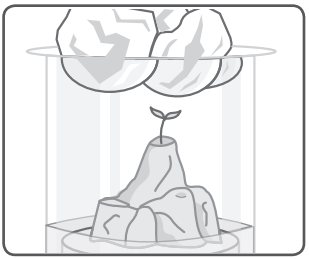




You will also notice some rain water collects in the small dip in the mountain, which represents a lake. In real life, this would be fresh water because the minerals that make sea water salty are left behind in the sea when the water evaporates. Some water will seep through the soil, and collect in the base of the mountain. This represent underground water.



If you want, you can grow a bean on the mountain. Cut open the mountain top with a scissors. Germinate a broad bean. Put the germinating bean into the hole in mountain so it can continue growing. The plant will use water from the water cycle to stay alive. It will also release some water vapour into the atmosphere from its leaves (this is called transpiration).



FUN FACTS

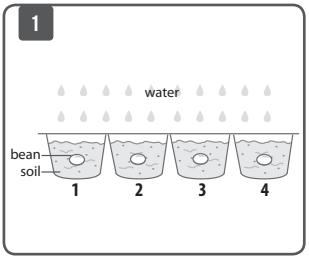
- The water in the oceans is salty, but rain is made of fresh water. That's because the minerals in the sea are left behind when the water evaporates.
- In a hundred years, an average particle of water spends 98 years in the ocean on its way round the water cycle.
- Only about one hundredth of a thousandth of all the water on Earth is in the atmosphere at one time.
- The water going round the water cycle today is the same water that was going round the water cycle when the dinosaurs were alive.

G. ACID RAIN

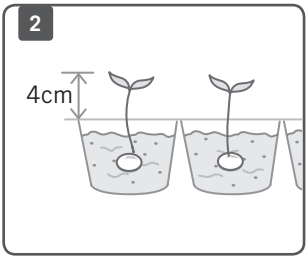
When we burn some sorts of fossil fuels, such as coal, gases are released into the air. These gases include sulfur dioxide and nitrogen oxides. When these gases mix with water droplets in clouds, they make materials called acids. When the water falls from the clouds, it is known as acid rain. Acid rain harms plants that it falls on, even large trees. It also harms animals in rivers and lakes. In this activity you can see how acid affects the growth of plants.

Materials required from kit: seed tray, pH paper
Materials required from home: vinegar, cotton pads or compost, some beans (such as runner beans or mung beans)

1. Fill each compartment of the seed tray with a cotton pad, or with some compost. Wash your hands after handling compost. Put a bean into each compartment, and water the cotton pad or compost to make it damp. Note the numbers marked on the tray.



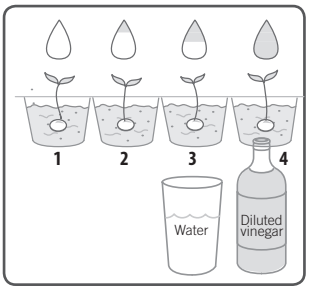
2. Put the seed tray somewhere warm. Now you need to wait until the beans germinate (that means a shoot grows upwards and a root grows downwards from the bean). This could take a few days. Keep adding a little water to keep the cotton or compost damp. When the beans have germinated, put the beans by a window, where they will get some light.



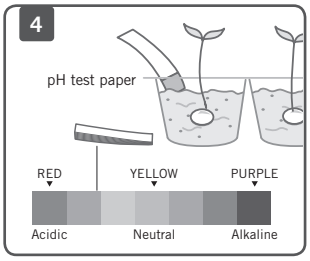
3. Put 250 ml of water into a clean jar. Add two teaspoons (10 ml) of vinegar to the water to make diluted vinegar. Now water plants as follows each day, for five days:

- Plant 1: 2 teaspoons (10 ml) of plain water only
- Plant 2: 0.5 teaspoon (2.5 ml) of diluted vinegar from your jar, and 1.5 teaspoons of plain water
- Plant 3: 1 teaspoon (5 ml) of diluted vinegar, and 1 teaspoon of plain water
- Plant 4: 1.5 teaspoon (7.5 ml) of diluted vinegar from your jar, and 0.5 teaspoon (2.5 ml) of plain water

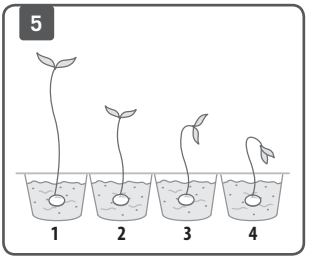
PLANT	1	2	3	4
Water *(teaspoon)*	2	1.5	1	0.5
Diluted Vinegar *(teaspoon)*	0	0.5	1	1.5
pH indicator colour				
pH value				
Observation				



4. After the five days, test the pH of each pot. To test a pot, press a small piece of pH test paper into the soil. Match the colour of the paper against the pH colour scale (punch out from the box flip) and write down the pH values. Different colours indicate the degree of acidity and alkalinity. For example, red is very acidic, purple is very alkaline, and yellow is neutral. The level of acidity or alkalinity can also be represented with numbers, with 1 = very acidic, 7 = neutral and 14 = very alkaline. Here are the pH values of some household materials e.g. tap water = pH7, tea = pH6, coffee = pH4, vinegar= pH3 tomato= pH8, Olive oil = pH9.



5. After five days, look at your plants. Which plants have grown best?



WHAT HAPPENED?

You should find that the plant grown in plain water grows best, and the plant grown with most vinegar grows least well. Vinegar contains acid that damages the plants so they can't grow properly. The acid in acid rain is a different sort of acid, but it affects plants in the same way.

The pH paper shows the acidity of the soil in each pot. The lower the pH number is, the more acidic the soil is. The pot with the most vinegar added to it will be the most acidic. pH paper contains special chemicals called indicators that change colour when they touch acids (or chemicals called alkalis, which are the opposite of acids).

FUN FACTS

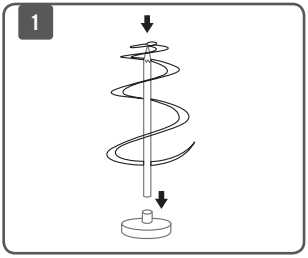
- Some acid rain is as strong as the acid in lemon juice.
- Natural rain is a little bit acidic. That's because it contains carbon dioxide, which turns it into carbonic acid.
- There is acid snow and acid fog as well as acid rain.
- Acid rain also damages stone buildings because it slowly eats away some sorts of rock (especially limestone).

H. WIND

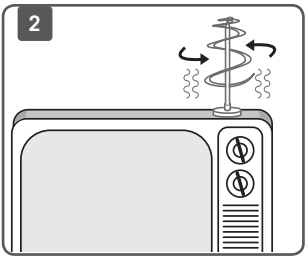
Winds are simply made by air moving from place to place. Air starts moving because it gets warmed by the ground and then rises upwards. This activity shows you how warm air rises.

Materials required from kit: pencil stand, spiral template
Materials required from home: a sharpened pencil and a ball-point pen

1. Carefully punch out the spiral template. Gently push the nib of a ball-point pen into the very centre of the spiral to make a small dent in the paper. Be careful not to make a hole in the paper. Put a sharpened pencil, with its sharp end pointing up, into the pencil holder. Carefully balance the spiral on the pencil, with the central dent of the spiral on the pencil's tip.



2. You need to stand the pencil and spiral on top of a television or computer monitor which emits warmth. Watch what happens to the spiral (you might have to give it a nudge to get it moving).



HOW IT WORKS

The television or computer heats the air around it, making the air warm. Warm air is lighter than cool air, and it floats up through the cool air around it. So warm air rises from the heater. It pushes against the paper of the spiral, and this makes the spiral spin slowly. The moving air is called a convection current. When the Sun heats the ground, the ground gets warm. The ground heats up the air above it, making the air warm. The air floats upwards. Cool air flows in from side to replace the rising air, making winds.

FUN FACTS

- You can see how rising air causes winds when you visit the seaside on a hot day. The Sun heats the land, making it warm. The land heats the air above, making the air warm. The air rises, and is replaced by cool air flowing in from over the sea. This flowing air is called a sea breeze.
- Glider pilots and birds of prey (such as vultures) use rising air currents to carry them up into the air. The rising currents they use are called thermals.
- Hot-air balloons use the fact that hot air floats upwards. The hot air makes the balloon lighter than the air around it.

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