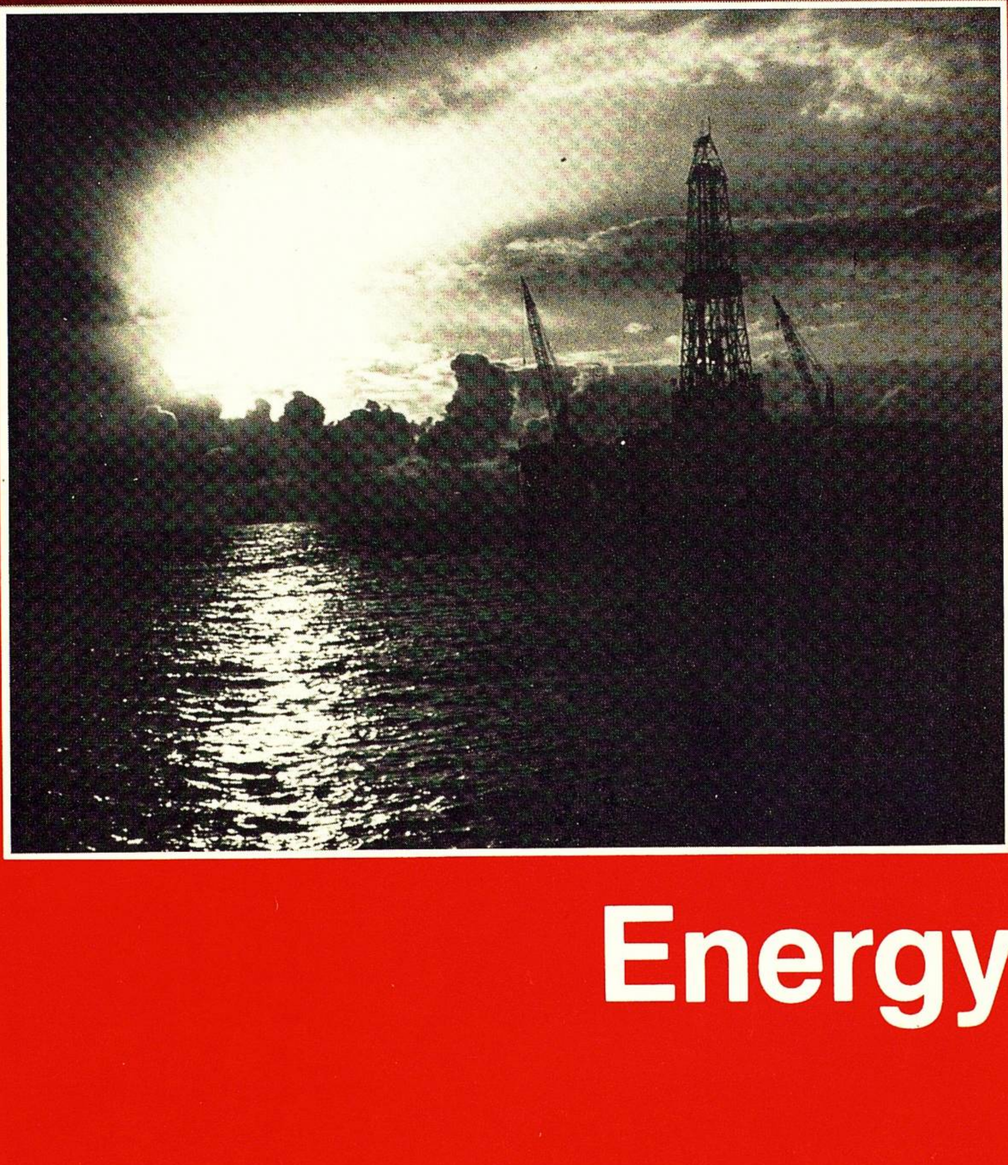
SCIENCE AT WORK



Energy

SCIENCE AT WORK

Editorial Team
Jackie Hardie
Peter Llewellyn
Colum Quinn

Language Consultant
Grahame Mitchell

Authors
Janet Ager
Richard Ager
Barbara May

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53 Bedford Square, London WC1B 3DZ

ISBN 201 14029 2

Designed, set and illustrated by Parkway Group and printed in Great Britain by Pindar Print, Scarborough

CDEF 89876543

Burning fuels

Apparatus

★ small bottle top ★ dropper ★ stop clock ★ tripod ★ gauze
★ Bunsen burner ★ heatproof mat ★ safety glasses ★ wooden splints
★ samples of oil, woodshavings, torn paper, margarine, paraffin and powdered coal

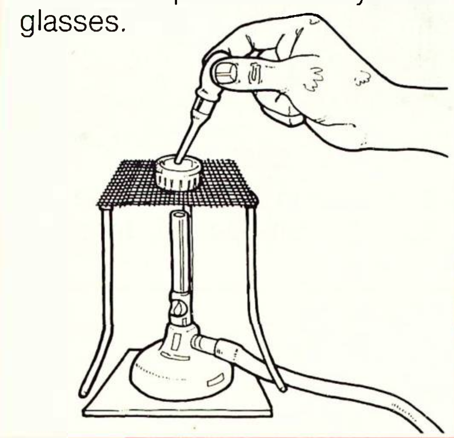
You are going to burn some substances that could be used as fuels.

Wear safety glasses.

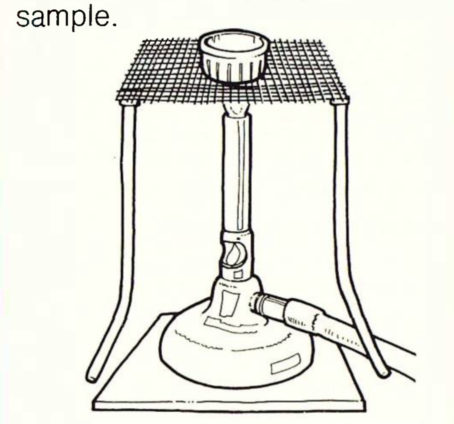
Q1 Copy this table.

Sample	How was it lit?	How long did it burn?

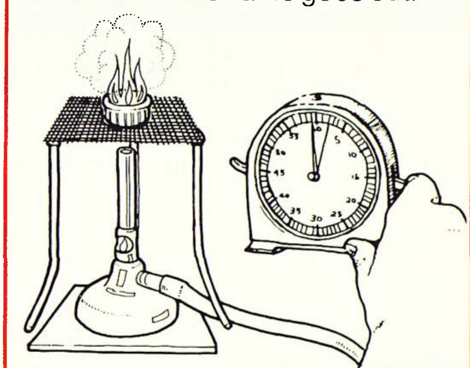
A Put one of the samples in the bottle top. Put on safety glasses.



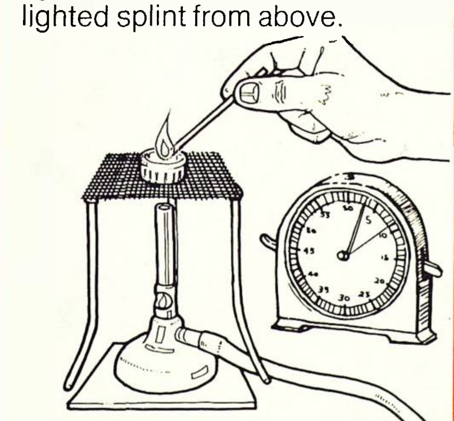
B Light the Bunsen burner. Use a blue flame. Heat the sample.



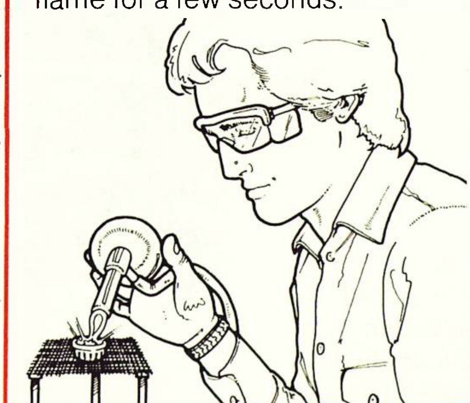
C When the sample lights, turn off the Bunsen burner and start the stop clock. Stop the clock when the flame goes out.



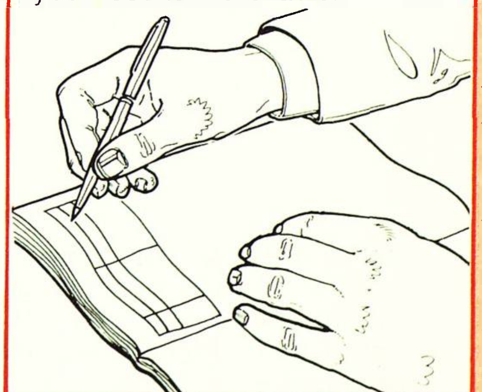
D If the sample does not light after 3 minutes, use a lighted splint from above.



E If the sample still does not light, heat it with a Bunsen flame for a few seconds.



F Repeat step A to E with the rest of the samples. Record your results in the table.



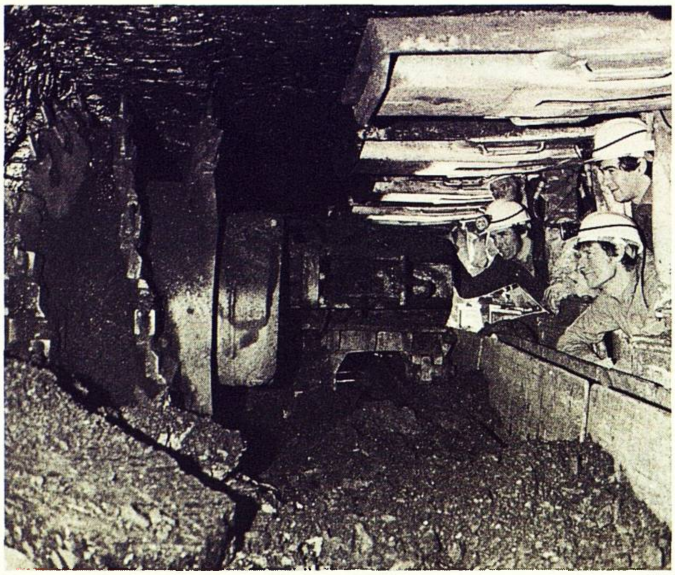
Q2 Which sample was easiest to light?

Q3 Which sample burned for the longest time?

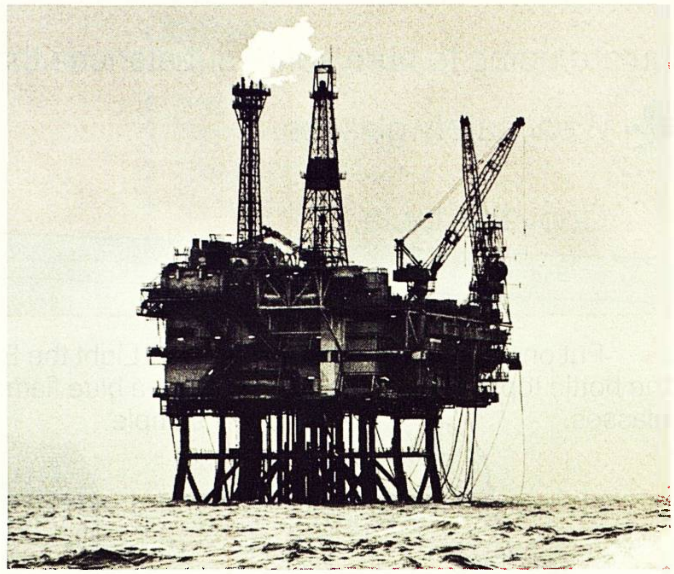
Q4 Which samples could be used as fuels?

Information: Fossil fuels

Most of the fuels we use today are made from plants and animals that lived millions of years ago. When the plants and animals died, they rotted and became buried by layers of rock. As they rotted they formed **gas, oil** and **coal.** These are called **fossil fuels.**



Coal is usually found underground. **Coal miners** tunnel into the ground and cut out the coal.



Oil and gas are often trapped in rocks under the sea. An **oil well** is formed when pipes are drilled into these rocks.

Fuels contain **stored energy.** The stored energy can be released and changed into other forms. We need fuels to drive engines and make them work. To provide all the energy we need, millions of tonnes of fossil fuels are burned each year.

The number of people in the world is increasing. As the population grows, more energy is needed. Fossil fuels cannot be replaced. They took millions of years to form. Scientists think that fossil fuels could run out within 80 years. They are looking for other sources of energy.

Q5 What is a fossil fuel?

Q6 What is an oil well?

Q7 Why do we need fuels?

Q8 Why will fossil fuels run out?

Burning fuel oils

Apparatus

★ 5 bottle tops ★ mineral wool ★ boiling tube ★ 10 cm^3 measuring cylinder
★ dropper ★ stop clock ★ heatproof mat ★ splint ★ clampstand
★ thermometer ★ safety glasses ★ 5 fuel oil samples ★ tin lid

You are going to burn different fuel oils.

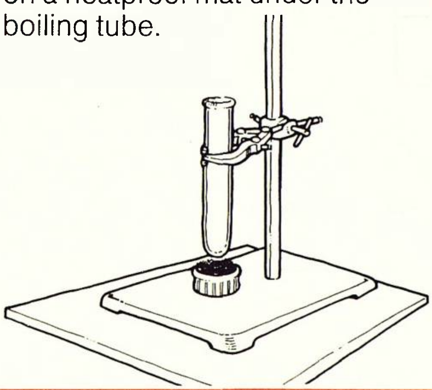
Wear safety glasses.

Q9 Copy this table.

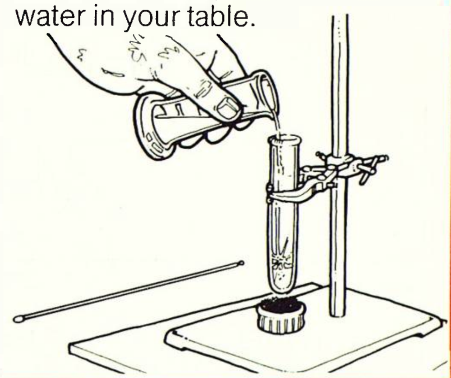
Sample	Temperature of water at start (°C)	Temperature of water at end (°C)	Temperature change (°C)

A Put some mineral wool in a bottle top. Add 10 drops of one of the fuel oils.

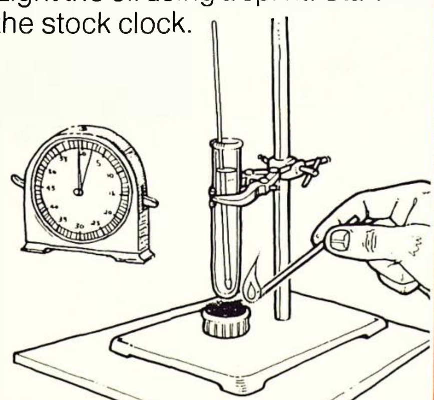
B Fix the boiling tube in a clampstand. Put the bottle top on a heatproof mat under the boiling tube.



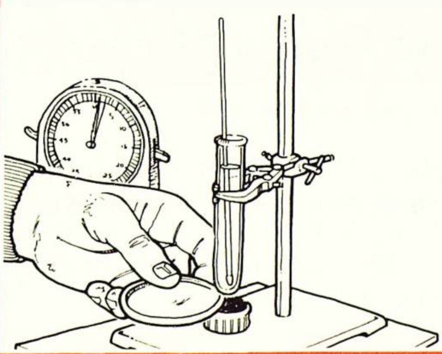
C Add 10 cm^3 of distilled water to the boiling tube. Record the temperature of the water in your table.



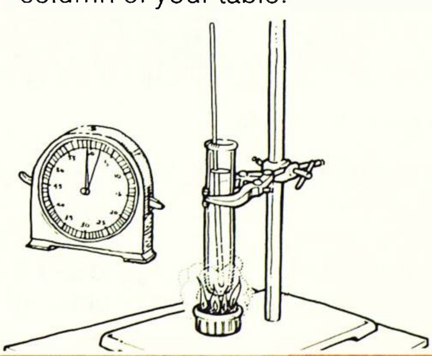
D Put on safety glasses. Light the oil using a splint. Start the stock clock.



E After one minute use a tin lid to put out the flames. Record the final temperature of the water.



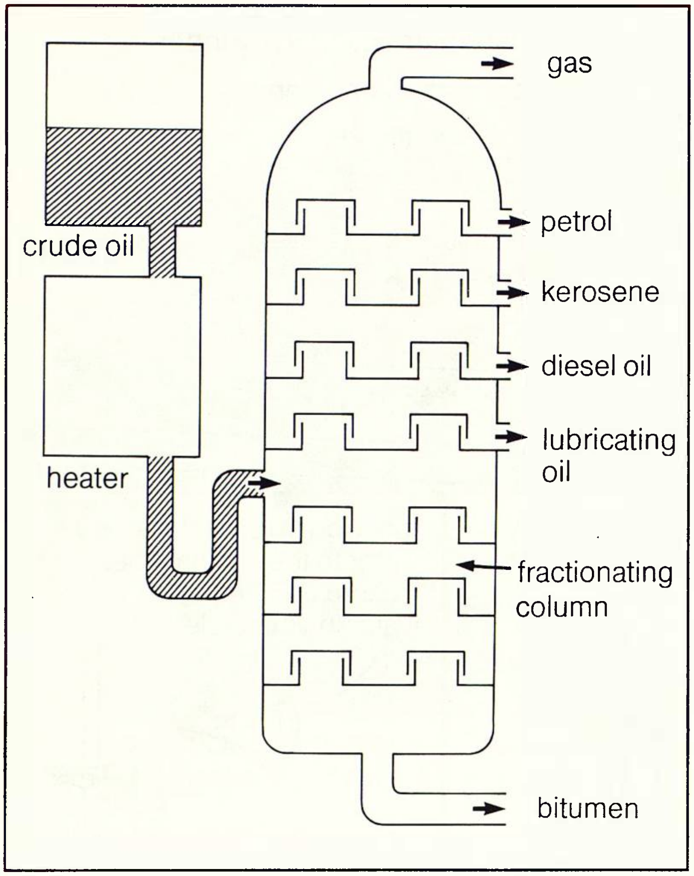
F Using fresh water repeat steps A to E with the rest of the samples. Fill in the fourth column of your table.



Q10 What happened to the temperature of the water in this experiment?

Q11 In the experiment, the stored energy of the fuel oils is changed into **heat energy**. Which fuel oil contained most stored energy?

Information: The importance of oil



Most fuels come from **crude oil**, a thick black liquid. Crude oil is a mixture of substances. Each substance boils at a different temperature.
To separate the substances, crude oil is heated and changed into gases. The gases are passed into a **fractionating column**. This separates the crude oil into **fractions** (the substances in crude oil with different boiling points).

Average 44 mpg

Average 39 mpg

Average 26 mpg

The fuel used in all these cars is **petrol** – a fraction of crude oil. The petrol is burned and the stored energy in the fuel is changed into **movement energy**. The engines in these cars are different sizes. Each car travels a different number of miles using the same amount of petrol. The number of miles each car will go on 1 gallon of petrol (miles per gallon) is shown.

Q12 How is crude oil separated into fractions?

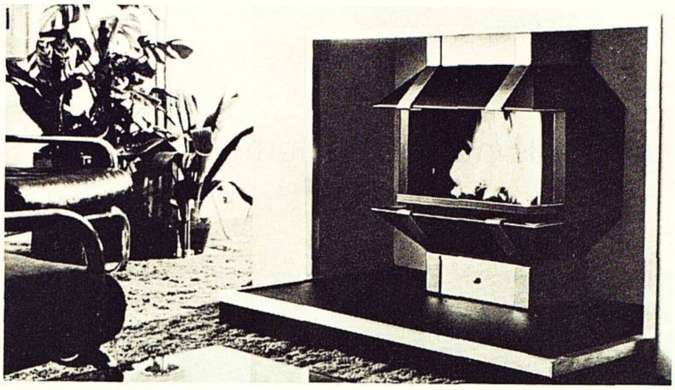
Q13 Which oil fraction is used to drive car engines?

Q14 The 3 cars above travel 100 miles. How much petrol does each car use?

2 Forms of energy

Information: Forms of energy and energy changes

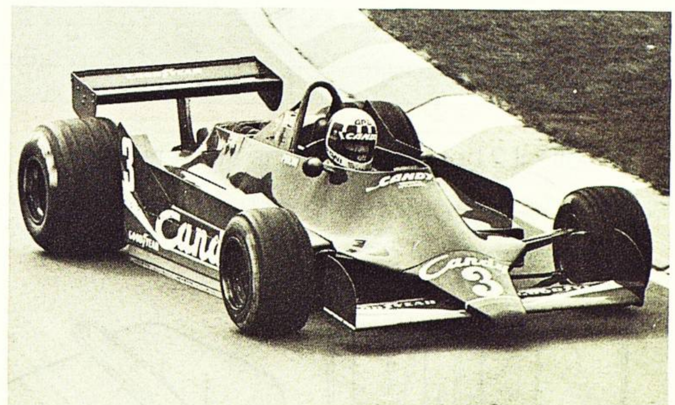
Energy cannot be **made**; it can only be **changed** from one form into another.



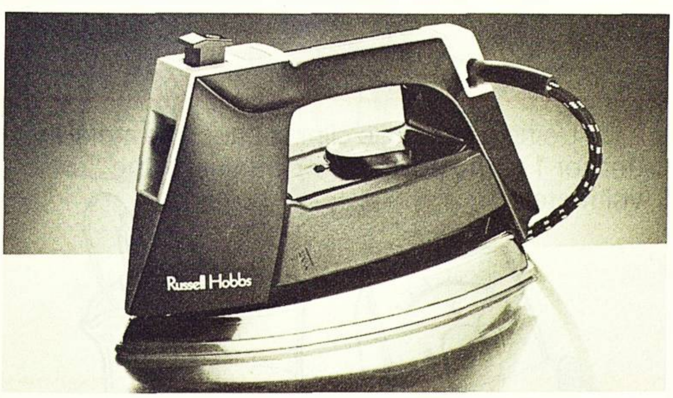
The **stored energy** of the coal is changed into **heat energy**.

Electrical energy is changed into **light energy** in a street lamp.

When the violinist plays, **movement energy** is changed into **sound energy**.



The **stored energy** of the petrol is changed into **movement energy.**



Q1 What type of energy does the iron use?

Q2 What is this energy changed into when the iron is switched on?

Q3 What energy change takes place when a man bangs a drum?

3 Electrical energy

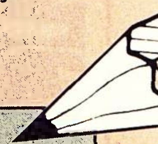
Energy from chemicals

Apparatus

★ two 100 cm^3 beakers ★ strips of metal P, Q, R and S
★ solutions P, Q, R and S ★ voltmeter ★ 6 strips of filter paper
★ labels ★ wire ★ 100 cm^3 measuring cylinder ★ crocodile clips

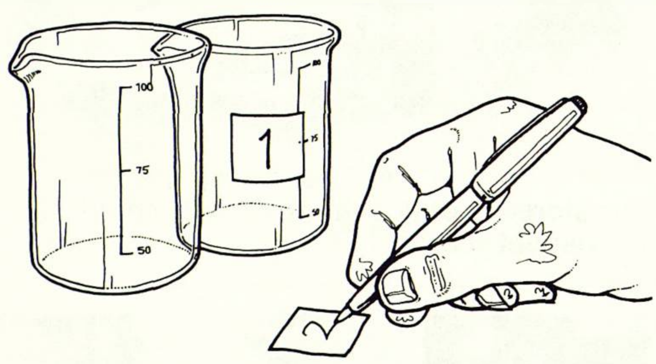
You are going to change the stored energy in chemicals into another form of energy.

Q1 Copy this table

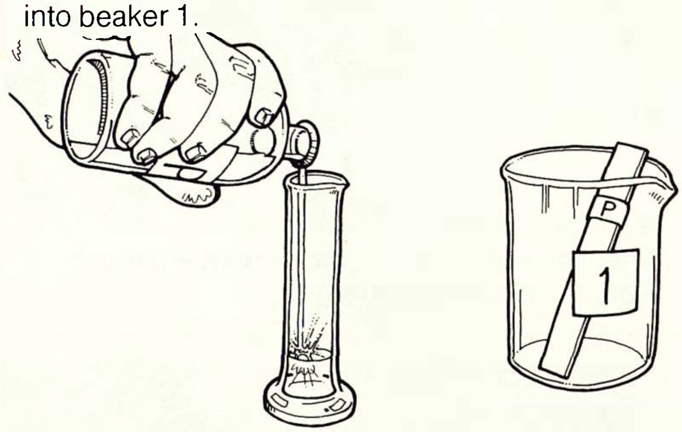


Metal and solution in beaker 1	Metal and solution in beaker 2	Reading on voltmeter (volts)
P	Q	
P	R	
P	S	
Q	S	
R	S	
R	Q	

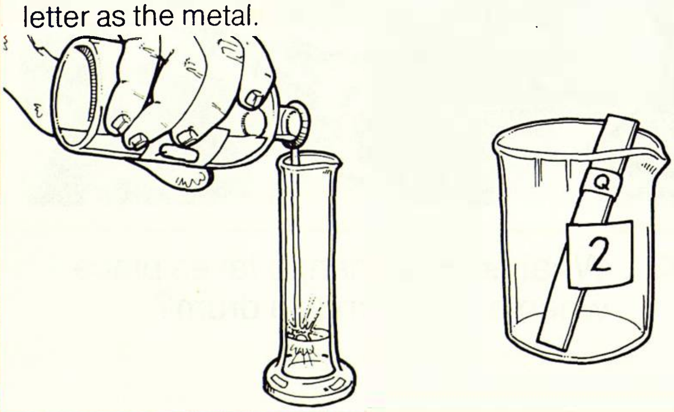
A Collect 2 beakers. Label the beakers 1 and 2.



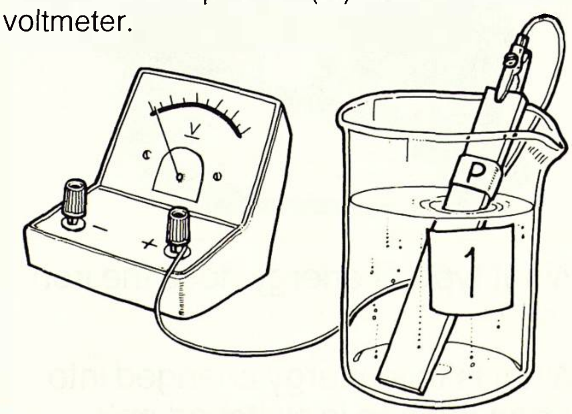
B Put 75 cm^3 of solution P and a strip of metal P into beaker 1.



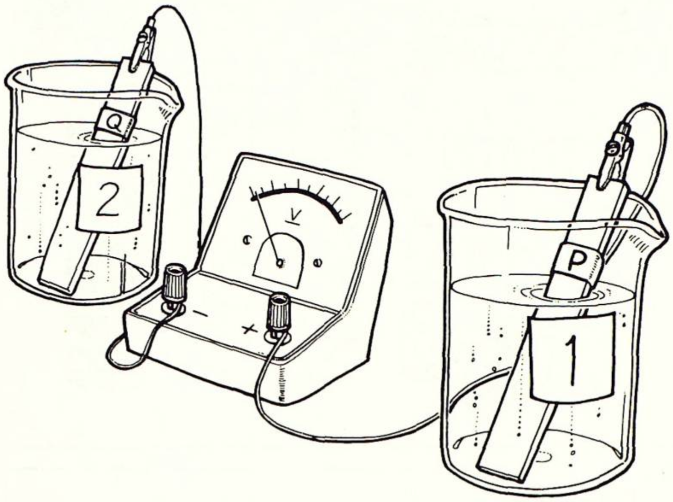
C Put 75 cm^3 of solution Q and a strip of metal Q in beaker 2. Always use the solution with the same letter as the metal.



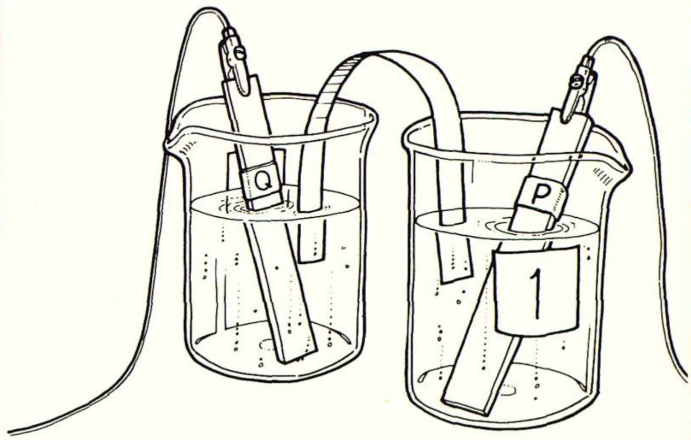
D Using a crocodile clip, connect the metal in beaker 1 to the positive (+) terminal of the voltmeter.



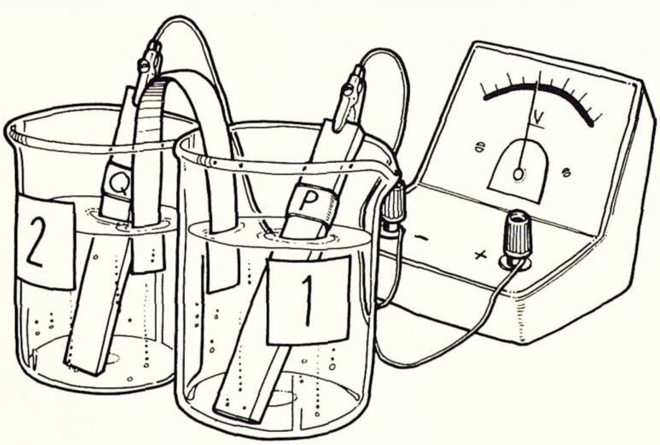
E Using a crocodile clip, connect the metal in beaker 2 to the negative (−) terminal of the voltmeter.



F Dampen a strip of filter paper. Place it between the two beakers. Make sure that it dips into both solutions.



G Record the reading on the voltmeter. This is the **voltage** produced.



H Repeat steps B to G for the other metals in your table. Make sure that you use the solution with the same letter as the metal.

Q2 The stored energy in the chemicals was changed into another form of energy. What kind of energy was produced?

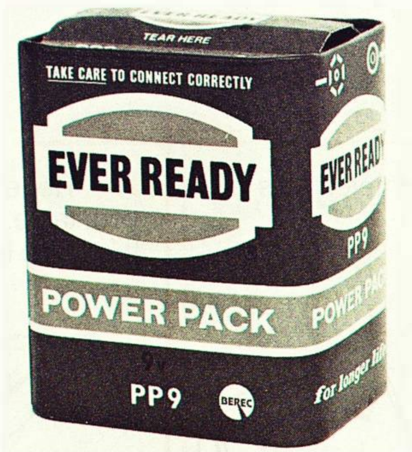
Q3 The **voltmeter** shows the **electrical force** produced by the chemicals. Which pair of metals produced the largest electrical force?

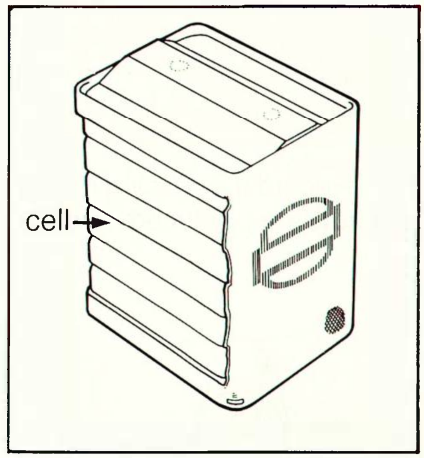
Information: Electrical energy from chemicals

Cells

These **cells** contain chemicals. The stored energy in the chemicals can be changed into electrical energy. The electrical force produced is shown by the number of **volts**. The cells provide a voltage of 1½ volts. No matter how large a cell is made, it cannot provide more than 1½ volts.

Batteries





9 volts is written on the side of this **battery**. This means that it contains 6 cells, each providing 1½ volts ($6 \times 1½\ V = 9\ V$). Each cell is flat. They are piled on top of each other. If you cut open a battery, you can see the cells. Once the cells are worn down, the battery has to be replaced.

There are different chemicals in a **car battery**. When a car battery becomes run down, it does not have to be replaced. A car battery can be **recharged** by passing electricity through it. Car batteries can be used to drive fork lift trucks.

Q4 Which will produce more volts – a cell or a battery?

Q5 How is a car battery different from the type of battery you would put in your radio?

A model power station

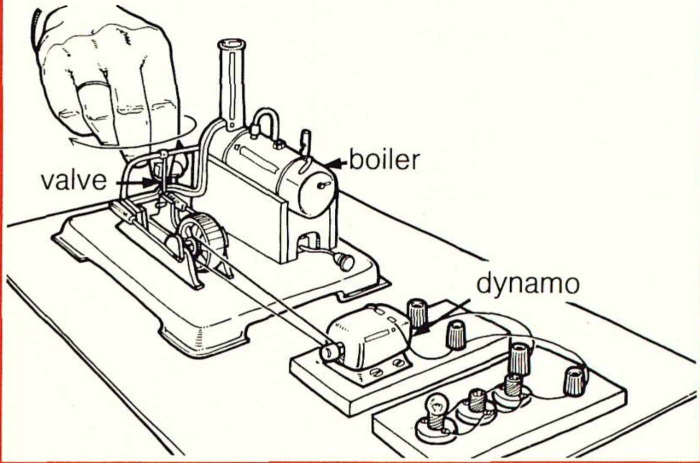
Apparatus

★ steam engine ★ dynamo ★ 3 lamps ★ fuel

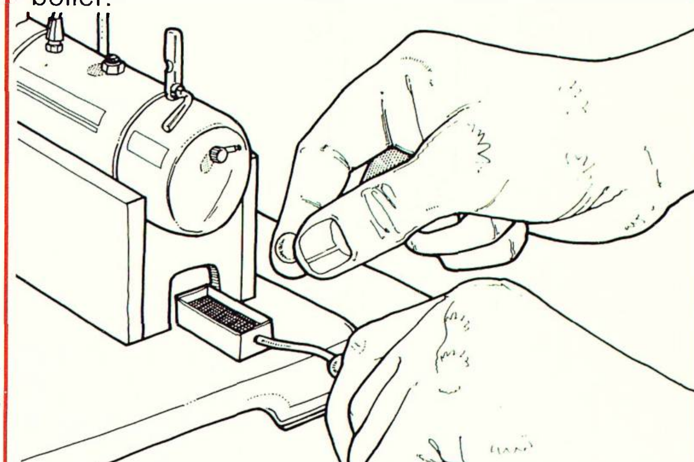
You are going to change the stored energy of a fuel into electricity and light.

Take care not to scald yourself on the hot steam.

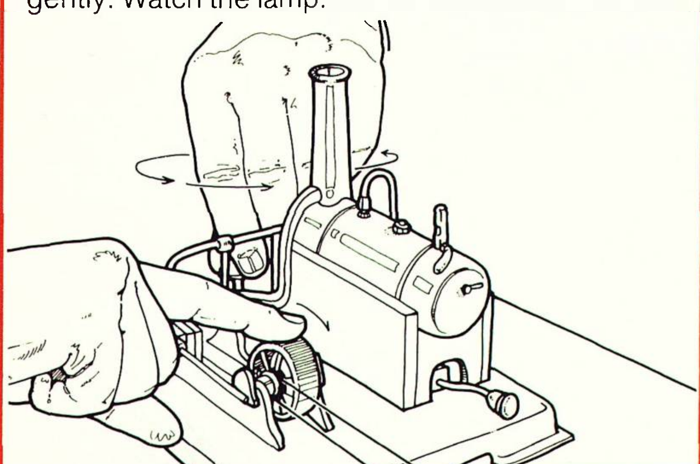
A Check that the water level in the boiler is above half way. If it is not, ask your teacher for help. Make sure the steam valve is closed.



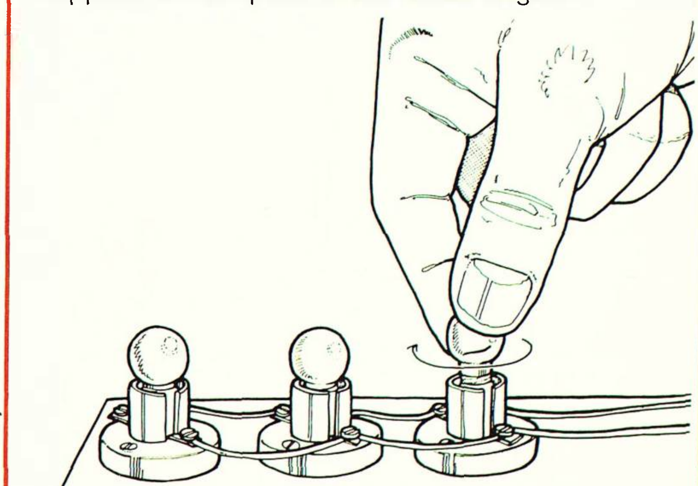
B Take out the fuel tray. Put the fuel into it. Light the fuel and carefully put the fuel tray under the boiler.



C Wait until the water is boiling, then open the steam valve. If the flywheel does not move, nudge it gently. Watch the lamp.



D Screw in another 2 lamps. Notice what happens to the speed of the steam engine.



The dynamo changes movement energy into electrical energy.

Q6 Did the steam engine go faster when it was lighting 3 lamps or 1 lamp?

Q7 The stored energy in the fuel is changed into heat energy. What other energy change takes place in the steam engine?

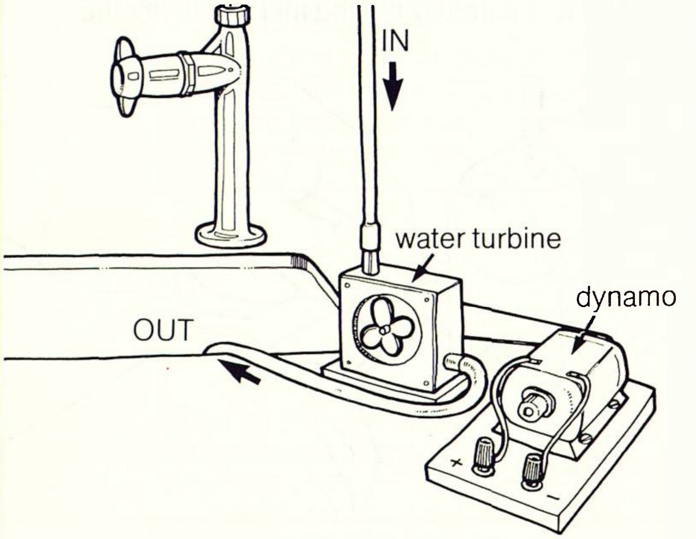
A model hydro-electric power station

Apparatus

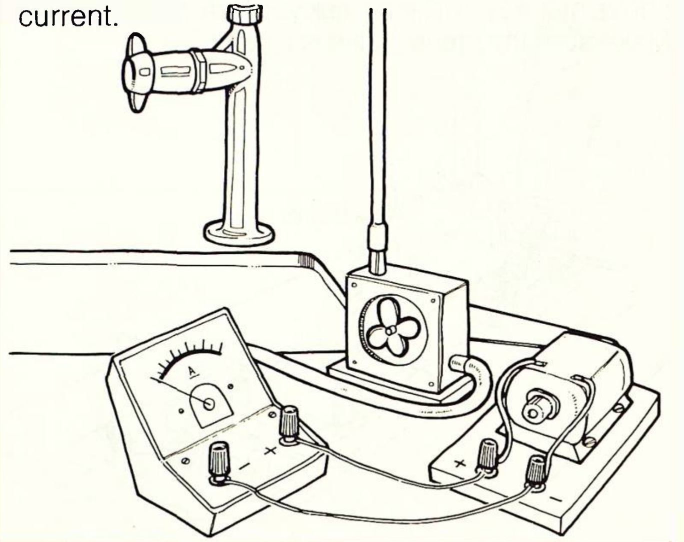
★ water turbine ★ dynamo ★ ammeter ★ wire

You are going to see how falling water can be used to change movement energy into electrical energy.

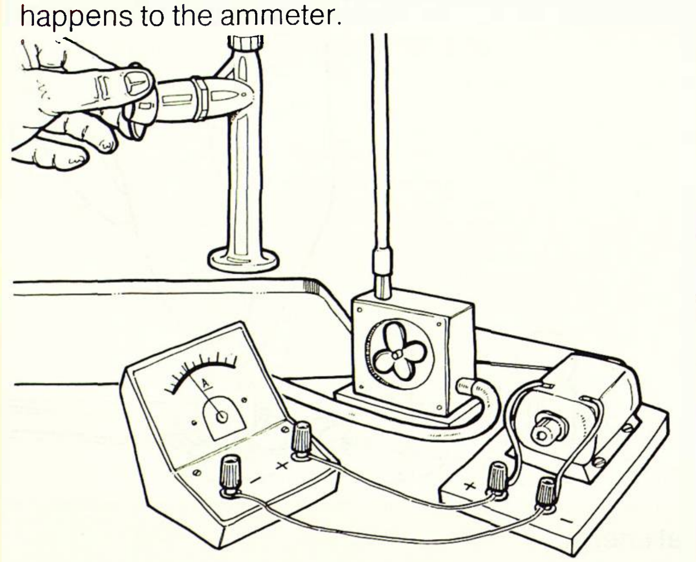
A Connect the tube marked IN to a water tap. Put the tube marked OUT into the sink.



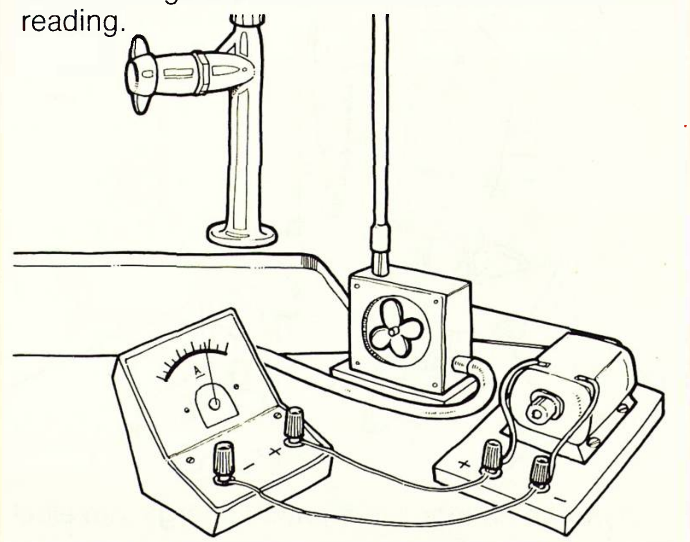
B Connect an **ammeter** to the dynamo. Remember that an ammeter measures electric current.



C Turn on the water tap gently. Notice what happens to the ammeter.



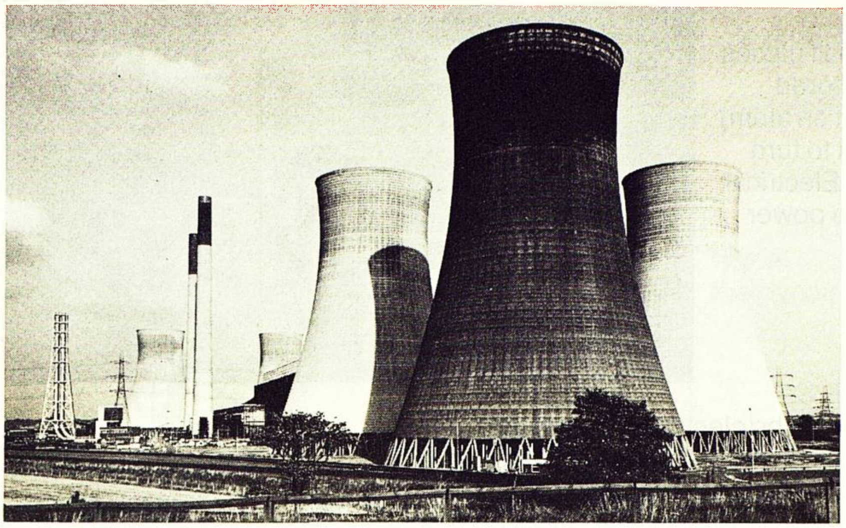
D Turn the tap on further so that more water flows through the turbine. Notice the ammeter reading.



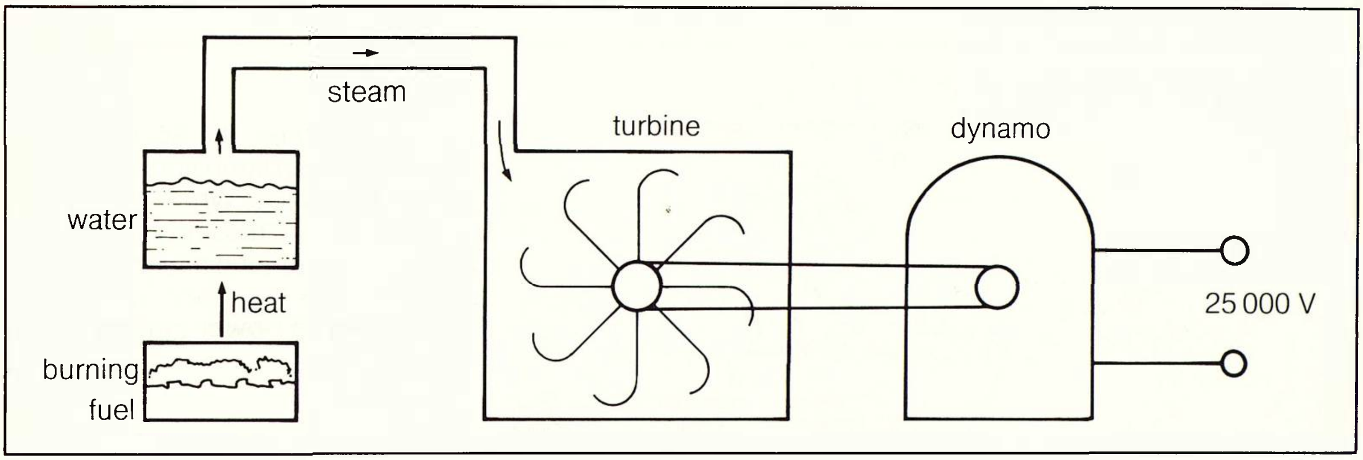
Q8 The falling water had movement energy. What kind of energy did it change into during the experiment?

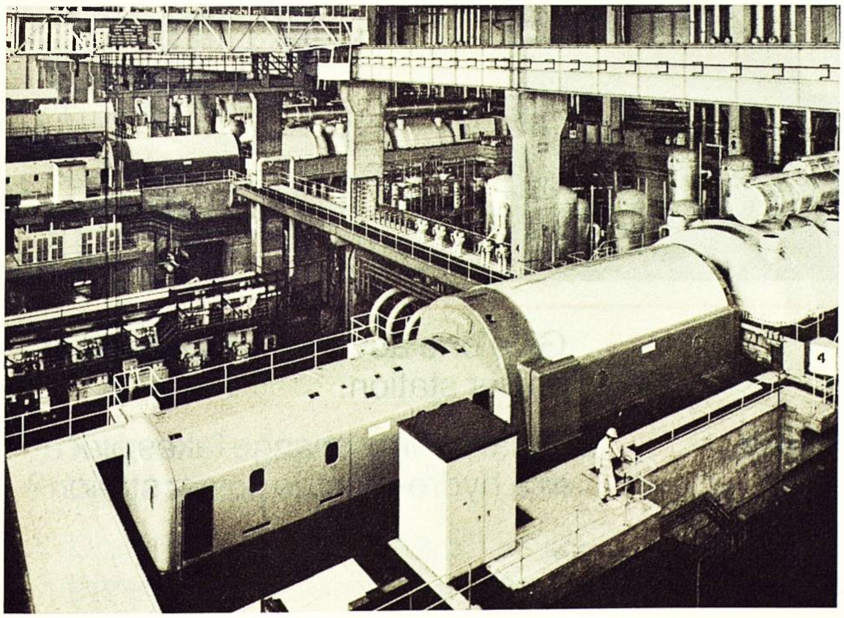
Q9 What would you do if you wanted to produce more electricity using this model?

Information: Power stations



Electrical energy is easy to use. Radios, stereos, televisions and lamps are plugged into sockets and work. **Power stations** provide the electrical energy we use.

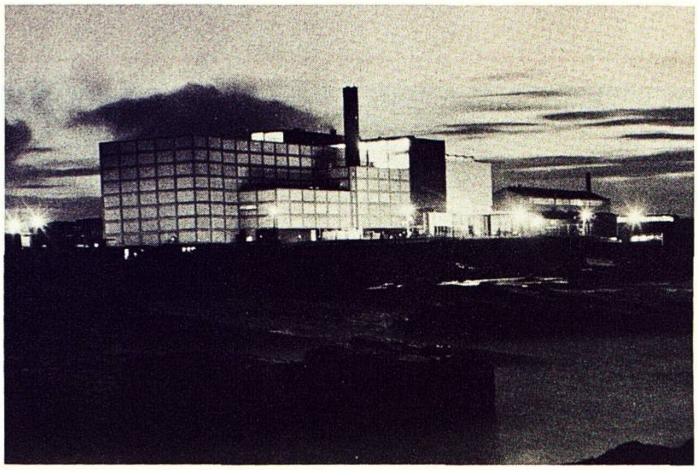




In a power station fuels such as coal, oil and gas are burned. The heat energy released is used to change water into steam. The steam passes through a **turbine**, which contains a large wheel. The steam makes the wheel turn quickly. The turbine is connected to a **dynamo**, which changes the movement energy into electrical energy. The photo shows a turbine and a dynamo in a power station.

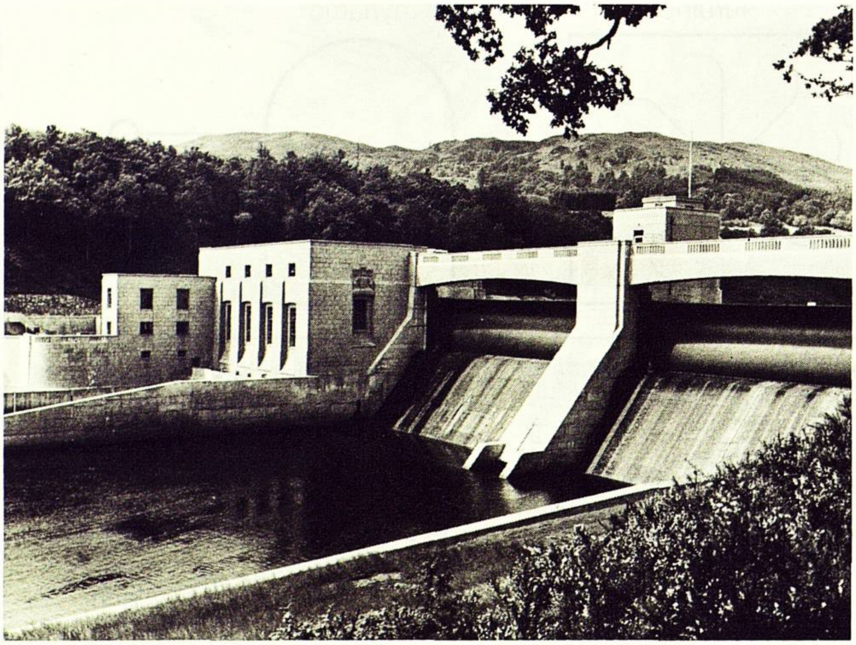
Nuclear power stations

Nuclear energy is also used in power stations. Some substances such as uranium are **radioactive**. Their atoms split up and small pieces fly off. When this happens, some of the stored energy in the **nucleus** (the central part of an atom) is changed into heat energy. This is used to turn water into steam, which drives a turbine. Electrical energy is produced in the same way as in power stations burning coal or oil.



Nuclear power stations produce one-tenth of the electricity used in the United Kingdom. This electricity costs less than electricity produced by burning coal or oil. However, radioactive materials are dangerous. They can cause burns and sickness. Great care must be taken whenever radioactive substances are used.

Hydro-electric power stations



In some countries, like Scotland, it is possible to keep large amounts of water in reservoirs. When it is released, the fast moving water can be used to turn a turbine and produce electricity. This is called a **hydro-electric power station**.

Q10 What is the purpose of a dynamo?

Q11 What energy changes take place when coal is burned in a power station?

Q12 Give an example of a radioactive substance.

Q13 Give one advantage of a nuclear power station.

Q14 What energy change takes place in a hydro-electric power station?

4 Stored energy

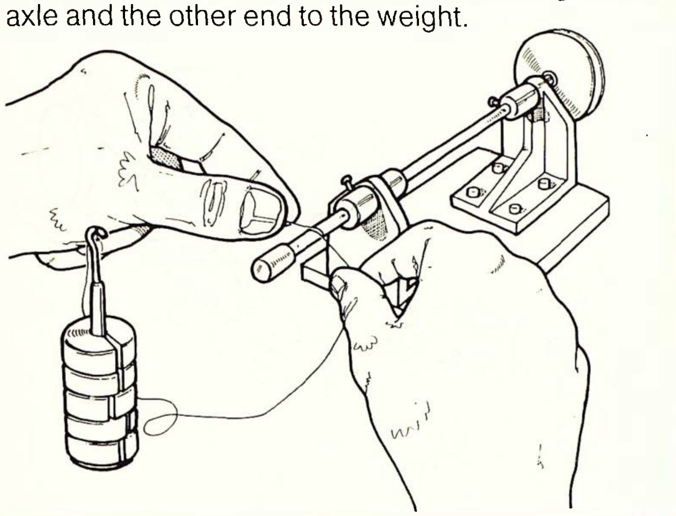
Falling weight

Apparatus

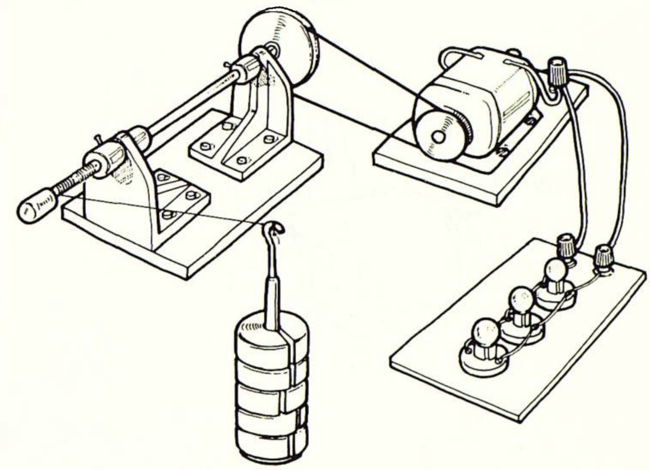
★ wheel and axle ★ dynamo ★ 3 lamps ★ weight ★ string

You are going to change the stored energy of a weight into electrical energy.

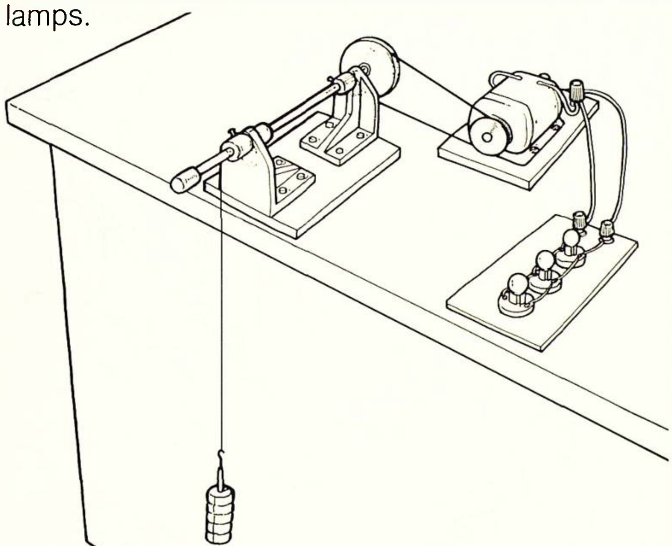
A Put the weight on the floor, and the wheel and axle on your bench. Tie one end of the string to the axle and the other end to the weight.



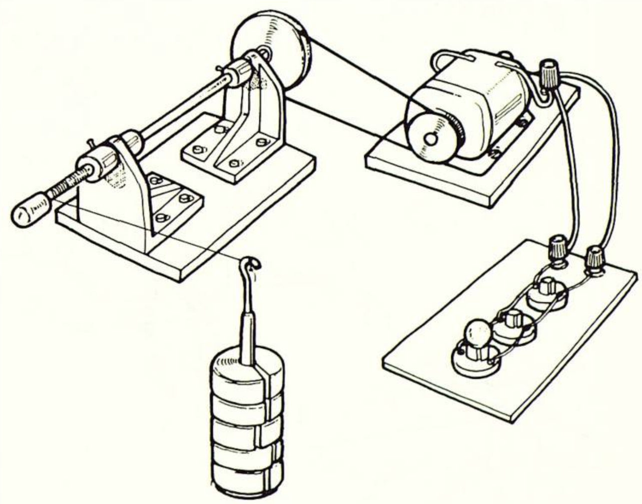
B Wind the string on the axle by turning the wheel. Connect the wheel to a dynamo. Connect the dynamo to the 3 lamps.



C Let the weight fall to the floor. Watch the lamps.



D Repeat steps B and C with only 1 lamp in the circuit.



Q1 What sort of energy is used in the lamps?

Q2 Does the weight fall faster when the dynamo is connected to 3 lamps or to 1 lamp?

Q3 When the weight is near the axle, it is not moving. What kind of energy does it have?

Q4 What kind of energy is this changed into as the weight falls?

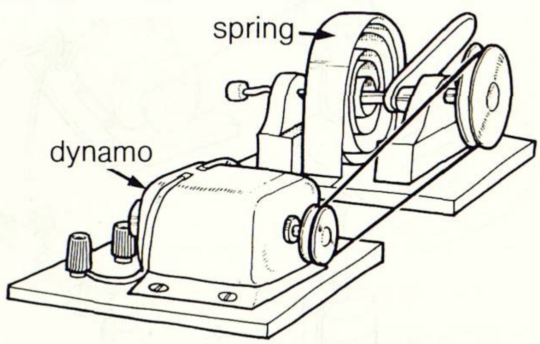
Springs

Apparatus

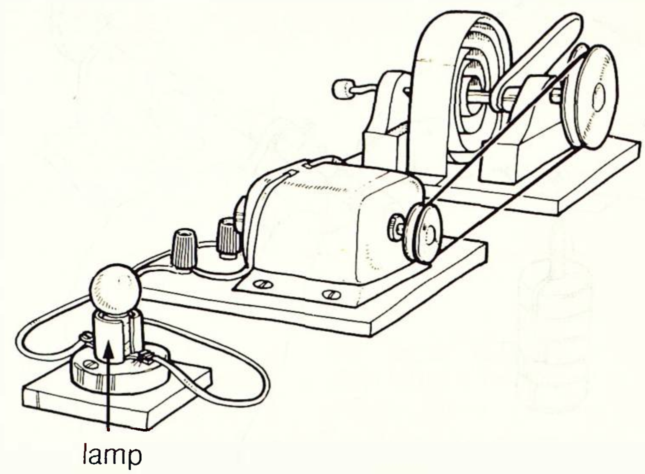
★ spring ★ dynamo ★ lamp

You are going to see how energy can be stored in a spring.

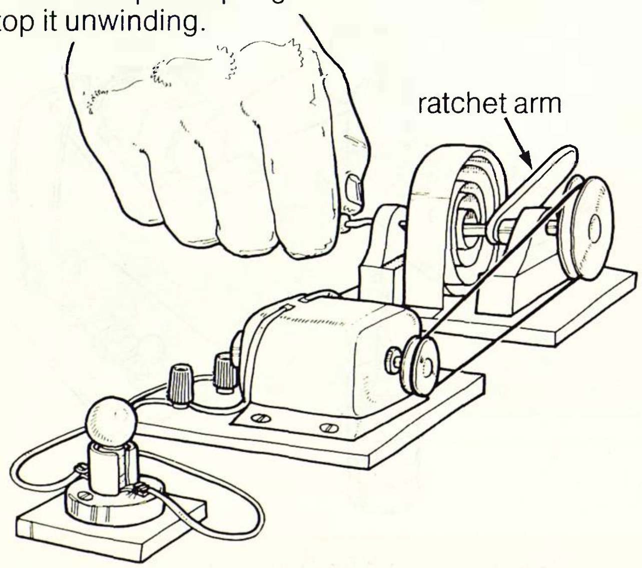
A Connect the spring to the dynamo.



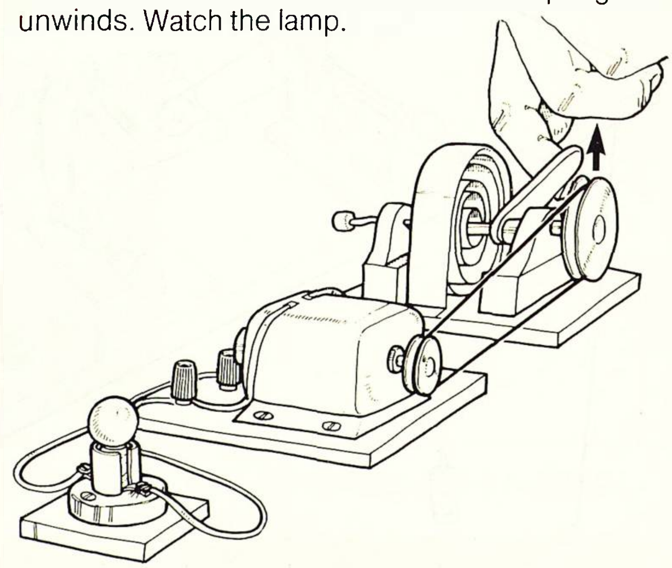
B Connect the dynamo to the lamp.



C Wind up the spring. Use the ratchet arm to stop it unwinding.



D Release the ratchet arm so that the spring unwinds. Watch the lamp.



Q5 This spring could be left wound up for hundreds of years. What kind of energy does the spring have?

Q6 When the spring is released, this energy is changed into movement energy. What other energy changes take place to light the lamp?

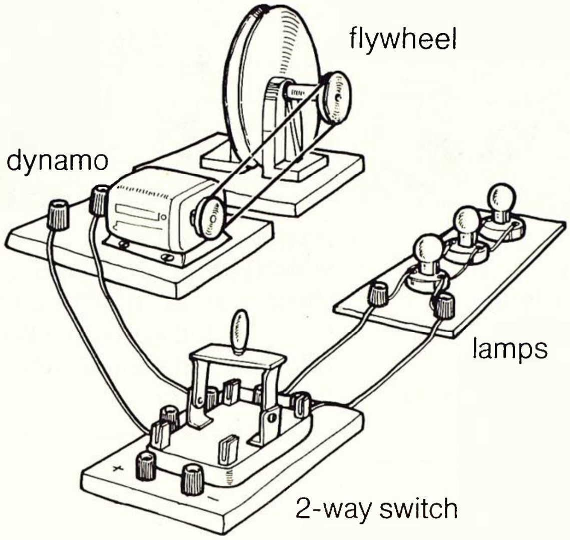
Flywheels

Apparatus

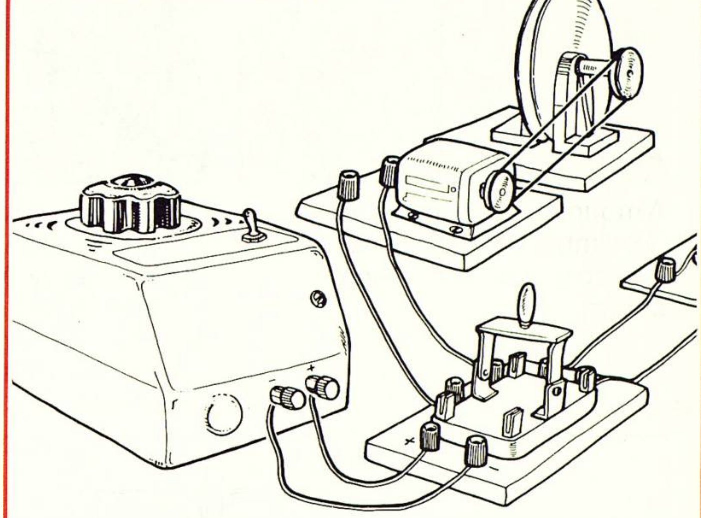
★ flywheel ★ dynamo ★ 2-way switch ★ 3 lamps ★ wire
★ low voltage d.c. power supply

You are going to find out how a flywheel can be used to store energy.

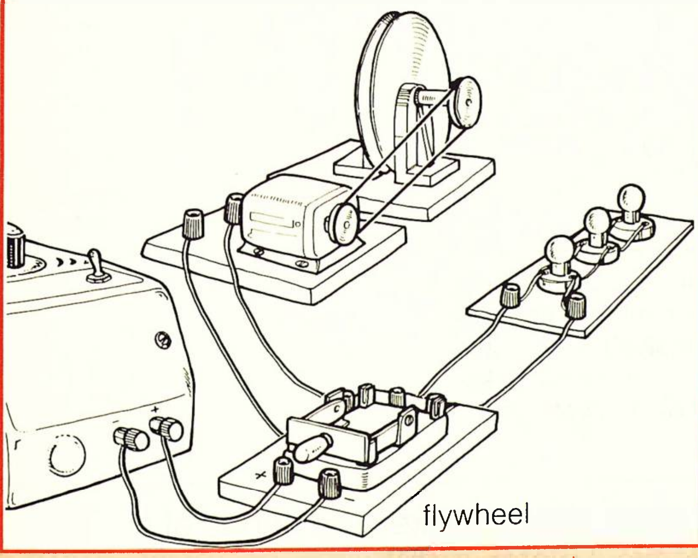
A Connect the flywheel to the dynamo. Connect the switch to the lamp and to the dynamo.



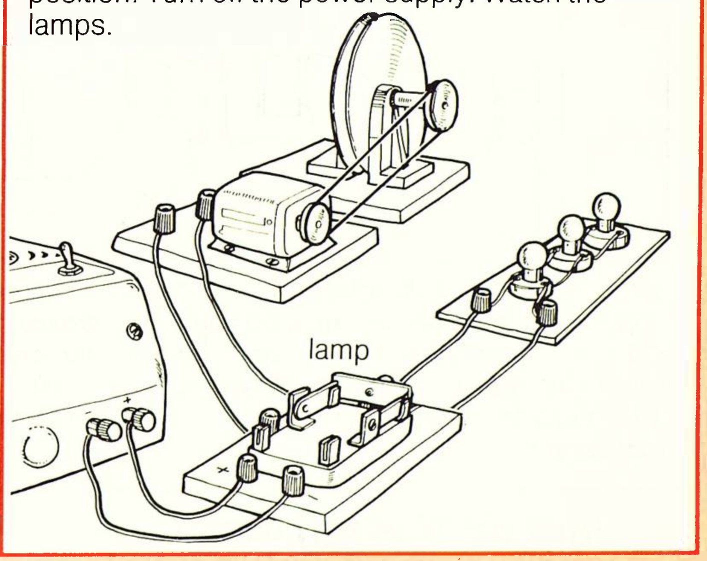
B Make sure that the switch is in the upright position. Connect the power supply to the correct terminals on the switch.



C Put the switch into the flywheel position. The dynamo will drive the flywheel.



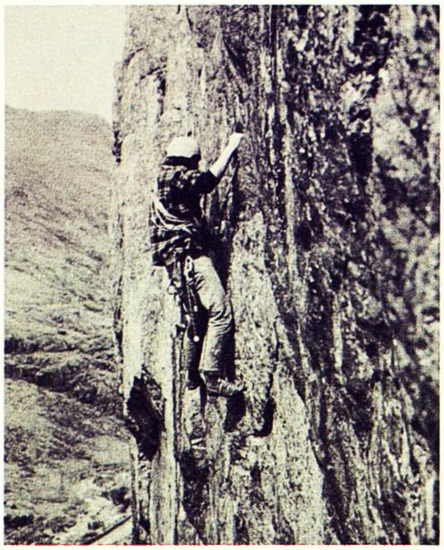
D After one minute, move the switch to the lamp position. Turn off the power supply. Watch the lamps.



Q7 How could you make the lamp stay alight for a longer time, without changing the apparatus?

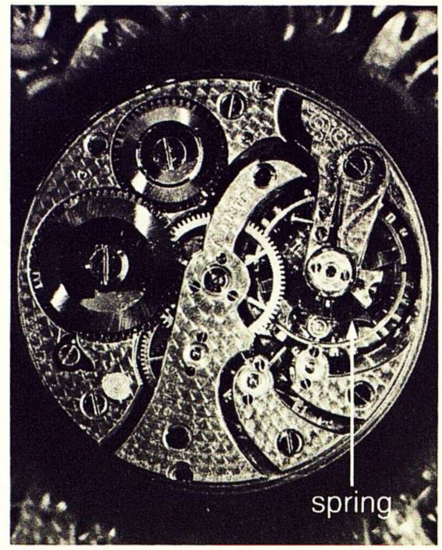
Q8 How could you change the flywheel to make it store more energy?

Information: How energy is stored

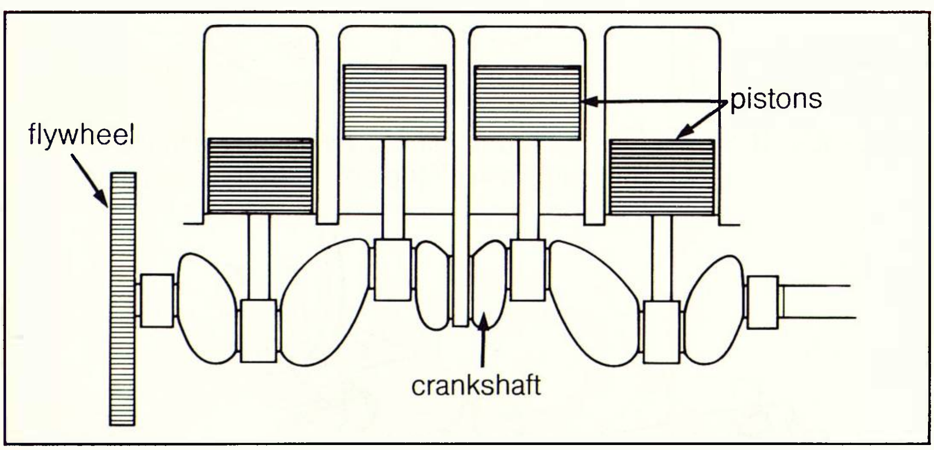


A mountaineer uses energy as he climbs. When he reaches the top, his body has stored energy.

When the heavy weight is at the end of its swing, it has stored energy. This is changed into movement energy as it swings. The energy can be used to knock down buildings.



A watch has a spring inside it, which is wound by hand. When the watch is started, the energy stored in the spring is slowly released. This makes the hands turn round.



Inside a motor car, the **pistons** move because of small explosions. These happen when petrol vapour is set alight. The explosions in the pistons take place at different times. Each explosion turns the **crankshaft**. This would make cars move very jerkily. Flywheels are used to smooth out the jerks. They store the energy from each explosion and give it out between the explosions.

Q9 What sort of energy does a window cleaner have, when he is at the top of a ladder?

Q10 What makes the hands of a watch turn?

Q11 Why would a car journey be jerky without a flywheel in the engine?

5 Energy and your body

Energy from food

Apparatus

★ 2 clampstands ★ small syringe connected to a stopper
★ 6 clean dry test tubes ★ Bunsen burner ★ heatproof mat ★ tongs
★ safety glasses ★ 6 bottle tops ★ 2 peanuts ★ rice ★ margarine
★ dried milk ★ sugar ★ flour

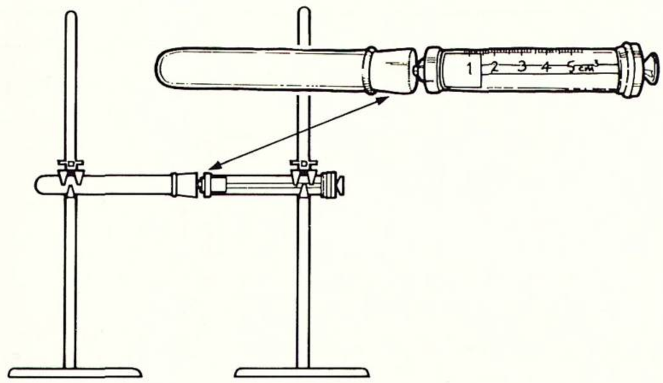
You are going to see how much energy foods can give.


Wear safety glasses.

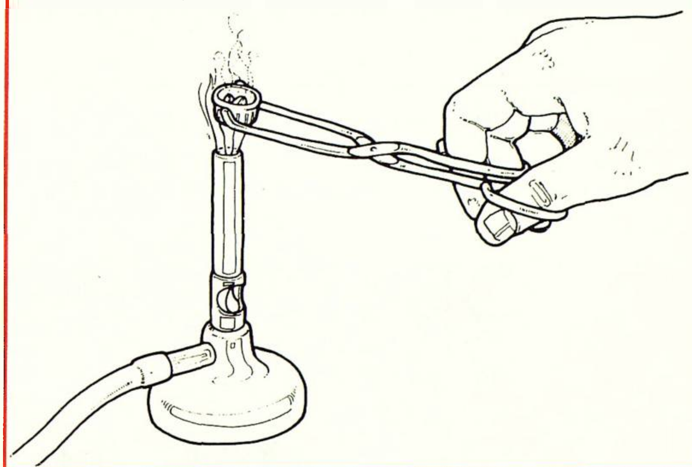
Q1 Copy this table.

Name of food	Syringe measurement (cm^3)
Nuts	

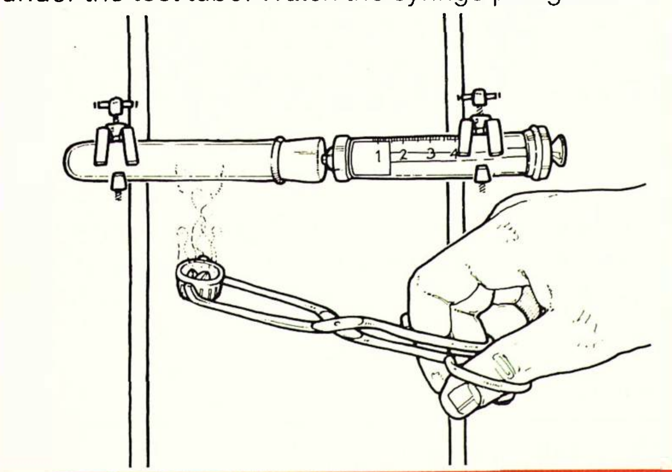
A Make sure that the plunger in the syringe is pushed fully in. Connect the syringe to a clean dry test tube. Use 2 clampstands to support the test tube and syringe.



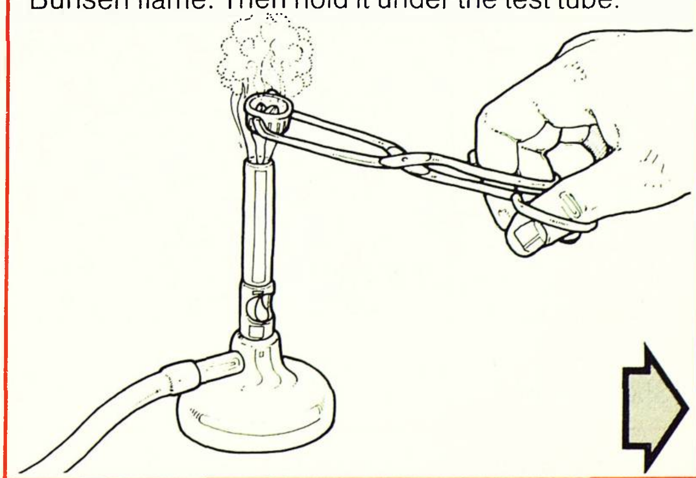
B Put 2 peanuts in a bottle top. Use tongs to hold the bottle top in a Bunsen flame.



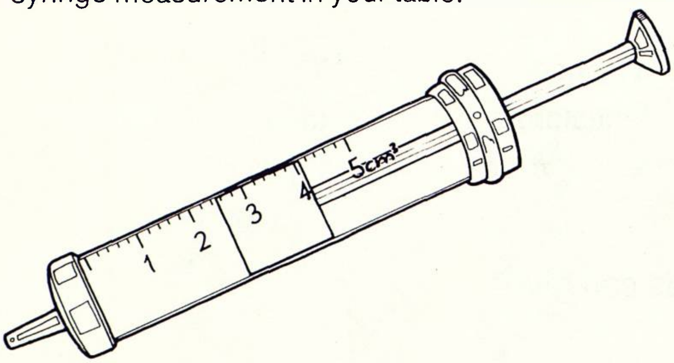
C When the nuts start to burn, hold the bottle top under the test tube. Watch the syringe plunger.



D If the food stops burning, put it back in the Bunsen flame. Then hold it under the test tube.



E When all the food has burned, record the syringe measurement in your table.



F Repeat steps A to E with the other foods. Use half a bottle top of each food.

Q2 Which food made the plunger move furthest?

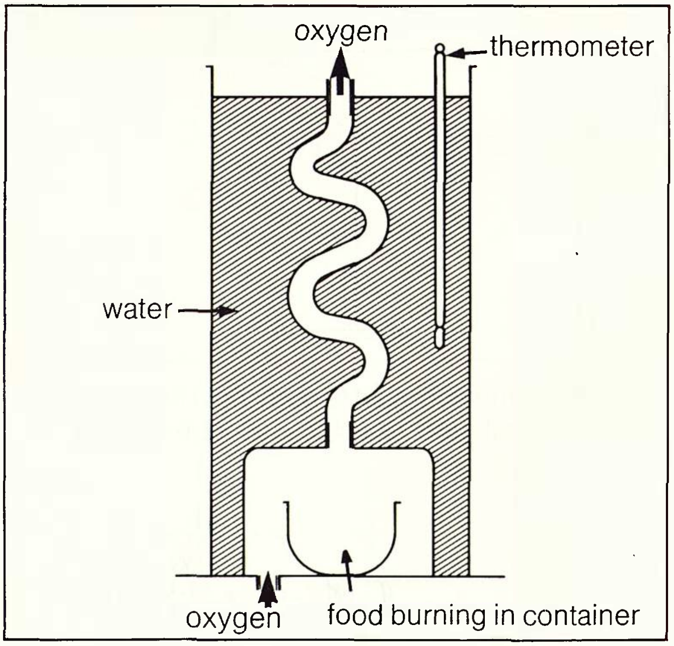
Q3 Which food gave out the most energy?

Q4 When the food burns, stored energy is changed into heat energy. What energy change takes place when the plunger moves?

Information: Measuring the energy in foods

The number of **calories** in a food shows how much energy the food can give us. Scientists use a different unit to measure the amount of energy. This is called the **joule.**

A portion of the meal shown in the photo contains 350 calories.



The amount of energy in a food can be found by burning it in a **calorimeter.** The burning food heats up water. The rise in temperature of the water is measured with a thermometer. A large rise in temperature shows the food contains a lot of energy.

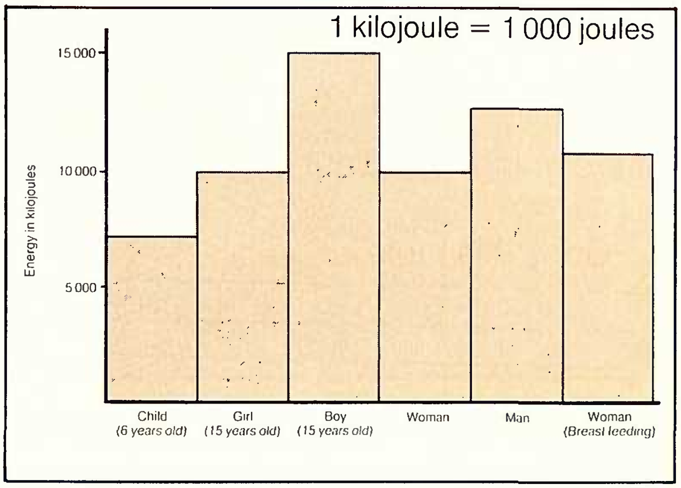
Q5 What is a calorimeter used for?

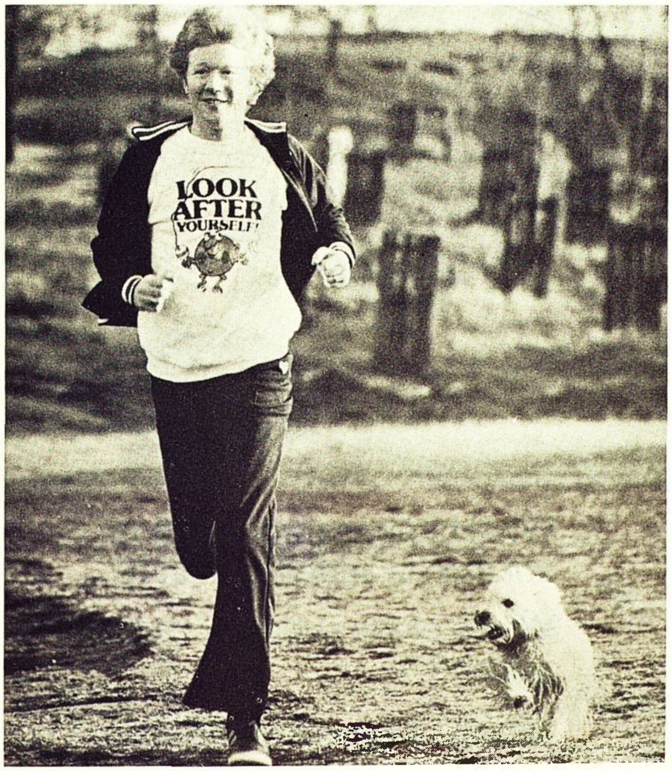
Q6 What is a joule?

Information: How much food do we need?

Food gives us energy. The amount of food we need depends on how much energy our bodies need to work. An adult eats more food than a young child because an adult needs more energy.

This graph shows how much energy is needed by different people each day.





If you exercise regularly you use up more energy. Athletes eat energy-giving foods to provide the energy they need.

If you eat more food than you need, the extra food is changed into fat. You become overweight and you should eat less.

Q7 Why does a man need more food than a woman?

Q8 Why does a woman, who is breast feeding a baby, need more food than she normally does?

Q9 Why do athletes eat energy-giving foods?

Q10 Why may it be dangerous to be very overweight?

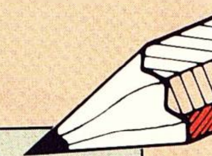
6 Energy and plants

Testing for starch

Apparatus

★ 4 watchglasses ★ spatula ★ dropper ★ iodine solution
★ starch ★ flour ★ sugar ★ salt

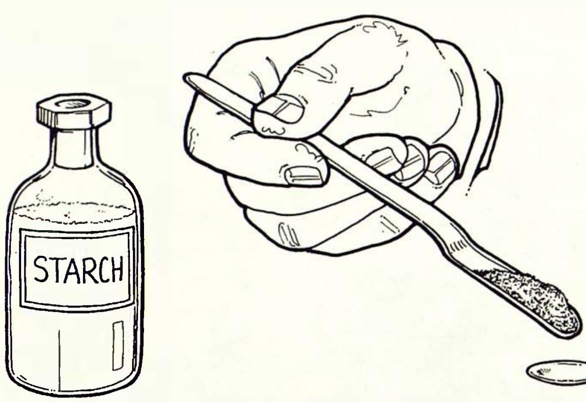
You are going to find out how to test for starch.



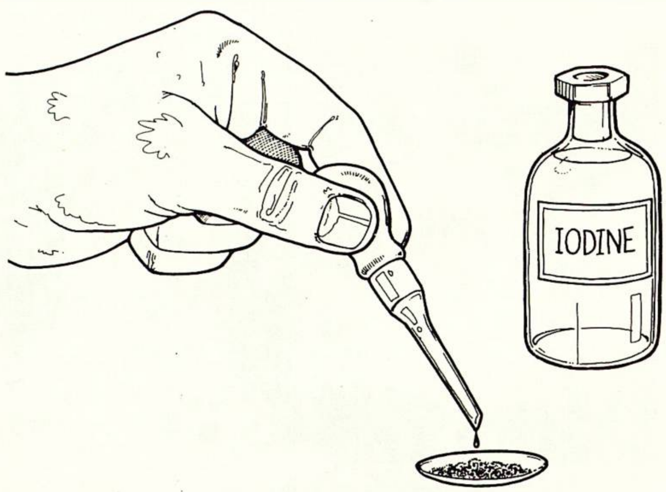
Q1 Copy this table.

Substance	What happened when iodine was added?
Pure starch	

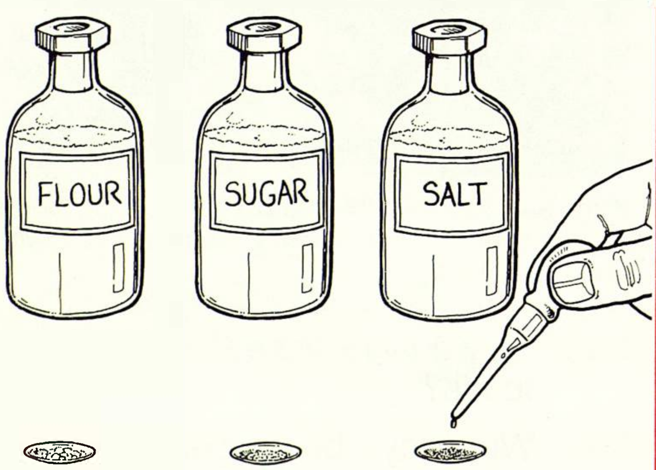
A Place 1 spatula of pure starch on a watchglass.



B Add 3 drops of iodine solution to the starch. Notice what happens.



C Repeat steps A and B with flour, sugar and salt instead of starch. Record the results in your table.



Q2 What happens when iodine solution is added to starch?

Q3 Which of the substances contain starch?

Q4 Which of the substances does not contain starch?

Why plants need light

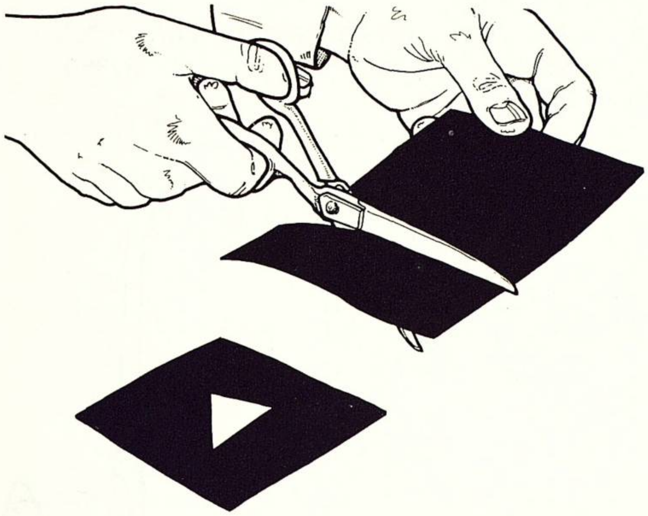
Apparatus

- ★ a leafy plant ★ black paper ★ scissors ★ 4 paperclips ★ lamp
- ★ 100 cm³ beaker ★ boiling tube ★ Bunsen burner ★ tripod ★ gauze
- ★ heatproof mat ★ tweezers ★ dropper ★ white tile ★ propanone
- ★ iodine solution

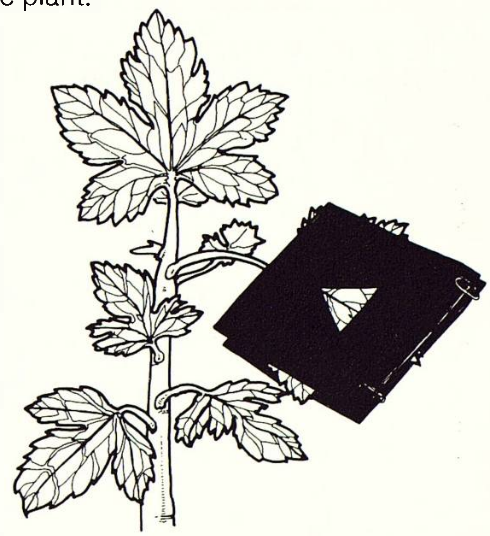
You are going to find out why plants need light.

Keep propanone away from flames.

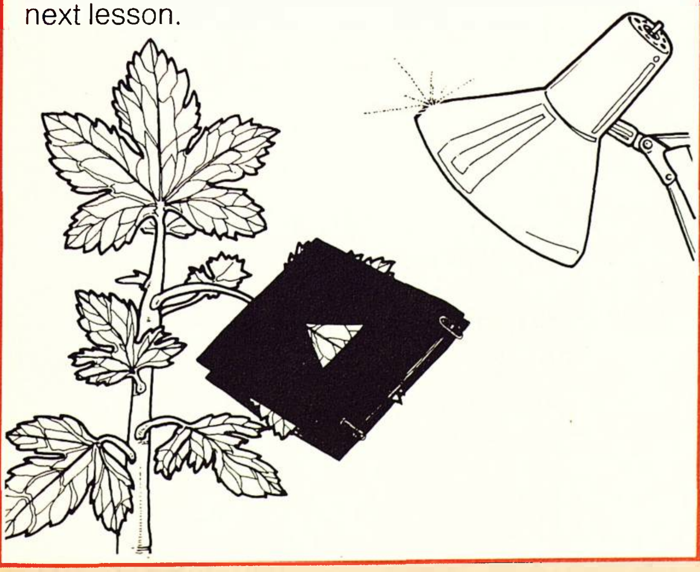
A Cut out 2 pieces of black paper about 8 cm square. Cut a triangular shape in one of the pieces.



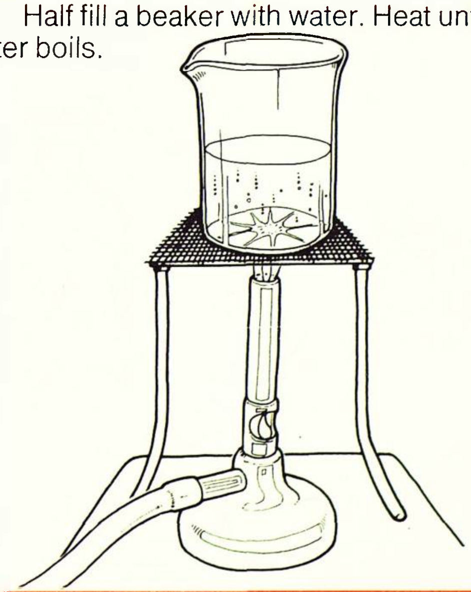
B Clip the 2 squares of paper to either side of a leaf of the plant.



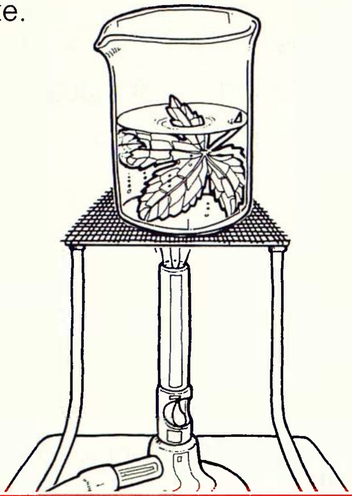
C Put the plant under a lamp. Leave it until the next lesson.



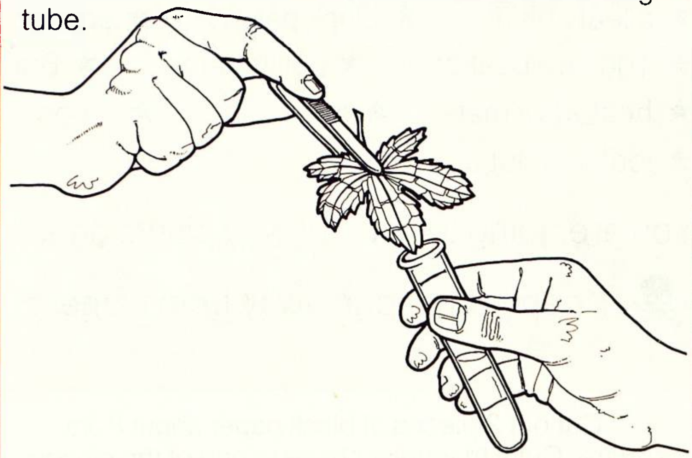
D Half fill a beaker with water. Heat until the water boils.



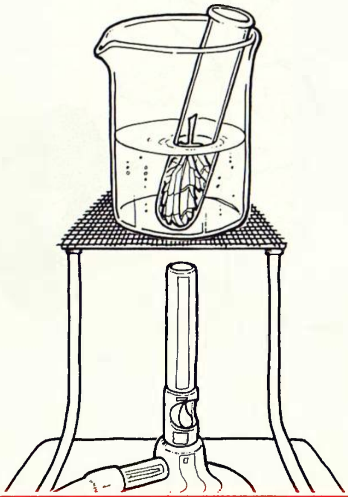
E Remove the covered leaf from the plant. Take off the black paper. Drop the leaf into boiling water for 1 minute.



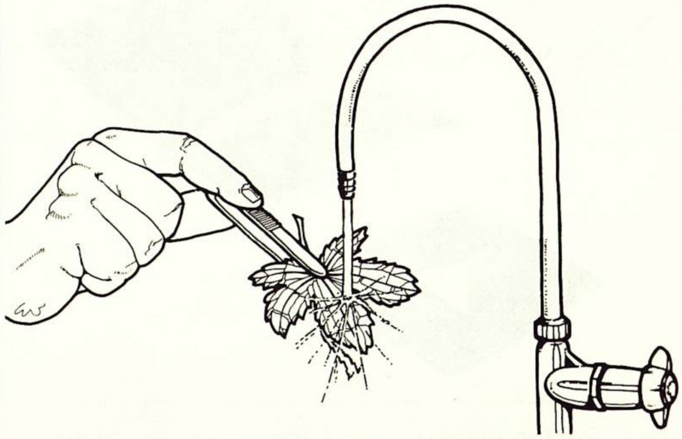
F Turn off the Bunsen burner. Half fill a boiling tube with propanone. Use tweezers to remove the leaf from the hot water. Put the leaf into the boiling tube.



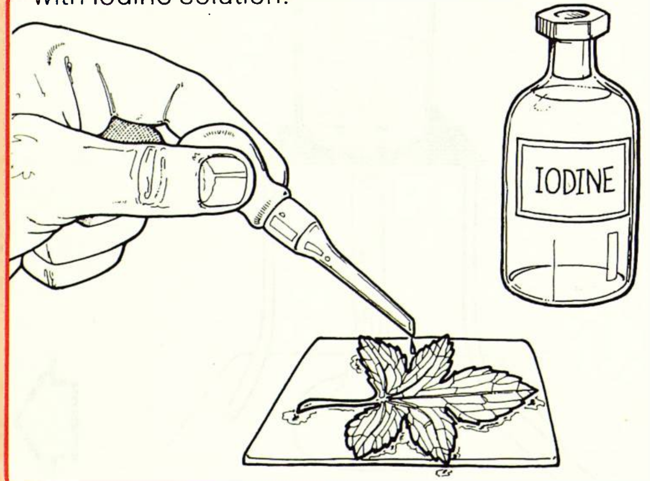
G Stand the boiling tube in the beaker of hot water. Do not relight the Bunsen burner.



H After about 5 minutes (when the green colour has gone out of the leaf) remove the leaf. Wash it under running water.



I Place the leaf on a white tile. Cover the leaf with iodine solution.



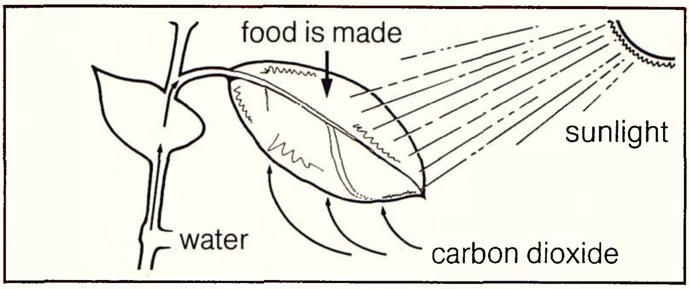
Q5 Which part of the leaf received light?

Q6 Which part of the leaf contained starch?

Q7 What does the leaf make when light shines on it?

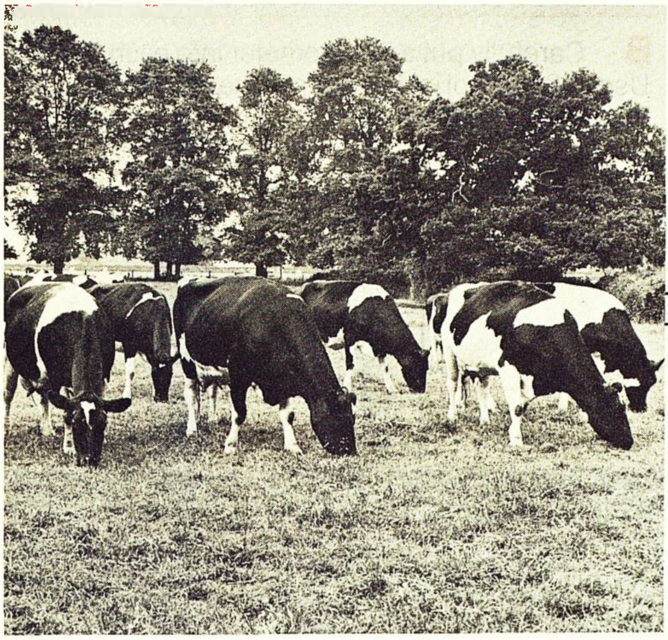
Q8 Starch contains stored energy. What energy change takes place when light shines on a leaf?

Information: Using energy from the sun

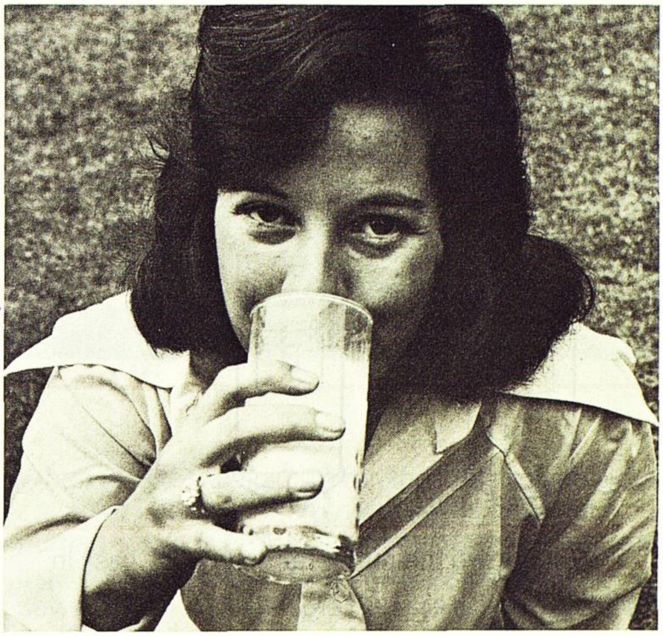


All green plants contain a substance called **chlorophyll**. Chlorophyll can trap the energy from the sun. Plants take in carbon dioxide through their leaves and water through their roots. They use the energy from sunlight to change carbon dioxide and water into simple foods like starch. This process is called **photosynthesis**.

Food chains

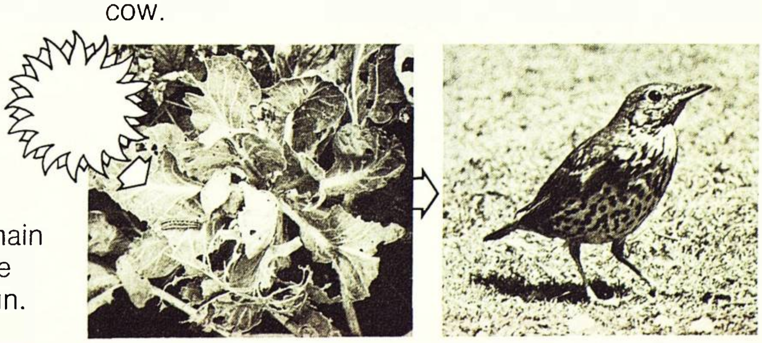


The energy in the grass has come from the sun. The cows get energy from the grass they eat.



The glass of milk will supply the body with the energy it needs to work. The milk comes from a cow.

This is one example of a **food chain**. A food chain shows how different animals get their food. The chain always starts with the energy from the sun. Here is another example.



Q9 How do green plants use the energy from the sun?

Q10 What substances does a plant need to make food?

Q11 What is a food chain?

Q12 Make up 2 food chains.

Energy from rotting plants

Apparatus

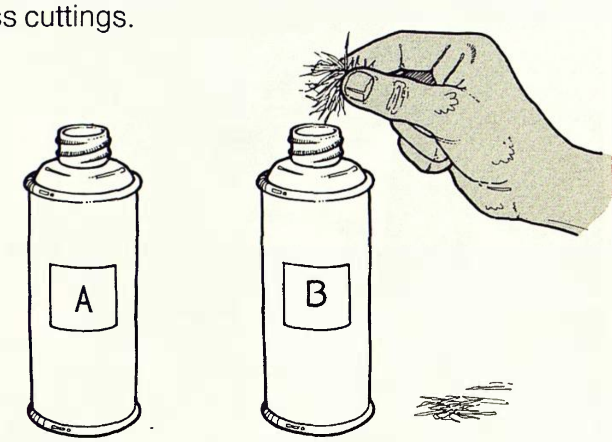
- ★ 2 vacuum flasks
- ★ 2 thermometers
- ★ labels
- ★ cotton wool
- ★ grass cuttings

You are going to find out what happens when grass rots.

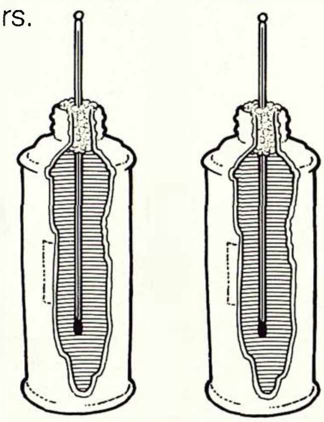
Q13 Copy this table.

Time	Temperature of flask A (°C)	Temperature of flask B (°C)
Start		
End of lesson		

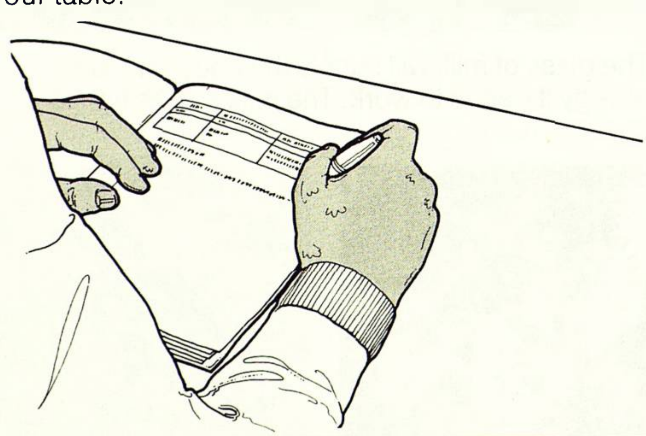
A Label one flask A, the other B. Fill flask B with grass cuttings.



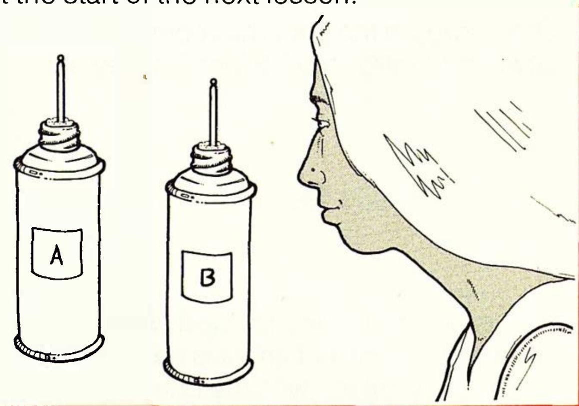
B Carefully put a thermometer into each flask. Use cotton wool in the necks of the flasks to support the thermometers.



C Write down the temperature of each flask in your table.



D Leave the 2 flasks set up. Record the temperatures at the end of the lesson. Record them again at the start of the next lesson.



Q14 What was the temperature change in flask A?

Q15 What was the temperature change in flask B?

Q16 When grass rots, its stored energy is released. What happens to the stored energy in this experiment?

Q17 Why did we have a flask with no grass in it?

Information: Using energy stored in plants

Fossil fuels will not last very much longer. Scientists are looking for new fuels to provide the energy we will need in the future.

Sugar as a fuel

Large amounts of sugar cane are grown in Brazil. When yeast and water are added to sugar, it can be changed into alcohol. This is called **fermentation**. It is the same as changing grape juice into wine.

The alcohol made from sugar is called **ethanol**. Ethanol burns and can be used as a fuel. In Brazil, ethanol is cheap to produce, and a mixture of ethanol and petrol is used as a fuel in cars.

Biothermal energy

When plants and animals rot, their stored energy is changed into heat energy. In a sewage works, human waste is broken down by bacteria. Heat and a gas called **methane** are produced. Modern sewage works use the methane as a fuel to run their machinery.

Q18 How can sugar be changed into ethanol?

Q19 Why is ethanol not used to run cars in Britain?

Q20 What energy change takes place when plants rot?

Q21 How can methane be used in a sewage works?

7 Energy for the future

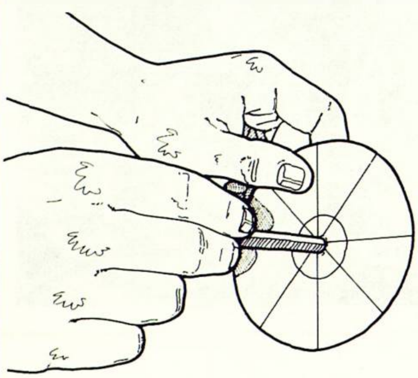
Making a model wind turbine

Apparatus

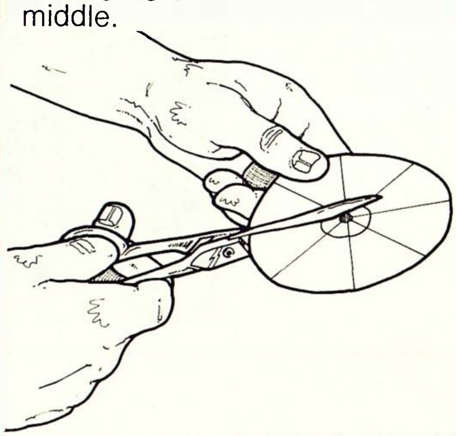
★ long pencil ★ cardboard ★ pair of compasses ★ scissors ★ cotton thread
★ button ★ 2 clothes pegs ★ 2 straight pins ★ plasticine ★ protractor
★ hairdryer

You are going to make a model wind turbine.

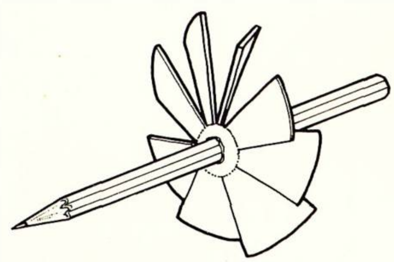
A Draw a circle of diameter 10 cm on the cardboard. Cut it out. Make a hole in the middle with your pencil.



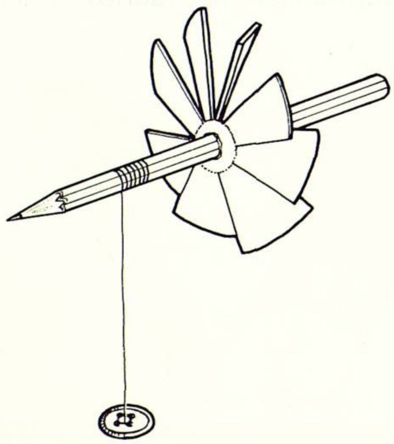
B Use a protractor to divide the circle into 8 equal sections. Carefully cut along the lines leaving a gap of 1 cm in the middle.



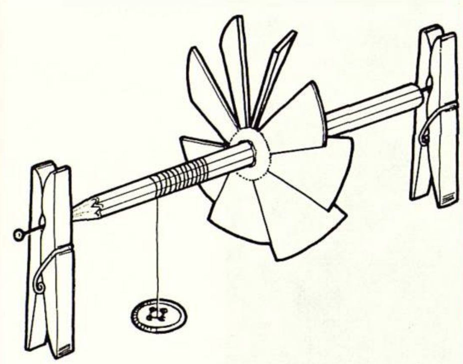
C Bend the card to make blades like a turbine. Carefully push the pencil through the hole in the middle of the card.



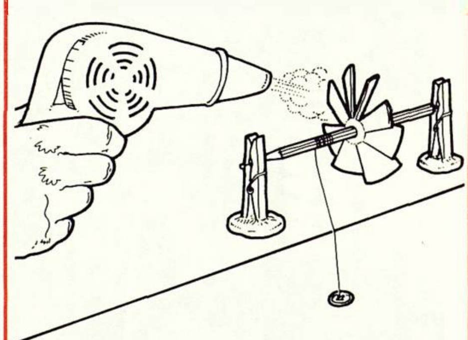
D Tie a piece of cotton, 20 cm long, around the pencil. Fix a button on the other end.



E Stick a pin into each end of the pencil. Rest the pins in the holes in the pegs.



F Fix the pegs firmly to the bench with plasticine. Direct a hairdryer on the blades of the turbine.



Q1 What did you use to provide the wind?

Q2 What energy changes take place in the hairdryer?

Q3 What happened to the button?

Q4 What sort of energy did the button have at the end of the experiment?

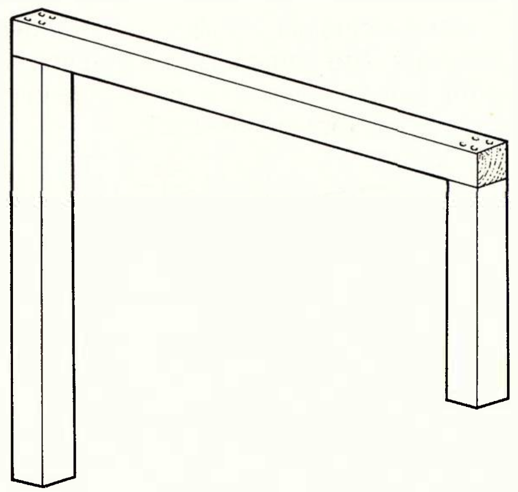
Energy from waves

Apparatus

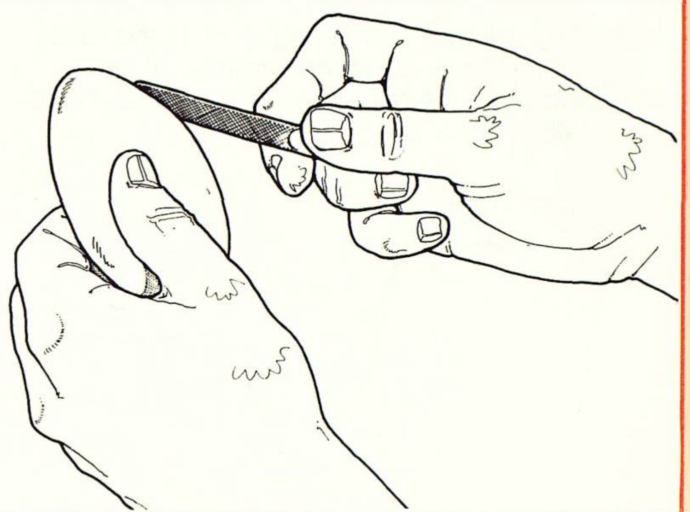
★ 3 lengths of balsa wood ★ balsa wood glue ★ a block of balsa wood
★ knife ★ file ★ sandpaper ★ magnet ★ plastic-covered wire
★ cardboard tube ★ 2 long pins ★ 8 small pins ★ 2 clampstands
★ washing-up bowl ★ tape ★ galvanometer

You are going to build a model to show how waves could be used to provide electricity.

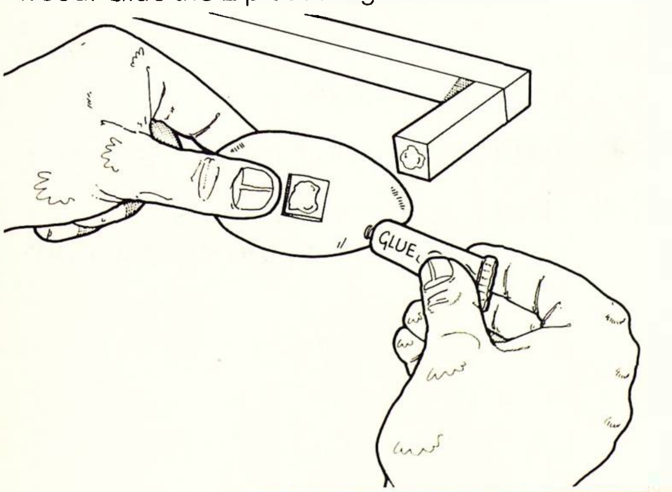
A Stick the 3 pieces of balsa wood together to make the shape in the picture. Use small pins to keep the balsa wood in place while the glue sets.



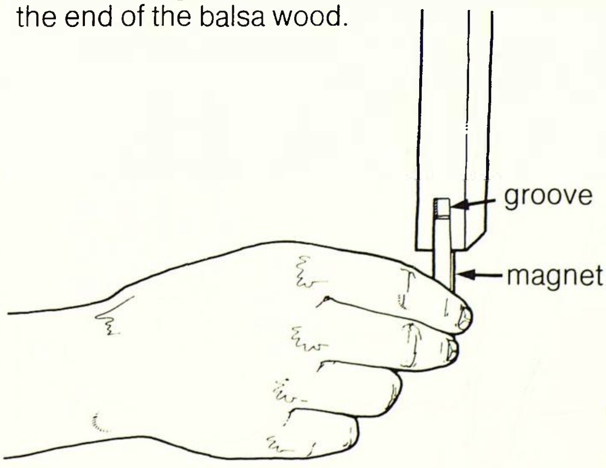
B Use a file and sandpaper to smooth down the edges of the block of balsa wood so that it becomes egg-shaped.



C Use a file to make a hole in the side of your egg-shaped piece of balsa wood. The hole must be large enough to fit the end of the shorter length of wood. Glue the 2 pieces together.

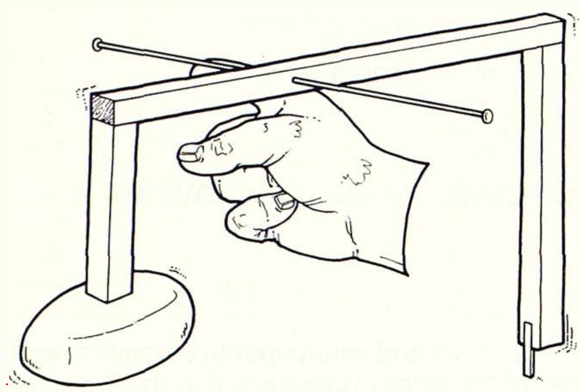


D Cut a small groove in the end of the longer length of wood so that the magnet will fit in tightly. Glue the magnet in place. It must stick out below the end of the balsa wood.

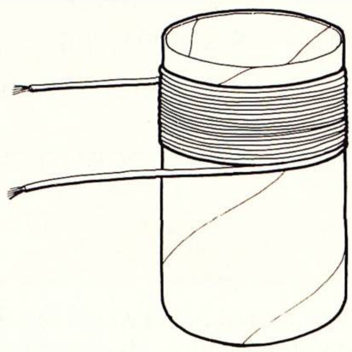


Energy for the future

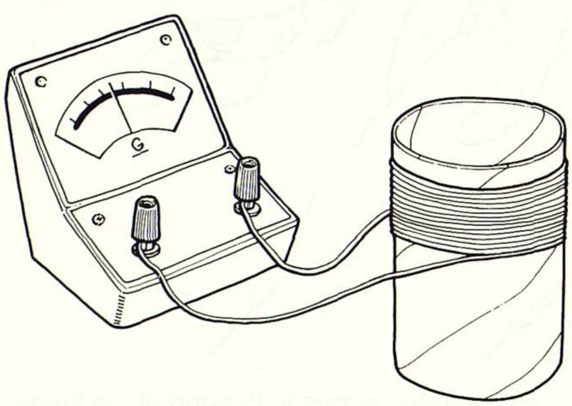
E Find the position where the frame balances evenly, by balancing it on your finger. Push long pins into the wood exactly at this point, one on each side.



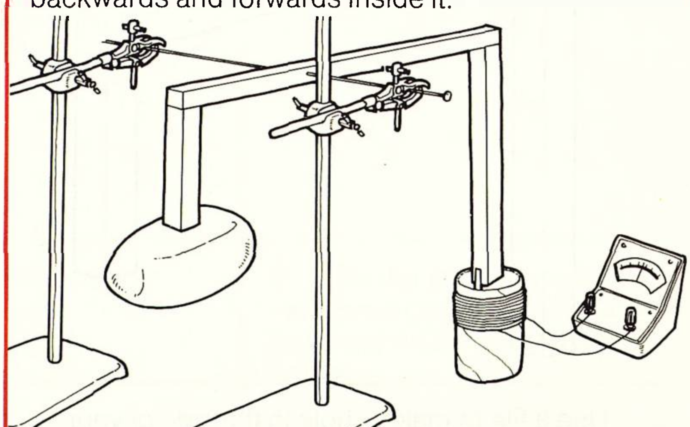
F Make a large coil of about 200 turns by winding plastic covered wire around a cardboard tube. The coil must be short and very thick. Use tape to stop it unwinding.



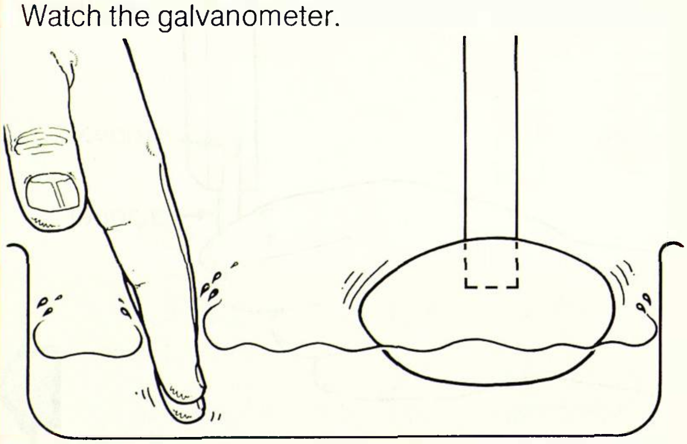
G Take the plastic covering off both ends of the wire. Fix the ends to the two terminals of the **galvanometer**. (A galvanometer measures small amounts of electricity.)



H Rest the pins of the balsa wood frame on 2 clampstands. The frame must be free to swing. Place the coil so that the magnet is able to move backwards and forwards inside it.



I Put a washing-up bowl under the egg-shaped float. Fill it with water until the float is in the water. Make small waves in the water with your hand. Watch the galvanometer.



Q5 What happens to the needle on the galvanometer?

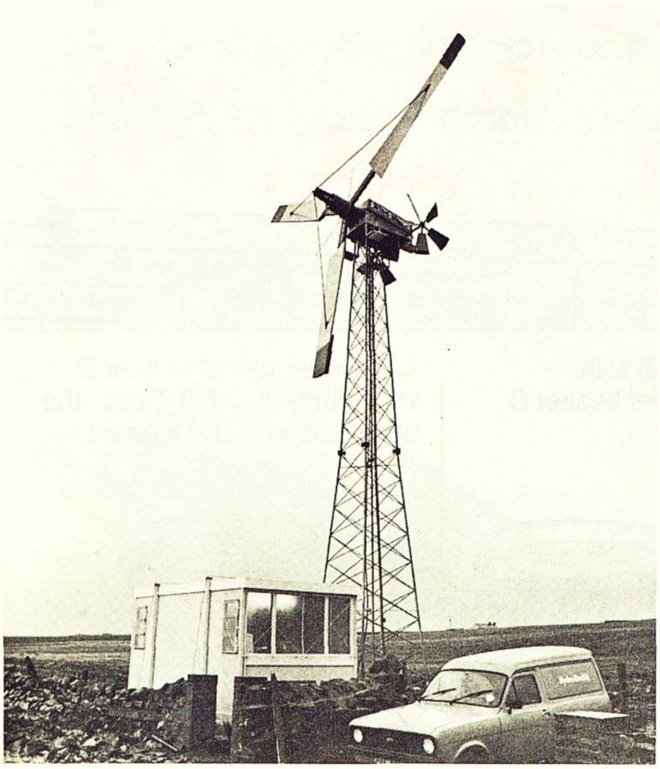
Q6 What sort of energy do the waves in the bowl have?

Q7 What energy change takes place?

Q8 How would you alter this equipment to use the energy from the sea?

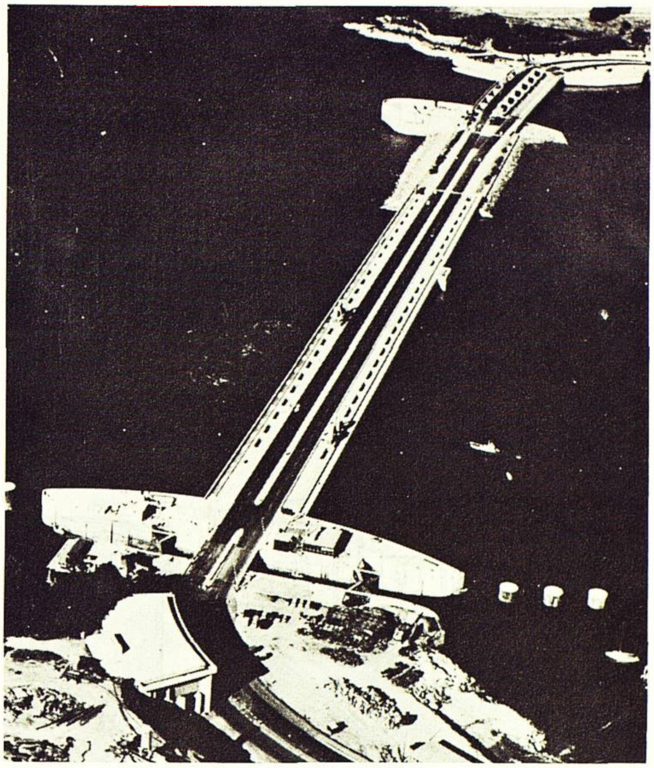
Information: Energy from the wind and the sea

Windmills



Many years ago, windmills were used to grind corn into flour. But if the wind did not blow, no flour was produced. When a more reliable way of grinding corn was found, most of the windmills were closed down. Fuels, like coal and oil, are becoming more expensive. The energy in the wind is free and windmills are now being used to produce electricity.

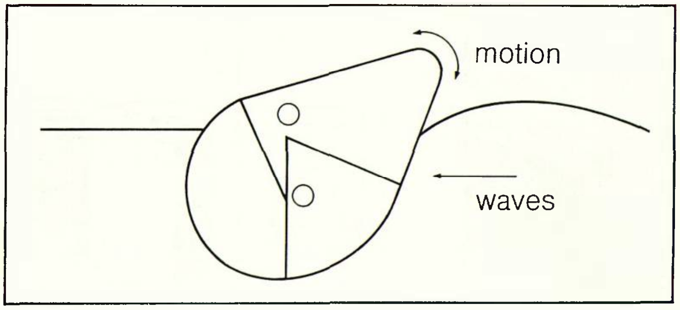
Tidal barrages



The **tides** of the sea are caused by the moon attracting the water and pulling it. This movement could provide enormous amounts of energy. In France, the estuary of the River La Rance is fitted with a barrier. There are giant turbines in the barrier. The turbines turn as the tide goes in and out and produce electricity.

Energy from waves

The surface of the sea is always moving up and down. A machine has been invented which can change the movement energy into electrical energy. As the float, shown in the diagram, moves with the waves, electricity is generated. At the moment this is a very expensive way of producing electricity.



Q9 Why did people stop using windmills?

Q10 Why are windmills now being used to produce electricity?

Q11 How can electrical energy be produced from the movement of the tides?

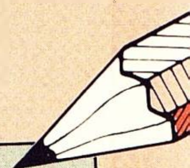
Trapping energy from the sun

Apparatus

★ four 100 cm^3 beakers ★ aluminium foil ★ black paper ★ scissors ★ labels
★ sticky tape ★ thermometer ★ 100 cm^3 measuring cylinder ★ stop clock

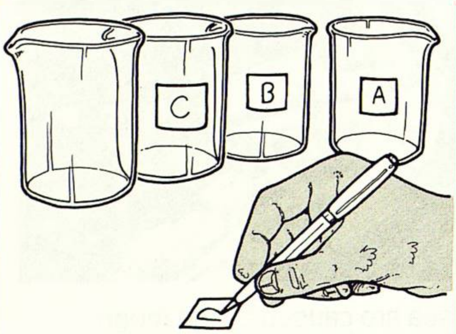
You are going to find the best way to trap the energy from the sun.

Q12 Copy this table.

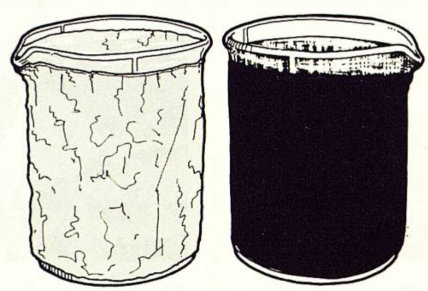


Time	Temperature of water (°C):			
	beaker A	beaker B	beaker C	beaker D

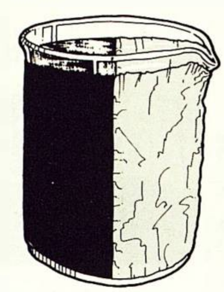
A Label 4 beakers, A, B, C and D.



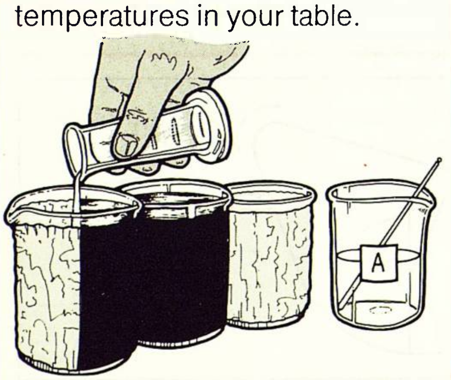
B Cover beaker B with aluminium foil. Cover beaker C with black paper.



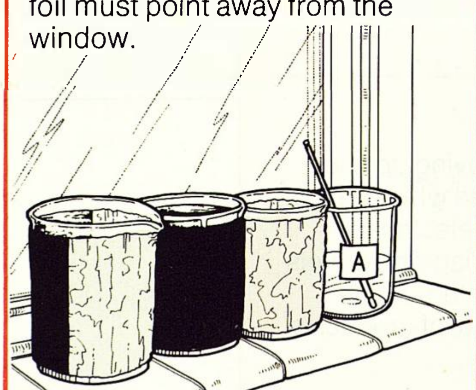
C Cover half of beaker D with aluminium foil. Cover the other half with black paper.



D Put 50 cm^3 of water into each of the beakers. Take the temperature of the water in each beaker. Record the temperatures in your table.



E Put the beaker on a sunny windowsill. For beaker D, the side covered with aluminium foil must point away from the window.



F Record in your table the temperature of the water in the beakers every 10 minutes.

Q13 In which beaker did the water get hottest?

Q14 Where did the heat come from?

Q15 Black paper **absorbs** (takes in) heat. Aluminium foil **reflects** (pushes back) heat. Why do we put aluminium foil behind beaker D to trap more energy?

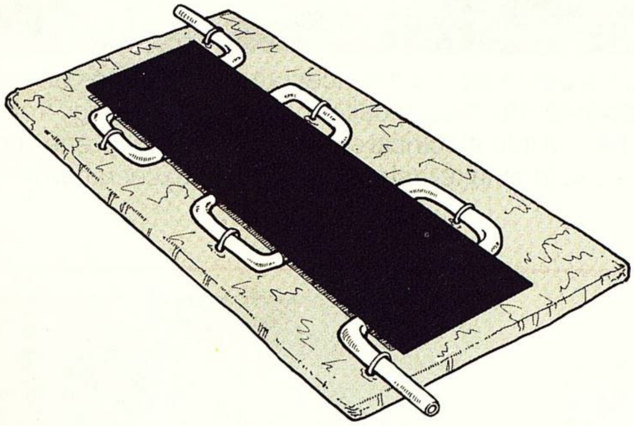
Making a solar panel

Apparatus

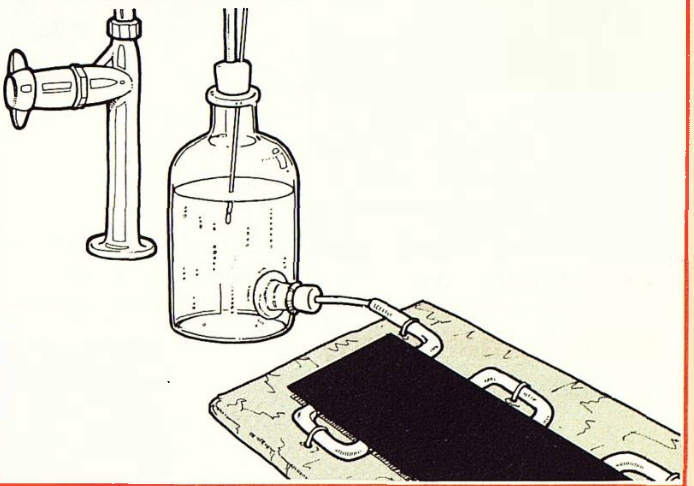
- ★ 2 reservoir bottles fitted with thermometers
- ★ plastic tubing
- ★ wire loops
- ★ pegboard
- ★ black paper
- ★ aluminium foil

You are going to make a solar panel.

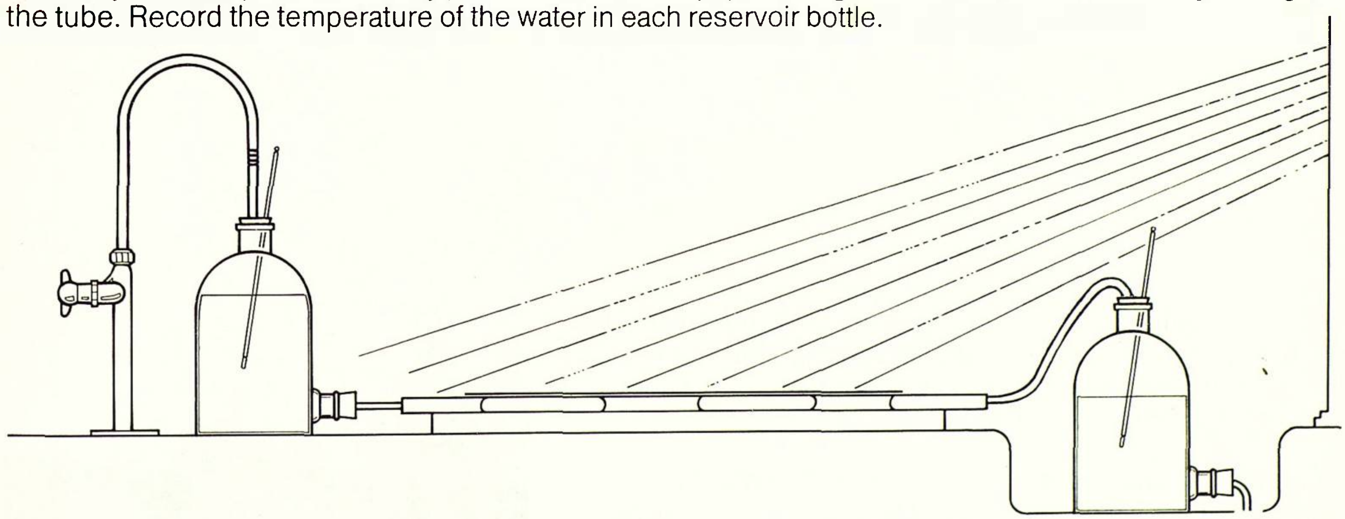
A Cover the pegboard with aluminium foil. Use wire loops to fix the plastic tubing to the pegboard. Cover the tube with a sheet of black paper.



B Connect a reservoir bottle to each end of the plastic tube. Connect 1 bottle to a tap and put the other bottle in the sink.



C Put your solar panel in a sunny place, with the black paper facing the sun. Let water flow slowly through the tube. Record the temperature of the water in each reservoir bottle.



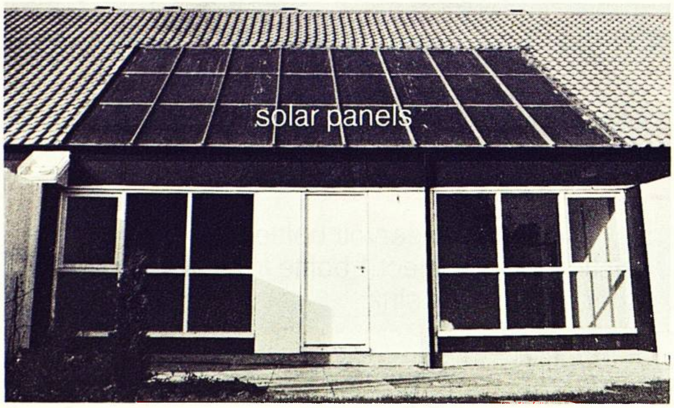
Q16 What happened to the temperature of the water as it passed through the solar panel?

Q17 Why is black paper put over the tube?

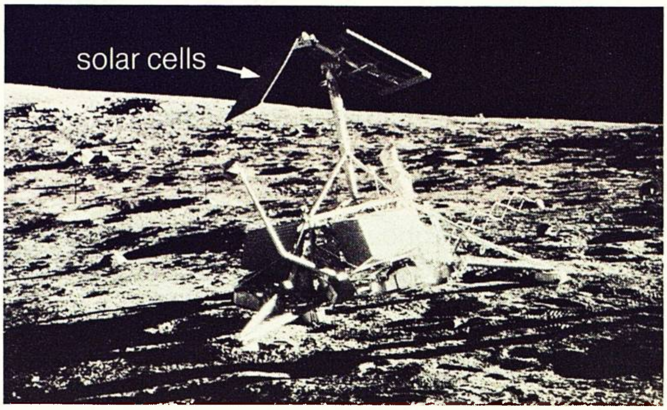
Q18 What would happen to the temperature of the water if you used a longer piece of tube with more curves in it?

Information: Energy from the sun and the earth

Solar energy



The sun is mainly made up of **hydrogen** gas. This gas is always being changed into another gas, **helium**. During this change an enormous amount of energy is produced. Some of this energy reaches the earth. This energy can be trapped by **solar panels** and used to heat water in a house.



This photo shows a spacecraft with batteries of **solar cells**. A solar cell can change the energy from the sun into electrical energy. The electrical energy is used to make instruments in the spacecraft work.

Geothermal energy

The centre of the earth is made up of very hot liquid rock. This warms up the rocks above. Water in underground streams can be heated by these hot rocks. The hot water may rise above ground as a hot spring or **geyser.**

Holes can be drilled deep into the earth to find hot water underground. This hot water could be used to heat houses.

Q19 Solar panels are used to heat water in countries where there is little sunshine. Why are solar panels used if the water never becomes really hot?

Q20 What energy changes take place in a solar cell?

Q21 How can houses be heated using geothermal energy?

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ISBN 201 14029 2