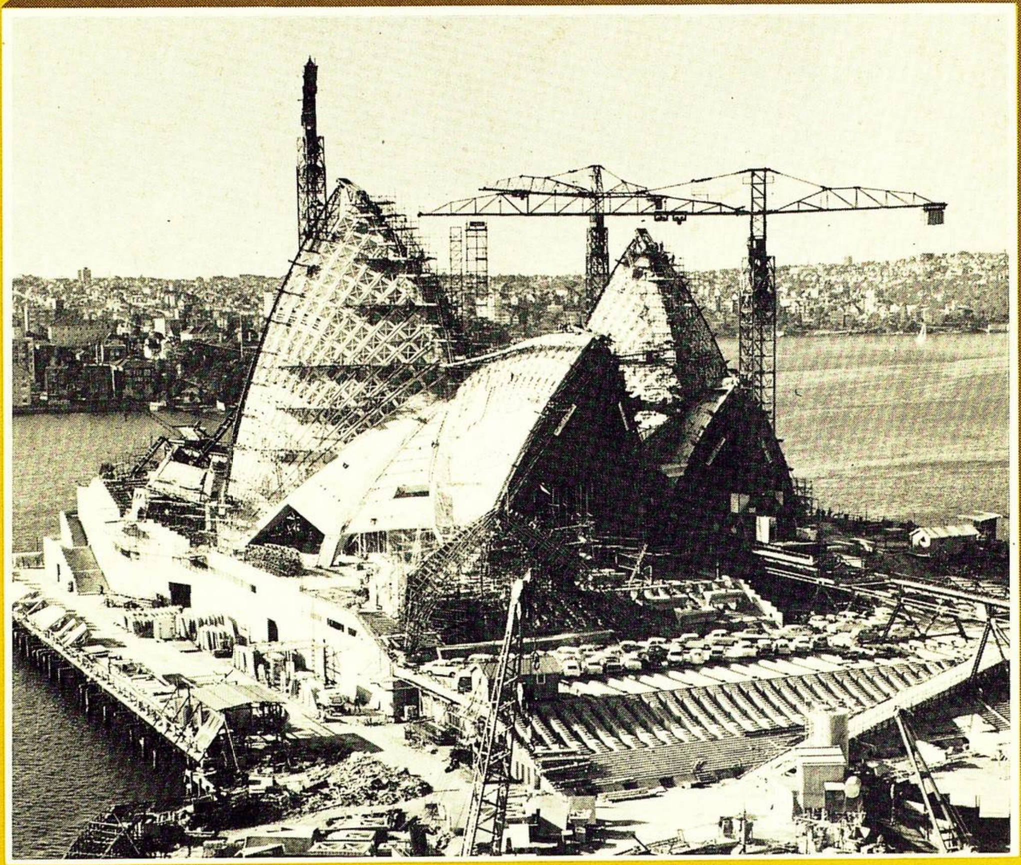
SCIENCE AT WORK



Building Science

REVISED EDITION

SCIENCE AT WORK

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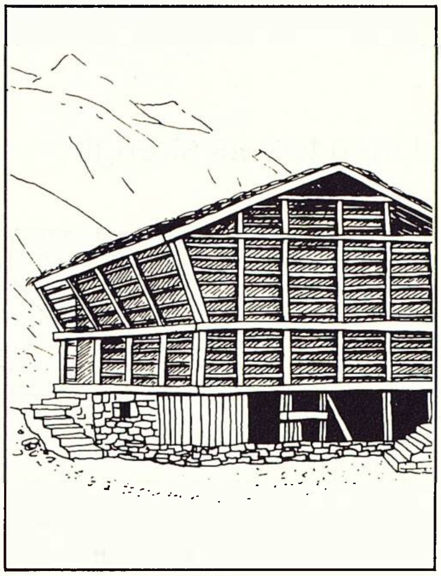
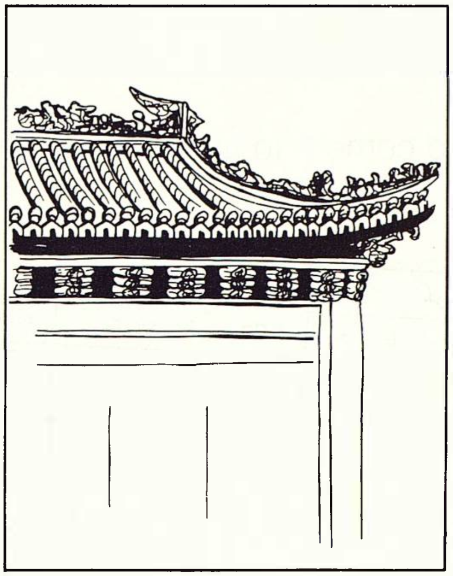
1 Building homes

Information: Types of home

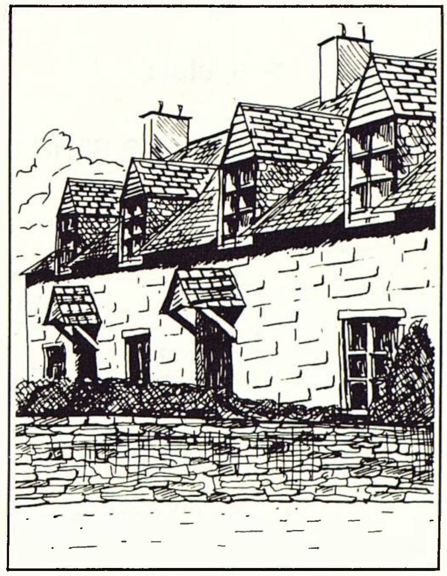
In olden times, people built their homes from whatever materials were available. The style of their home depended on the climate and how they used the building.



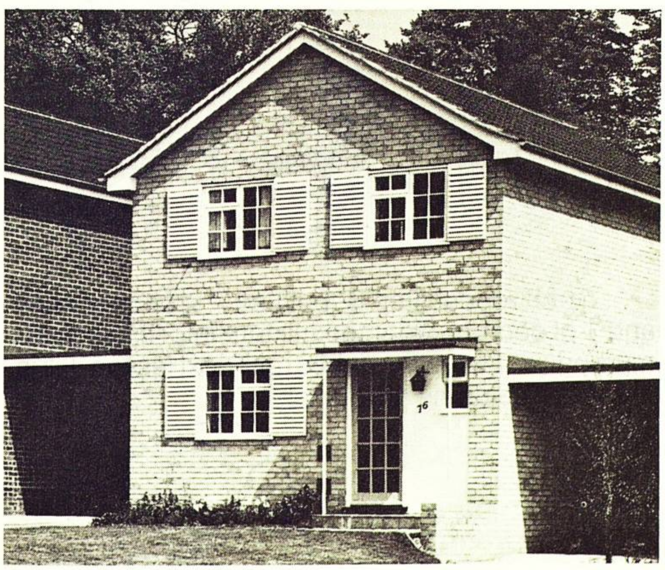
Wooden Alpine farm building with living-rooms, stable and barn.



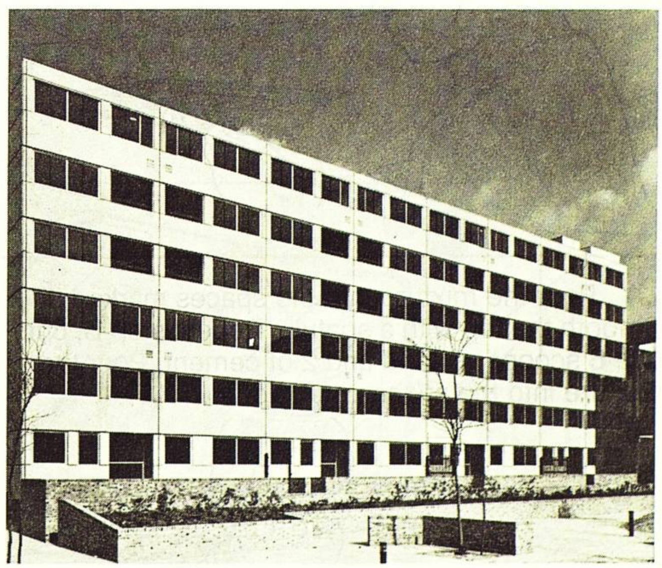
Roof of Emperor's Palace, Peking, protecting building from direct sunlight and monsoon rain.



Cottages of Cotswold stone.



About 6000 years ago, man learned how to make bricks from clay. Bricks are still one of the most common building materials.



Concrete and steel are two man-made materials often used in modern buildings. This block of flats is built from concrete and steel.

Q1 What are bricks made from?

Q2 What other materials are used in modern buildings?

Making and testing mortar

Apparatus

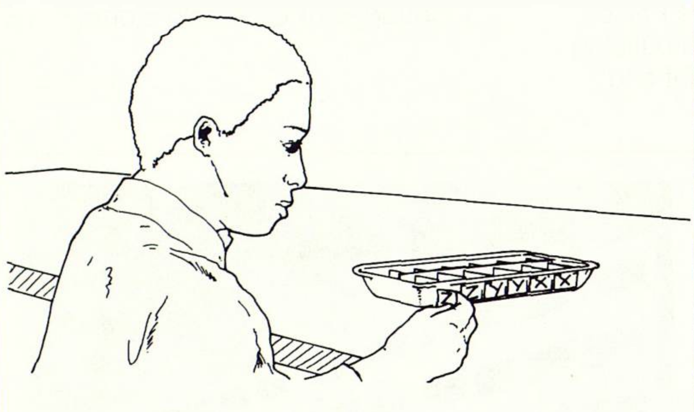
★ G-clamp fitted with disc ★ 2 pieces of wood ★ plastic mixing bowl ★ plastic scoop ★ wooden stirring rod ★ beaker of water ★ ice-cube tray ★ cement ★ sand ★ labels ★ spatula

You are going to use sand and cement to make **mortar** and then test its strength.

Q3 Copy this table.

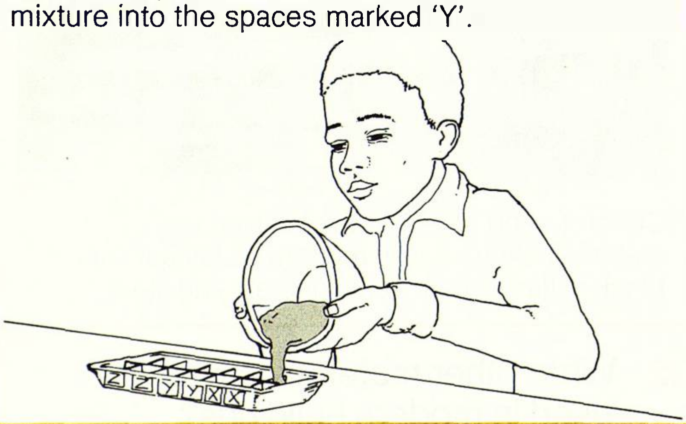
Mixture letter	Number of scoops of:		Ratio of sand : cement	Final reading on G-clamp disc for each cube			
	sand	cement					

A Label the first 4 spaces in the ice-cube tray 'X', the middle 4 'Y', and the last 4 'Z'.

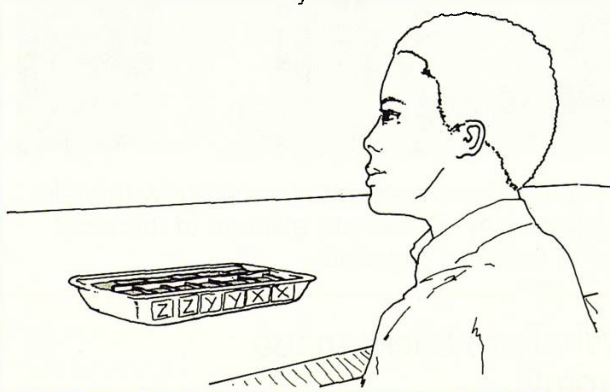


B Put 4 scoops of sand and 4 scoops of cement in a bowl. Add a small amount of water. Stir. Continue to add water until you have a creamy paste.

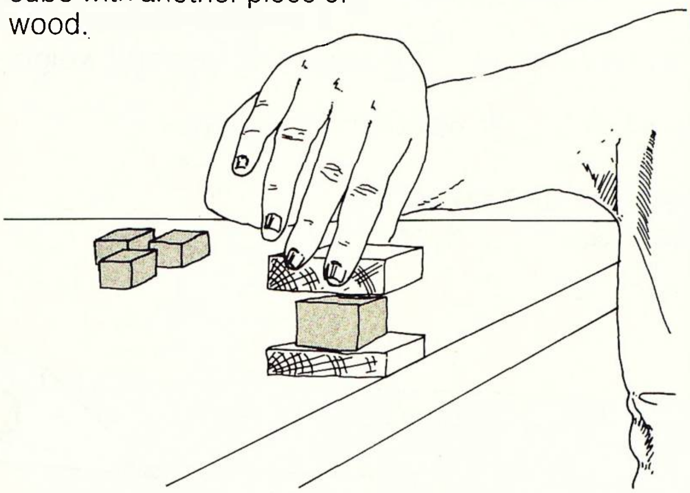
C Pour the mixture into the spaces marked 'X'. Smooth the top with a spatula. Repeat step B, but use 6 scoops of sand and 2 of cement. Pour the mixture into the spaces marked 'Y'.



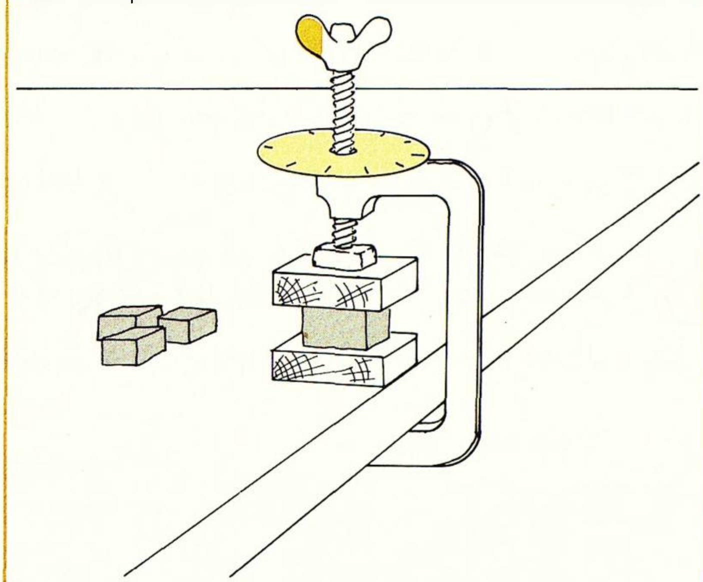
D Then repeat step B, but use 7 scoops of sand and 1 of cement. Pour the mixture into the spaces marked 'Z'. Leave the cubes until next lesson. Fill in the first 4 columns of your table.



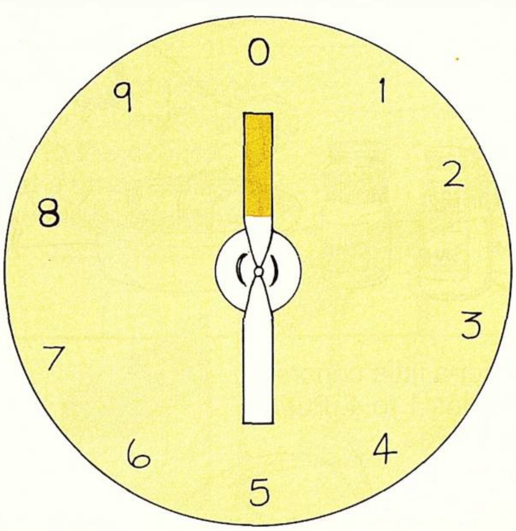
E Push the 'X' cubes out of the tray. Put a piece of wood on the edge of the bench. Put one cube on top of this wood. Cover the cube with another piece of wood.



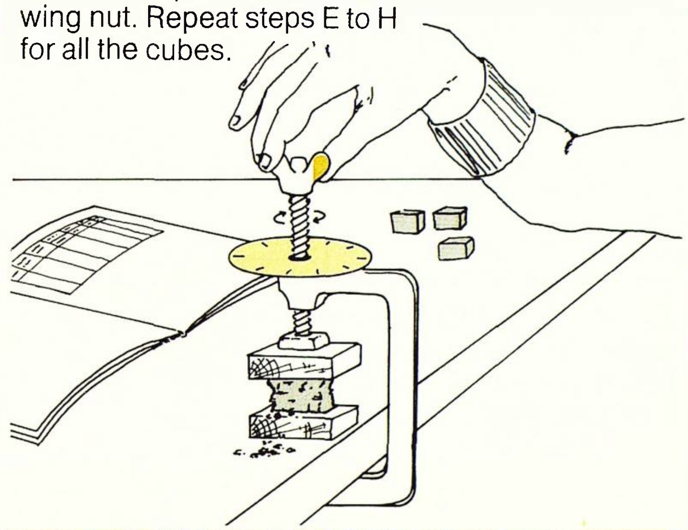
F Hold the mortar cube and wood in place by **gently** screwing down the G-clamp.



G Move the disc on the G-clamp until 0 is underneath the painted half of the wing-nut.



H Turn the screw. Make sure the disc does not move. When the mortar cube starts to crumble, write down the number on the disc that is nearest the painted half of the wing nut. Repeat steps E to H for all the cubes.



Q4 Mortar is used to join bricks together to make walls.
Why should mortar be able to stand up to crushing?

Q5 Which mixture made the strongest mortar?

Q6 Which mixture made the weakest mortar?

Making and testing concrete

Apparatus

★ moulds for 4 concrete blocks ★ labels ★ plastic tweezers ★ plastic mixing bowl

★ spatula ★ cement ★ sand ★ gravel ★ plastic scoop ★ 4 lengths of steel wire

★ few strands each of glass fibre and straw ★ bucket of sand ★ weight hanger and weights

★ 2 G-clamps ★ beaker of water ★ rubber gloves ★ wooden stirring rod

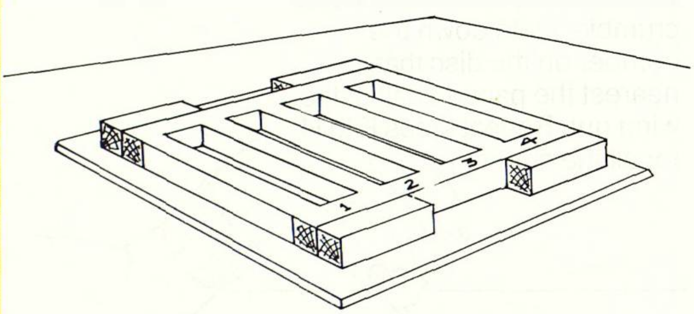
You are going to use sand, cement and gravel to make **concrete.**
You will add various things to the concrete and test it for strength.

Gloves must be worn when using glass fibre.

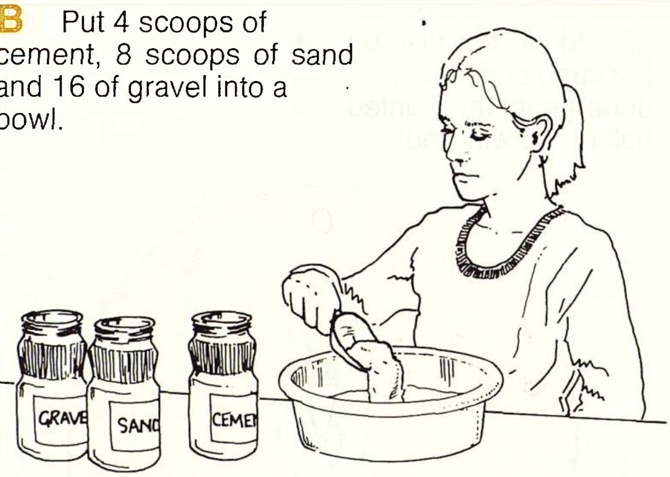
Q7 Copy this table.

Block number	Material added to concrete	Mass (weight, g) needed to snap block

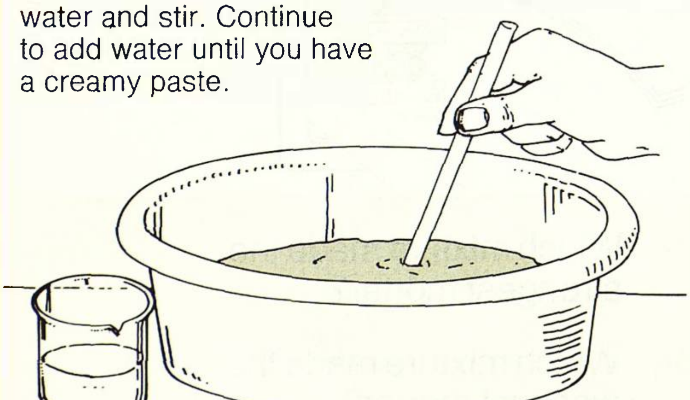
A Label the moulds 1 to 4.



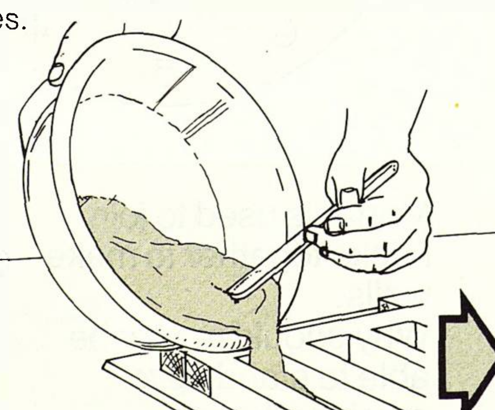
B Put 4 scoops of cement, 8 scoops of sand and 16 of gravel into a bowl.



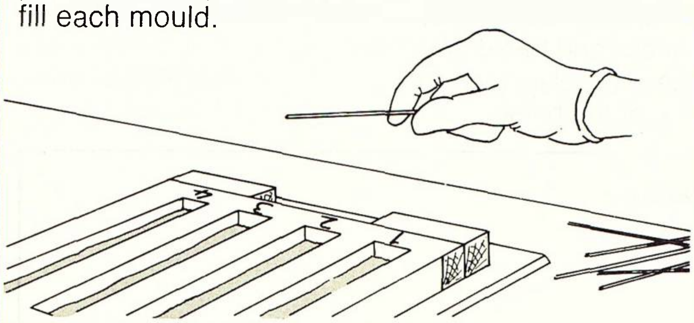
C Add a small amount of water and stir. Continue to add water until you have a creamy paste.



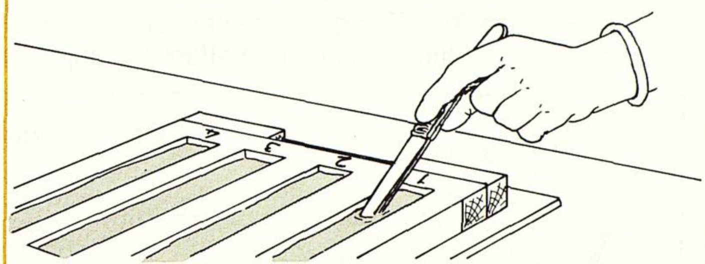
D Pour a little concrete into moulds 1 to 4. Put on rubber gloves.



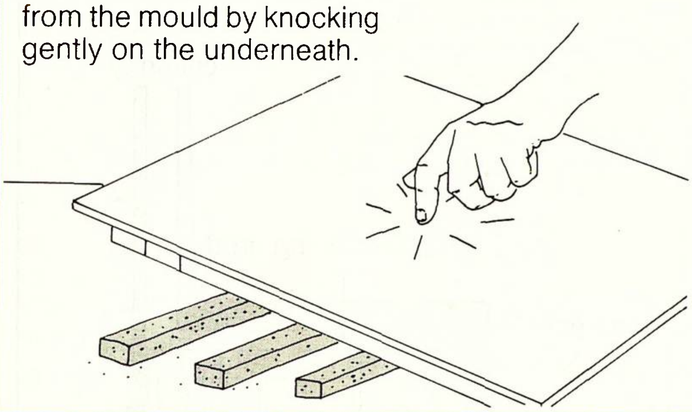
E Put straw into mould 1, glass fibre into mould 2 and wires into mould 3. Then pour in more concrete to fill each mould.



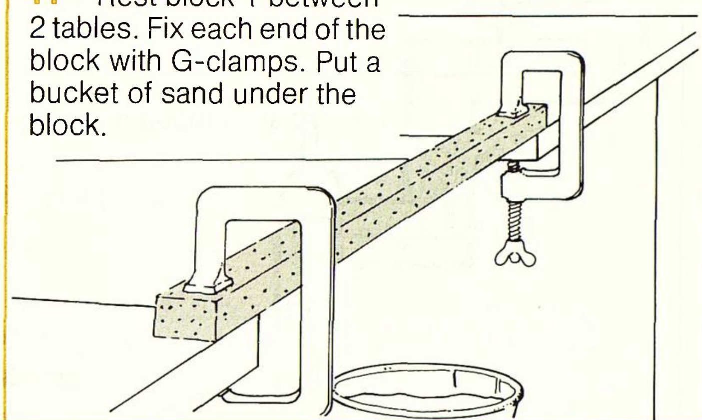
F Use tweezers to mix the strands in the concrete. Leave the concrete blocks until next lesson.



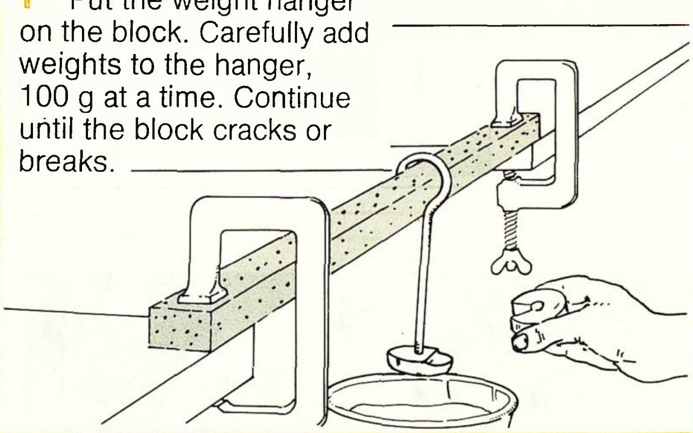
G Remove the blocks from the mould by knocking gently on the underneath.



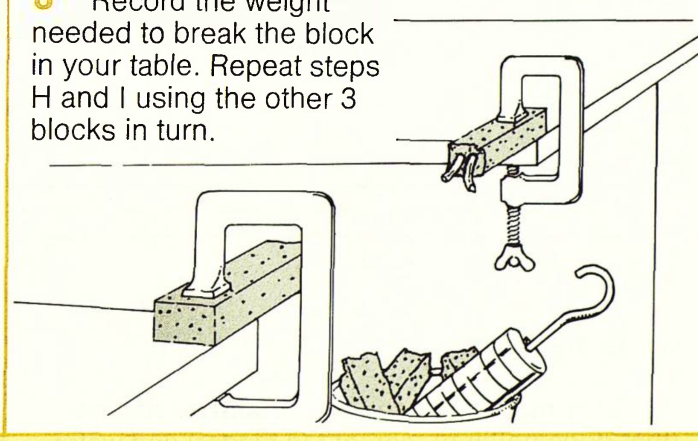
H Rest block 1 between 2 tables. Fix each end of the block with G-clamps. Put a bucket of sand under the block.



I Put the weight hanger on the block. Carefully add weights to the hanger, 100 g at a time. Continue until the block cracks or breaks.



J Record the weight needed to break the block in your table. Repeat steps H and I using the other 3 blocks in turn.



Q8 What is the difference between mortar and concrete? (Hint: look at page 2.)

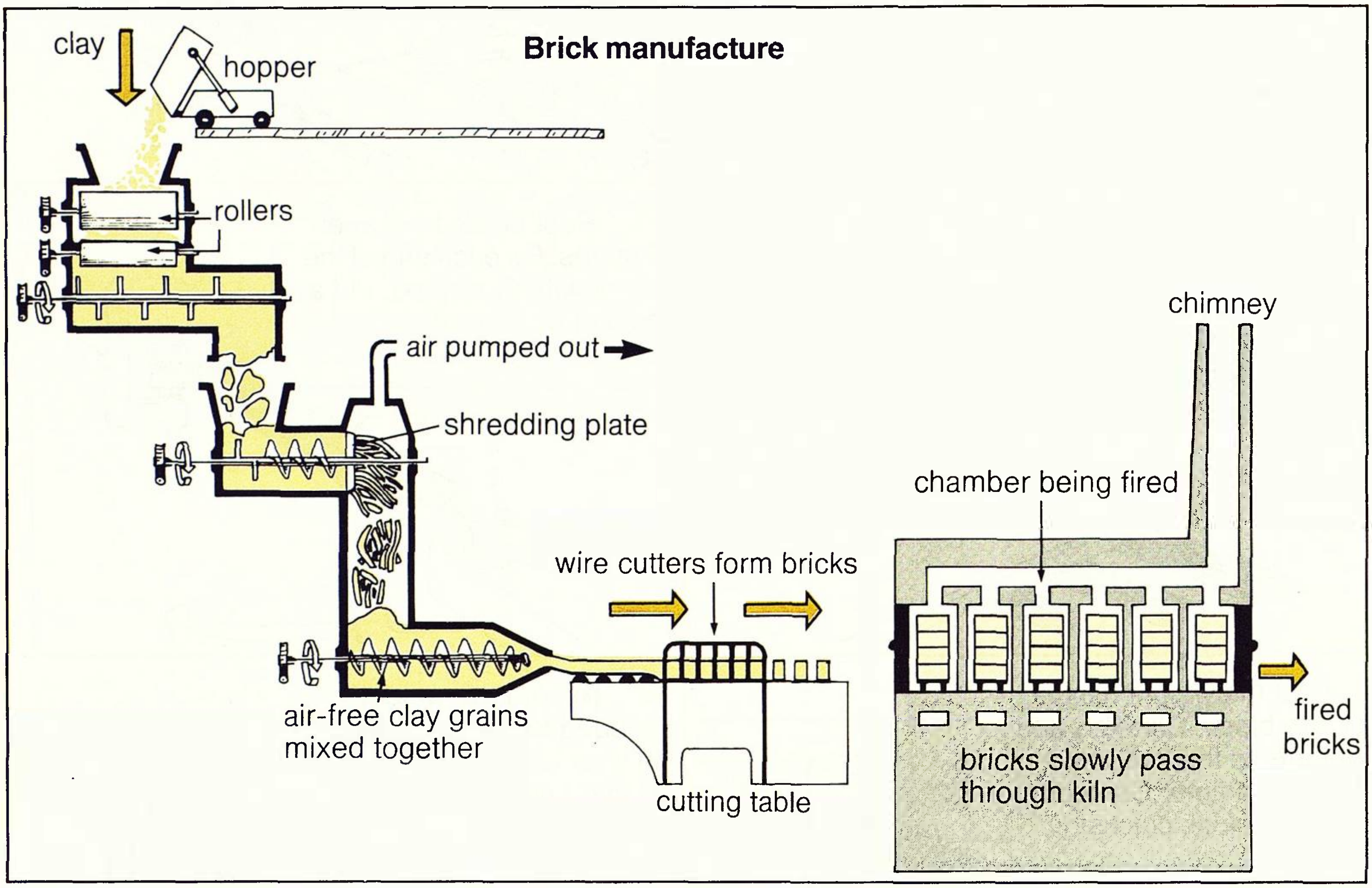
Q9 How can you tell that adding strands made the concrete stronger?

Q10 Adding materials to concrete **reinforces** it (makes it stronger). Which material was best at reinforcing concrete?

Information: Materials used for building homes

Bricks

To make bricks, raw clay is dug out of the ground and crushed into grains. Air is removed from the grains. They are shaped into bricks and these are heated in a **kiln.** This **firing** causes changes to take place in the clay; the temperature and time of firing can affect the appearance of the bricks.



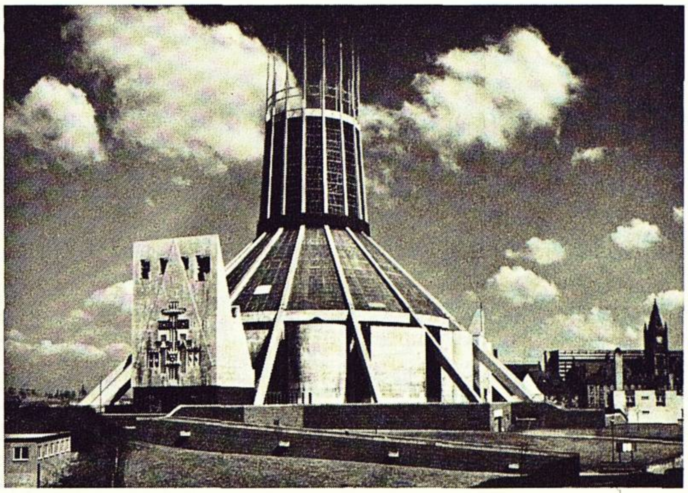
Mortar

Bricks are joined together with mortar.

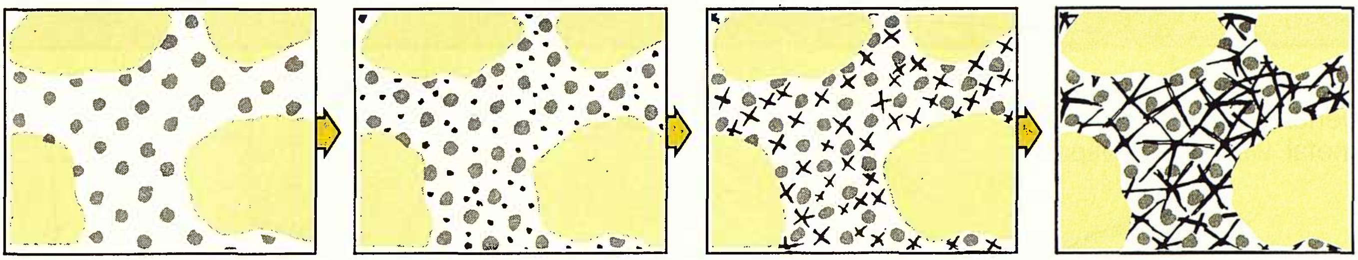
Mortar is made from sand, an **inactive** material (that does nothing), cement (a binder) and water.

Concrete

Concrete is used in many ways. It is used to make fence posts and street lights, roads, dams, houses, oil-production platforms and even cathedrals. Concrete is a mixture of **inert** (inactive) materials called **aggregates** bound together by cement. Aggregates are tiny stones.



How concrete is made

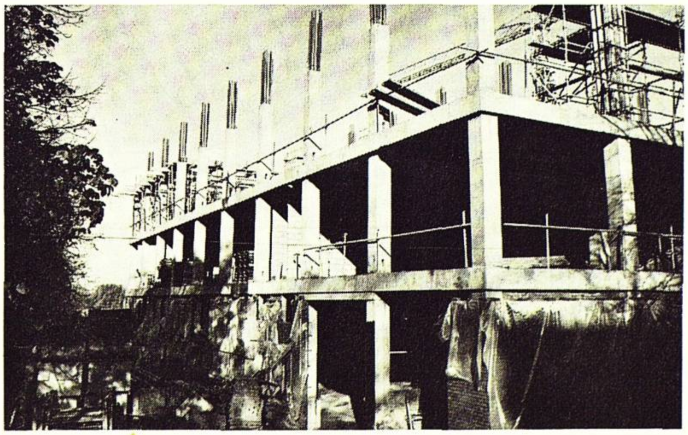


Sand and small stones are mixed together

Cement is added

When water is added, the cement forms crystals which bind the sand and gravel together.

The strength of concrete can be made greater by reinforcing it. One way is by putting metal rods into the concrete. Concrete reinforced with glass fibre is used to make strong, thin panels for the fronts of buildings.



Q11 What is an inert substance?

Q12 What happens to cement when water is added?

Q13 How can concrete be strengthened?

Q14 Look around the streets near your school. List all the things that are made from concrete.

2 Metals

Damage to metals

Apparatus

★ 4 strips each of aluminium, copper, steel and iron ★ plasticine ★ newspaper

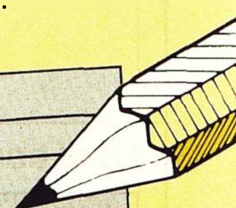
★ emery paper ★ labels ★ cling film ★ four 100 cm^3 beakers

★ labelled beakers of sea-water, water, and sodium metabisulphite solution

★ anhydrous calcium chloride

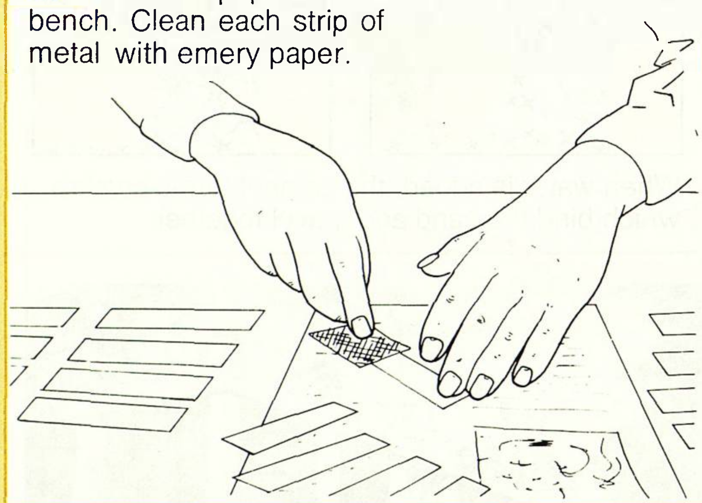
You are going to find out if metals can be damaged by air, water or solutions.

Q1 Copy this table.

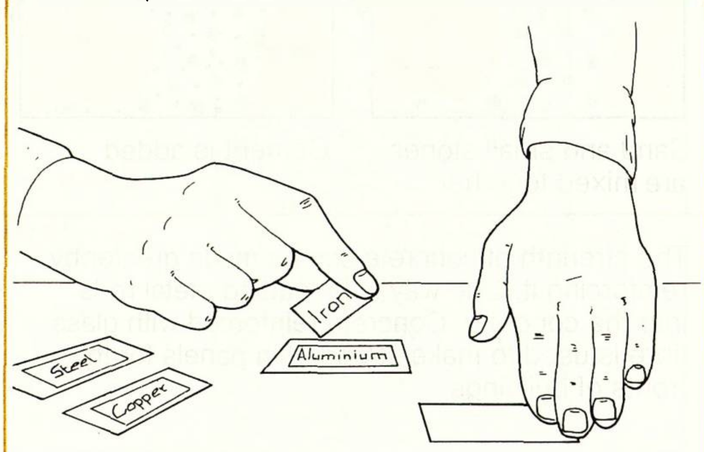


Beaker number	Chemical added to beaker	Appearance of metal after _______ days:			
		Aluminium	Iron	Steel	Copper

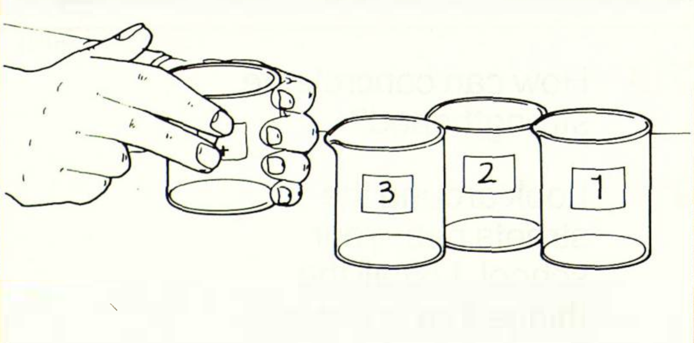
A Put newspaper on the bench. Clean each strip of metal with emery paper.



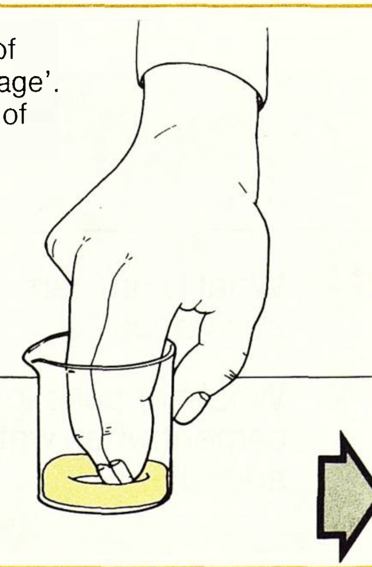
B Label the middle of each strip of metal.



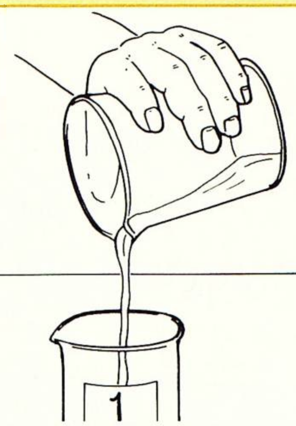
C Label the beakers 1, 2, 3 and 4.



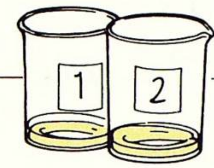
D Roll out a piece of plasticine into a 'sausage'. Put this in the bottom of beaker 1.



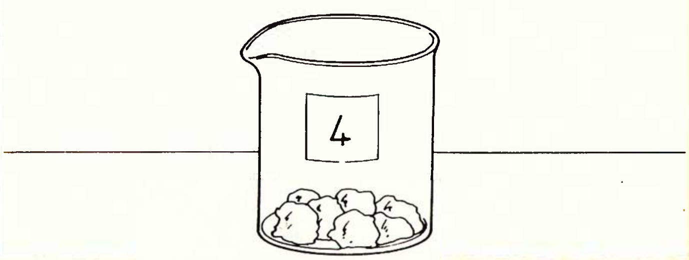
E Pour water into the beaker until it just covers the plasticine.



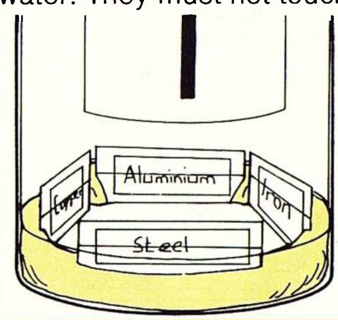
F Repeat step D for beakers 2 and 3. Put sea-water in beaker 2. Put sodium metabisulphite solution in beaker 3.



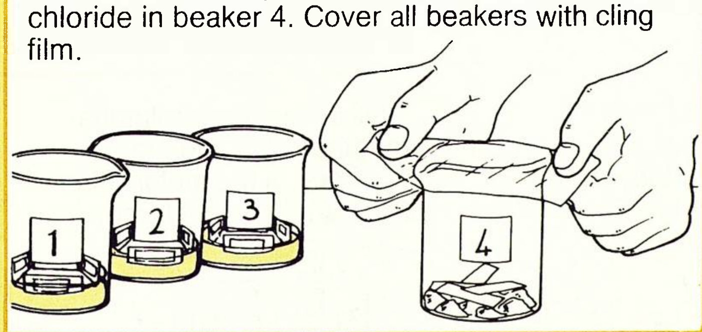
G Put a few lumps of anhydrous calcium chloride in beaker 4. (This chemical will remove water from the air.) Fill in the first 2 columns of your table.



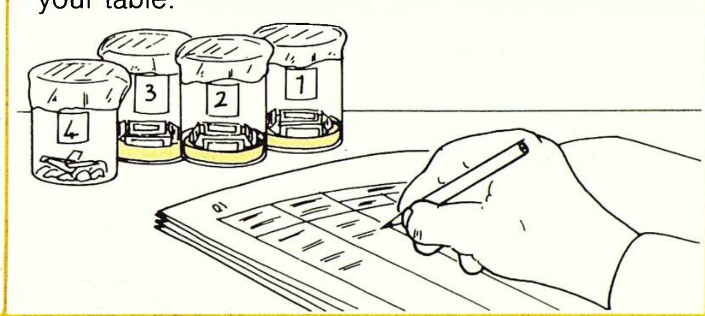
H Put one piece of each metal in the plasticine in beaker 1. The pieces should be half in and half out of the water. They must not touch each other.



I Repeat step H for beakers 2 and 3. Rest the bits of metal on top of the anhydrous calcium chloride in beaker 4. Cover all beakers with cling film.



J Leave the beakers for **at least** one week. Then examine them and write down their appearance in your table.



Q2 Were any of the metals unaffected in the experiment?

Q3 Which metals were damaged by water?

Q4 Which metal could not be used in a building near a beach?

Q5 Why were the beakers sealed with cling film?

Q6 Why was anhydrous calcium chloride used?

Q7 Sodium metabisulphite gives off sulphur dioxide. This is an acidic gas. How were the metals in beaker 3 affected?

Protecting metals

Apparatus

★ 5 iron nails ★ one strip each of zinc, tin, copper and magnesium ★ beaker of salt solution

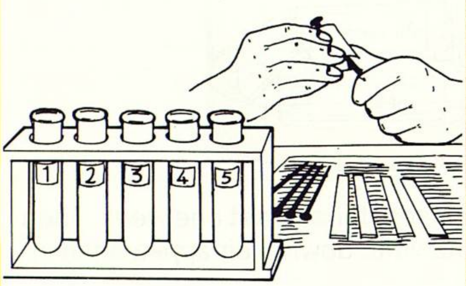
★ 5 boiling tubes ★ test tube rack ★ labels ★ emery paper ★ newspaper

You are going to find out if iron can be protected by joining it to another metal.

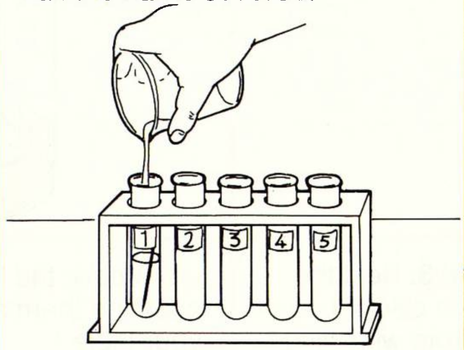
Q8 Copy this table.

Tube number	Metals in tube	Appearance of iron:		Appearance of other metal:	
		after ½ hour	next lesson	after ½ hour	next lesson

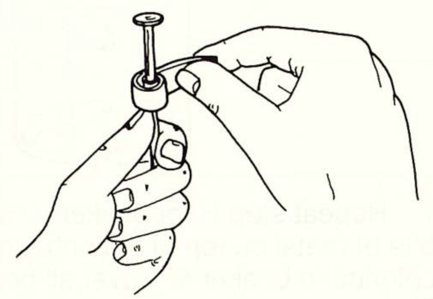
A Label the boiling tubes 1 to 5. Clean all the nails and strips of metal. Use newspaper and emery paper.



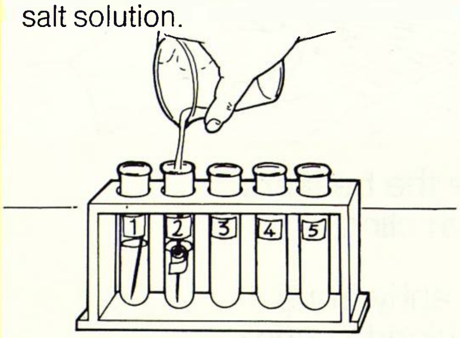
B Put an iron nail in tube 1. Pour in salt solution until about half the nail is covered.



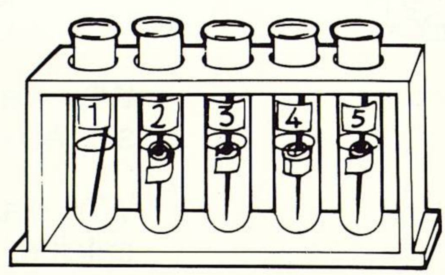
C Wrap the end of the strip of zinc round the middle of a nail. Make sure it is firmly joined. Put this in tube 2.



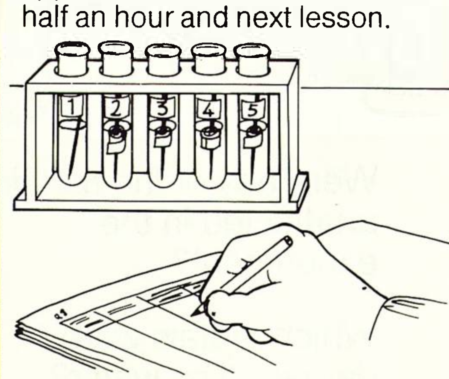
D Pour in salt solution until it just covers the zinc. The end of the nail should be out of the salt solution.



E Repeat steps C and D using different metal strips round each nail. In tube 3 use tin. Use copper in tube 4 and magnesium in tube 5.



F Fill in the first 2 columns of your table. Record the appearance of the metals after half an hour and next lesson.



Q9 Which metals speeded up the rusting of iron?

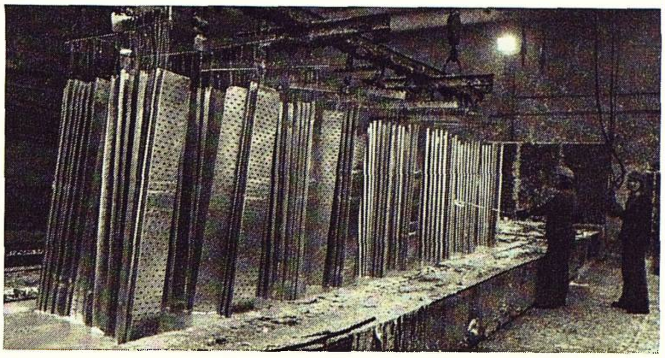
Q10 Which metals slowed down the rusting of iron?

Q11 A tin can is really iron coated with tin. What would happen if the tin was scratched off the iron?

Q12 How could the iron parts of an oil rig at sea be protected?

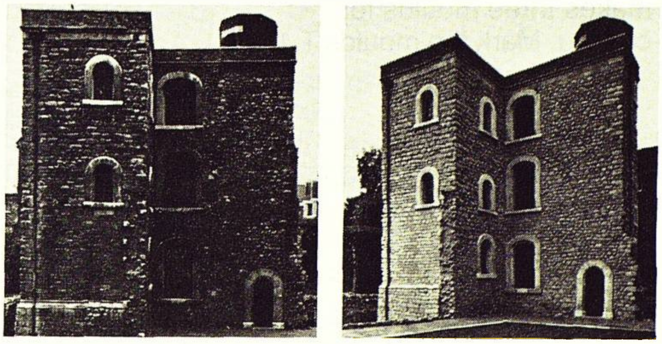
Information: Protecting metals

Metals such as steel, lead and copper are used in buildings. Water and chemicals in the air can **corrode** (damage) these metals. The spray from the sea is very corrosive. Corrosion is not easy to see, and a building may collapse if not checked regularly.



One metal can protect another from corrosion. One common method is **galvanising**. Iron is covered with a thin layer of zinc so the iron is protected. The photo shows iron being lifted out of a bath of zinc.

Metals can be protected by coating (covering) them. Coatings can be special paints, rubber or plastic. Cor-Ten is an unusual steel; in air it is **weathered** and protective rust forms on its surface. This rust stops further corrosion.



The air near factories and in cities may contain dirt and corrosive chemicals. Sulphur dioxide, found in smoke from factory chimneys can damage metal and stone. The photos show the Jewel Tower at the Palace of Westminster before and after cleaning.

Q13 What is corrosion?

Q14 How can metals be protected against corrosion?

Q15 What happens when Cor-Ten steel is weathered?

Q16 Name one chemical found in smoke from factories.

3 Joining metals

Making solder

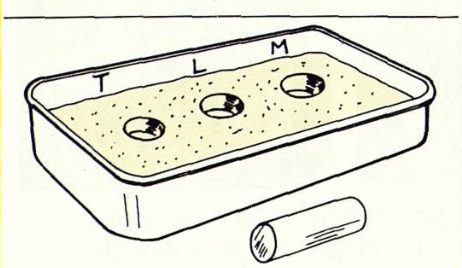
Apparatus

★ 3 silica crucibles ★ pipe-clay triangle ★ tripod ★ heatproof mat ★ Bunsen burner
★ pieces of tin ★ pieces of lead ★ 1 tobacco tin filled with damp sand
★ 1 labelled tin lid with wire hangers ★ 1 piece of wood dowel ★ tongs ★ clampstand
★ balance ★ fume cupboard

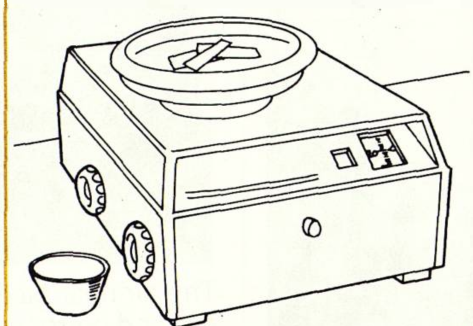
You are going to make **solder** and investigate one of its properties.

Safety glasses must be worn.

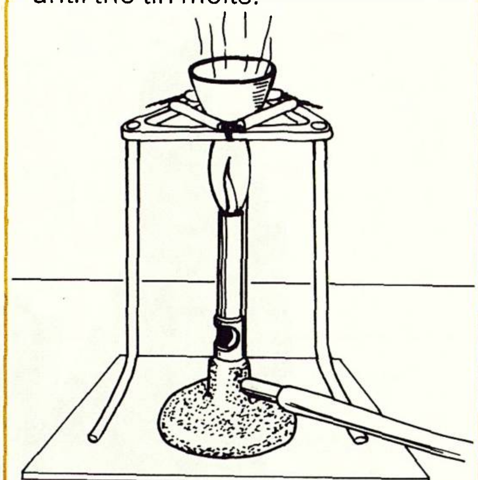
A Push the piece of wood into the damp sand three times, to a depth of 1 cm. This makes three moulds for casting. Mark the moulds T, L,M.



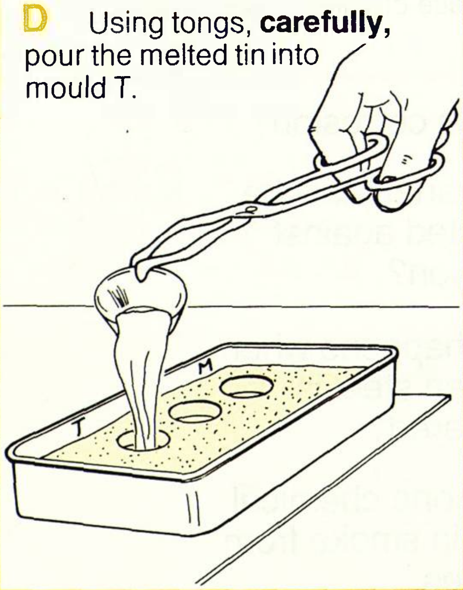
B Weigh out 20 g tin. Put it in a silica crucible.



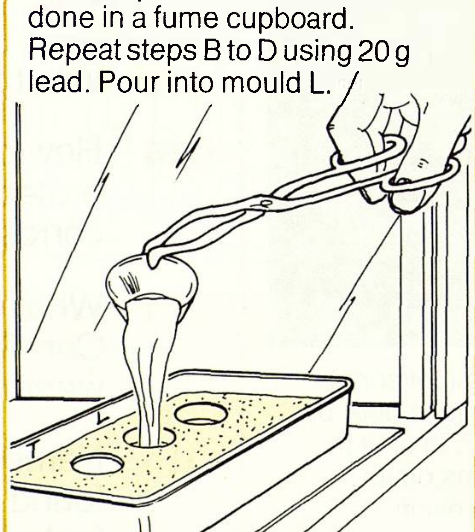
C Put on safety glasses. Heat the crucible strongly until the tin melts.



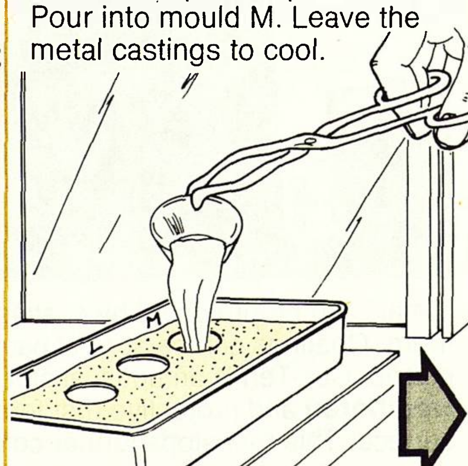
D Using tongs, **carefully,** pour the melted tin into mould T.



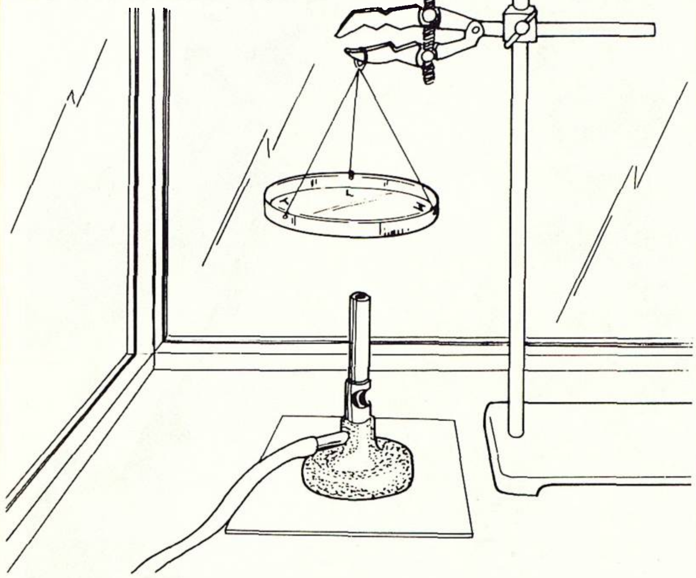
E Steps E and F **must** be done in a fume cupboard. Repeat steps B to D using 20 g lead. Pour into mould L.



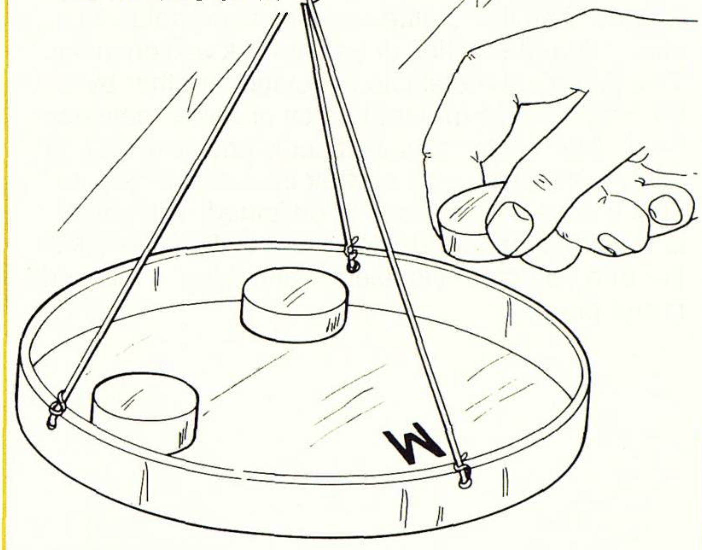
F Weigh out 10 g lead and 10 g tin. Mix them together in a crucible. Repeat steps B to D. Pour into mould M. Leave the metal castings to cool.



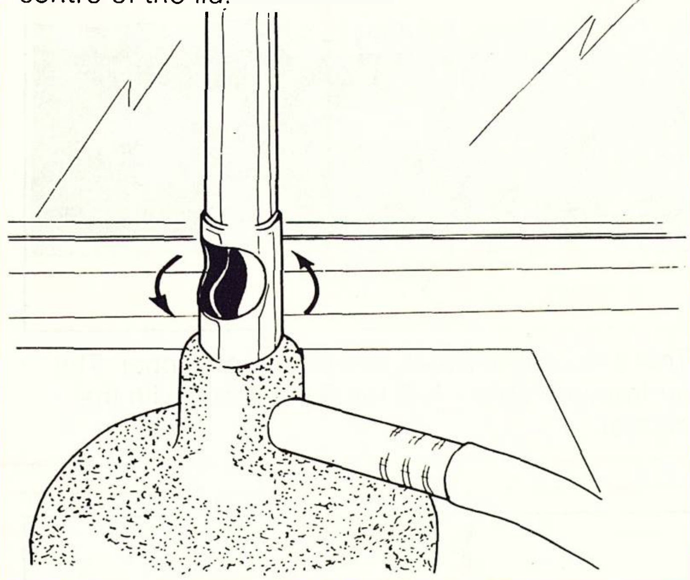
G Meanwhile, hang the tin lid from a clampstand in a fume cupboard. Put the Bunsen burner beneath the lid.



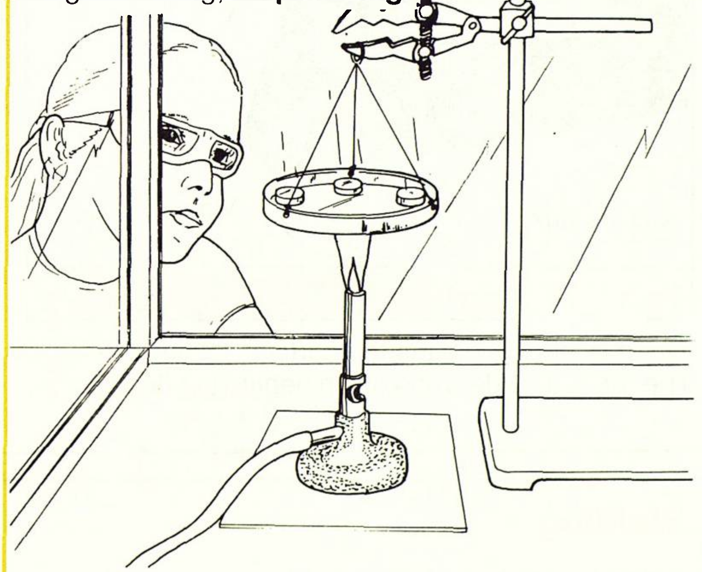
H Put the cold metal castings on the lid. Put:
Lead on L
Tin on T
the mixture on M



I Light the Bunsen burner. Adjust to a normal flame. Make sure the flame is under the centre of the lid.



J Watch the metal castings and note the order in which they melt. As soon as all have begun melting, **stop heating.**



When a mixture of metals is heated together, an alloy is made. The alloy you have made is solder.

Q1 Which metals are in solder?

Q2 What was the order in which the metal castings melted?

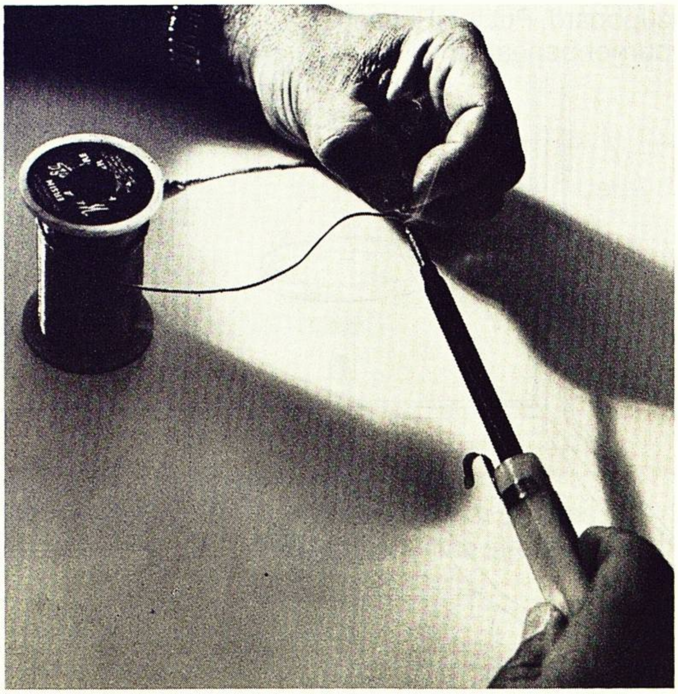
Q3 What was unusual about the melting of solder?

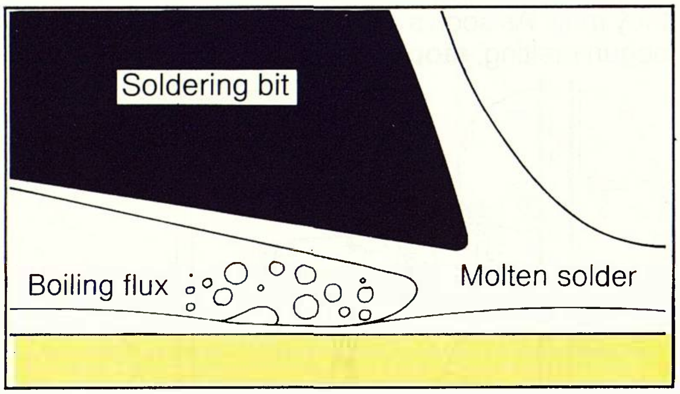
Joining metals

Information: Soldering and welding

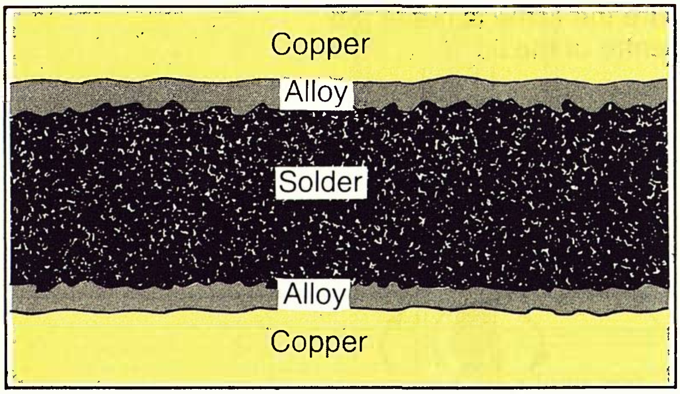
Soldering

When two pieces of wood are joined together, glue is used. The liquid glue sets solid and holds the pieces together. Glue does not work well on metal. Two pieces of metal can be joined together by running **molten** (melted) metal or solder between them. The solder sets as it cools and forms a firm joint. A substance called **flux** is used with solder. Flux cleans the surfaces to be joined. The solder is heated with a **soldering iron**. Soft solder (like the one you made) is used in plumbing to join and mend pipes.





The molten flux cleans the surface of the metal. The melted solder runs down behind the flux.

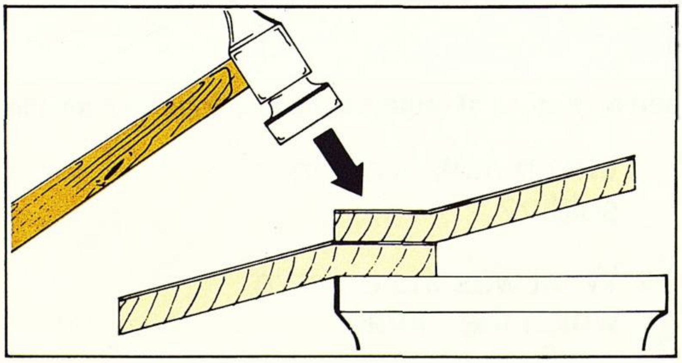


This is a joint between two pieces of copper. The tin from the solder has formed an alloy with the copper.

Welding

When two pieces of metal are joined together with *molten metal of the same kind*, it is known as **welding**.

Some metals, such as gold and lead, are soft enough to be hammered together or **hammer-welded** without being heated.



Most metals need heating before they will weld. The heating can be done by burning a jet of gases – the flame is at 3000°C. Electricity or lasers can also be used to heat the metal.

Large pieces of metal can be welded together. This happens in bridge and crane building.

Q4 What is solder?

Q5 What is flux?

Q6 Why is a soldering iron used?

Q7 Which metals can be hammer-welded?

Q8 What is the difference between soldering and welding?

Q9 Why must a welder wear protective clothes?

4 Bridges

Testing bridge shapes

Apparatus

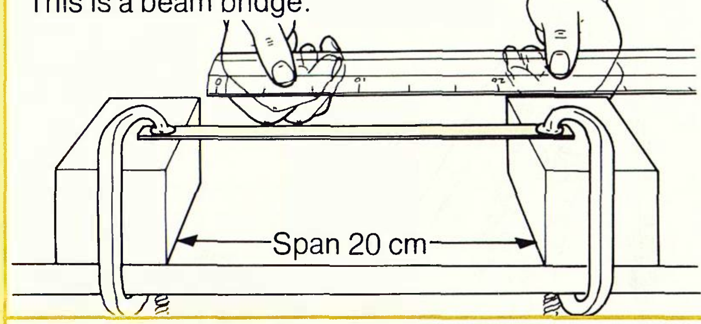
★ balsa wood strips ★ weights ★ 2 wooden blocks ★ 2 G-clamps ★ ruler ★ scissors

You are going to find out how the length and shape of a bridge affects its strength.

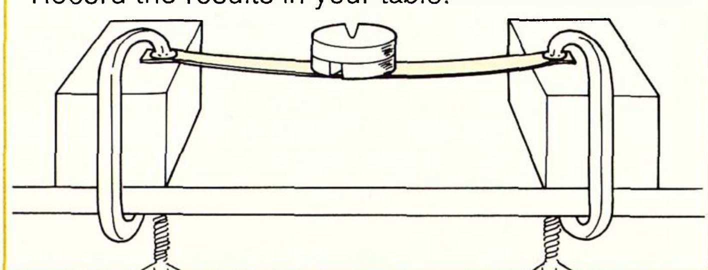
Q1 Copy this table.

Shape of bridge	Span of bridge (cm)	Mass (weight, g) needed to snap bridge

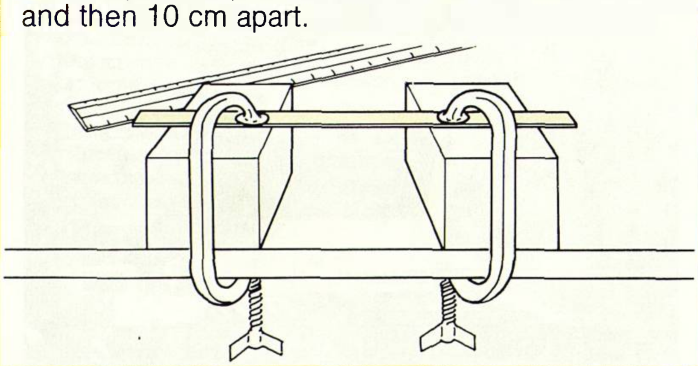
A Put the blocks 20 cm apart on the bench. Put a balsa wood strip across. Secure with G-clamps. This is a beam bridge.



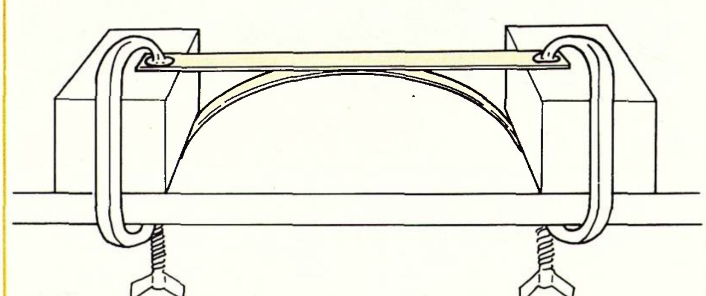
B Carefully add the weights 10 g at a time, until the wood snaps (or touches the bench). The weights must be piled up in the centre of the strip. Record the results in your table.



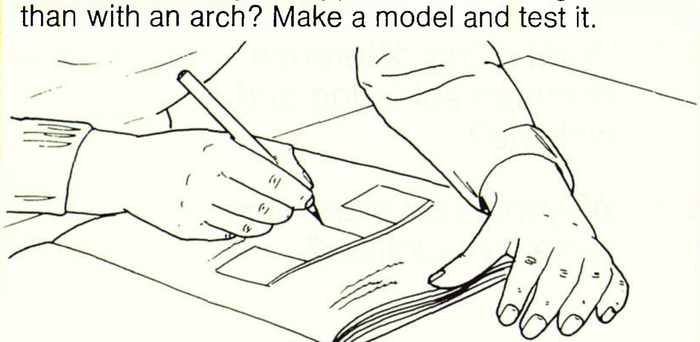
C Repeat steps A and B with the blocks 15 cm and then 10 cm apart.



D Make an arch bridge. Repeat steps A to C.



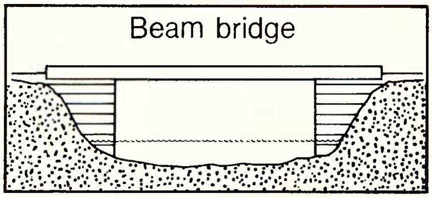
E How could you support a model bridge other than with an arch? Make a model and test it.

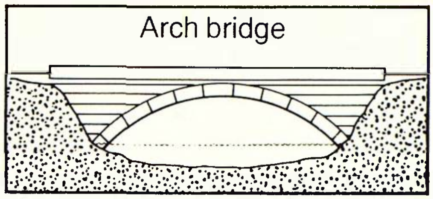


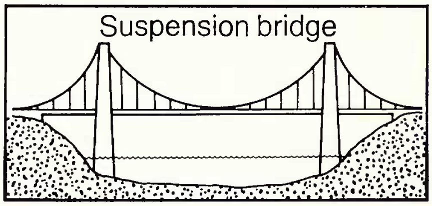
Q2 Is a long span bridge stronger than one with a short span?

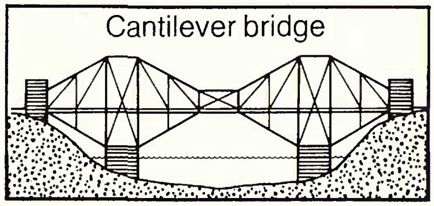
Q3 Is an arch bridge of 20 cm span stronger than a beam bridge of the same span? Why do you think this is?

Information: Bridge shapes

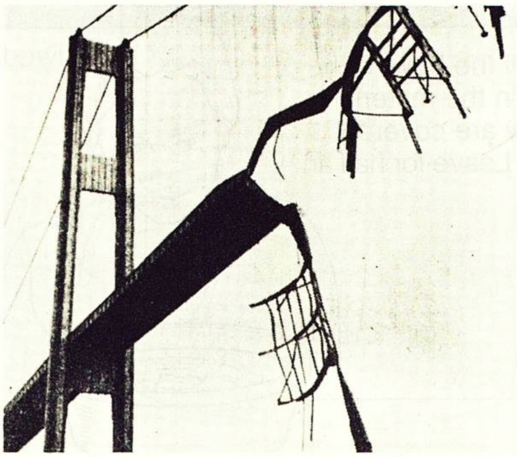




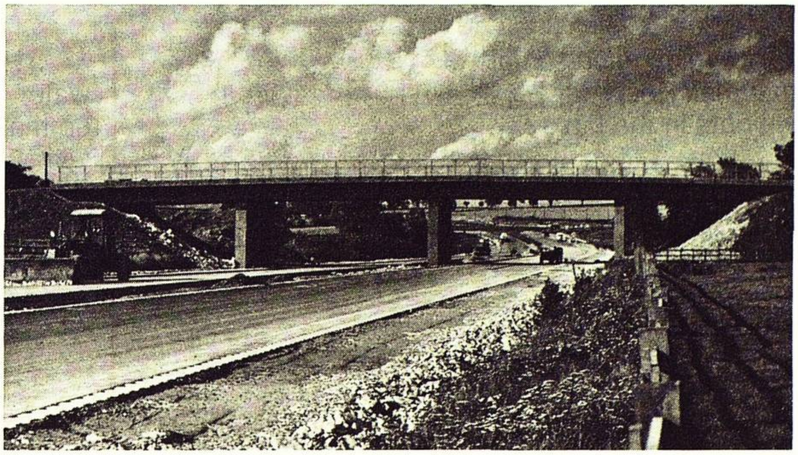




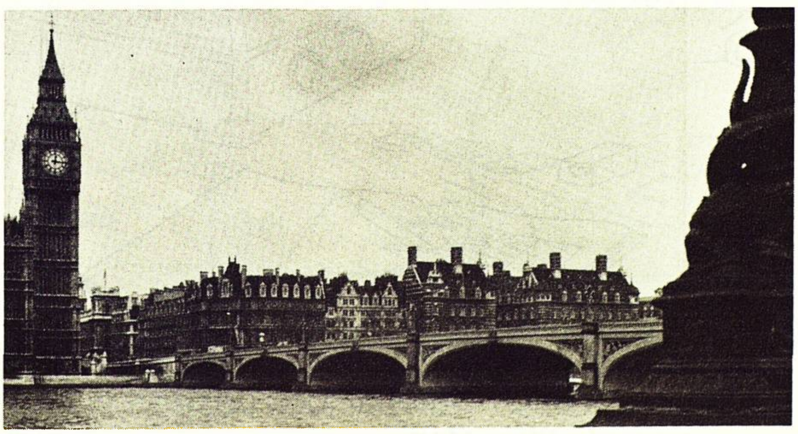
Before a bridge is built, engineers have to study the site, check on conditions such as wind and earth movements, and work out the loads the bridge must carry. They then decide the best method of building. Of the four main types of bridge, the **beam** bridge is most common.



Mistakes can be made. The Tachoma Narrows Bridge collapsed in high winds.



This photo shows a typical beam bridge. The bridge carries a smaller road over the new Stafford by-pass.



Westminster Bridge in London is an **arch** bridge. The distance from one side to the other, or the **span** is quite short.

The Severn Bridge is a **suspension** bridge. It has a span of about 1000 metres.

Q4 What does the 'span' of a bridge mean?

Q5 What type of bridge is the Severn Bridge?

5 Water and building materials

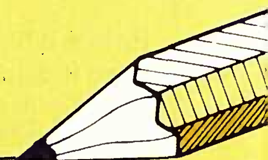
Uptake of water

Apparatus

★ samples of wood, brick, chipboard, plasterboard, slate, pantile ★ newspaper

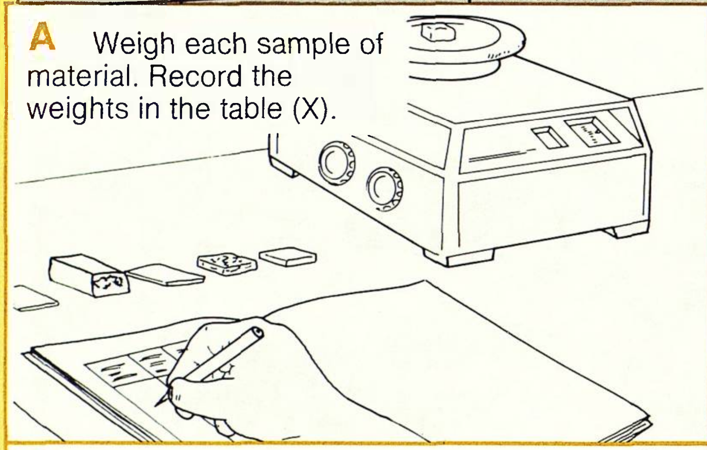
★ small sieve ★ plastic mixing bowl ★ balance

You are going to find out how much water is **absorbed** (taken in) by building materials.

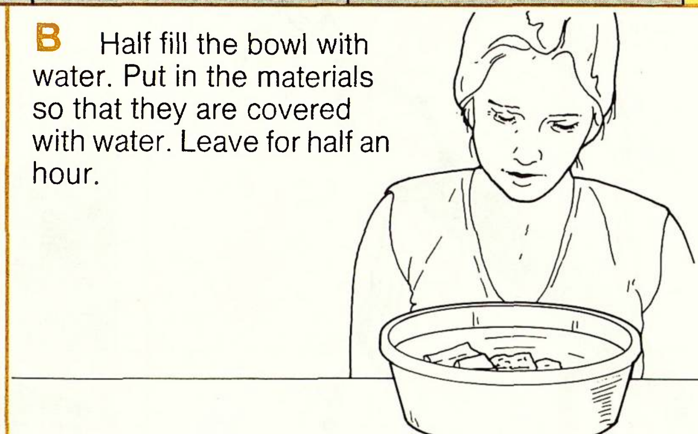


Q1 Copy this table.

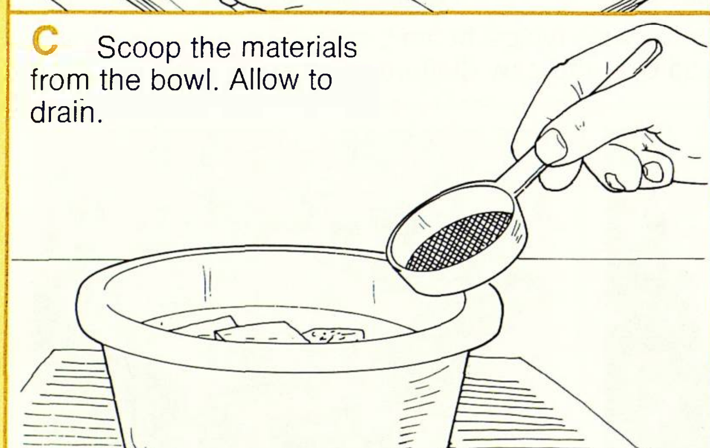
Name of material	Mass (weight, g) before soaking (X)	Mass (weight, g) after soaking (Y)	Mass (weight, g) of water absorbed (Z = Y − X)	Percentage of water absorbed ($\frac{Z}{X} \times 100$)



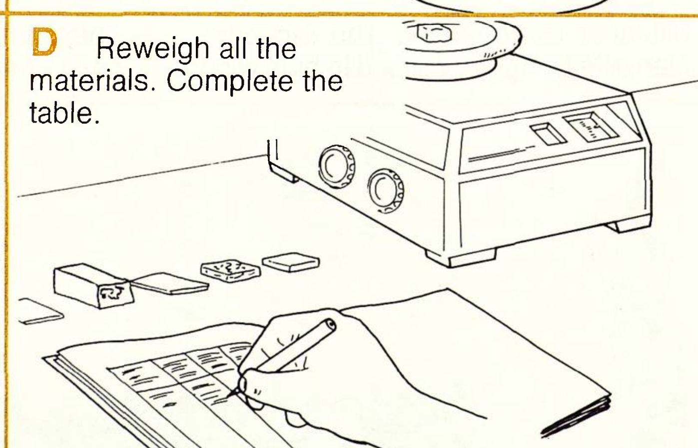
A Weigh each sample of material. Record the weights in the table (X).



B Half fill the bowl with water. Put in the materials so that they are covered with water. Leave for half an hour.



C Scoop the materials from the bowl. Allow to drain.



D Reweigh all the materials. Complete the table.

Q2 Why did you work out the **percentage** of water taken up?

Q3 Which material took up most water?

Q4 Which material took up least water?

Q5 Which materials could **not** be used to protect the outside of a house of a house from rain?

Water and bricks

Apparatus

★ ten half-bricks ★ large plastic bowl ★ jug ★ ruler

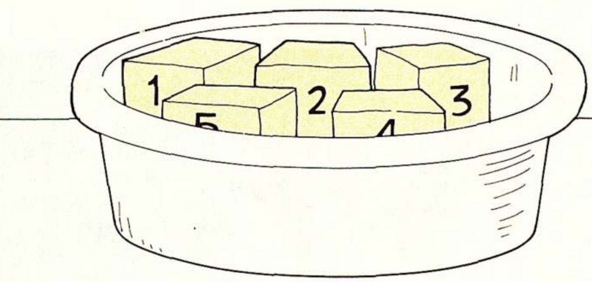
★ one sheet each of lead, polythene, felt and bitumen felt ★ wax pencil

You are going to find out how quickly water rises up bricks and if the movement can be stopped.

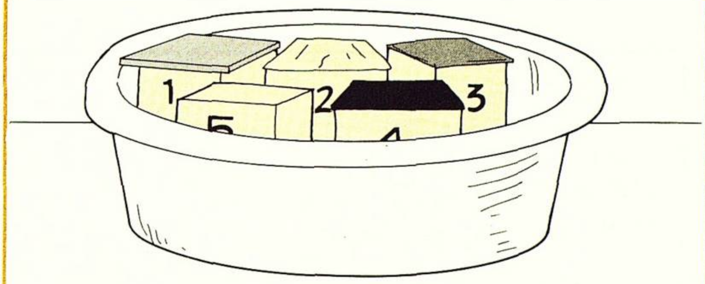
Q6 Copy this table.

Brick pair number	Material between bricks	Height (cm) of water in brick:	
		at end of lesson	after 24 hours

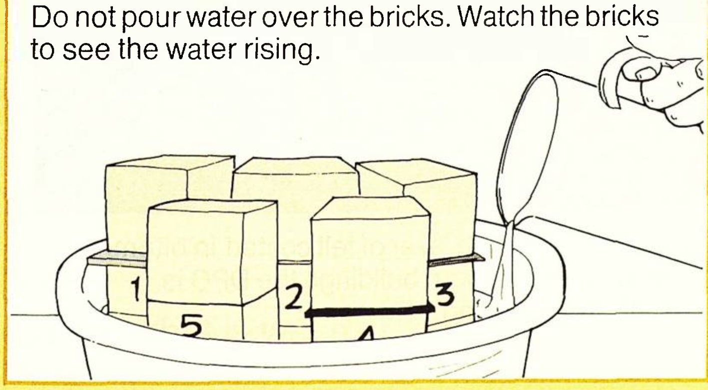
A Label 5 half-bricks 1 to 5. Put the bricks in a bowl.



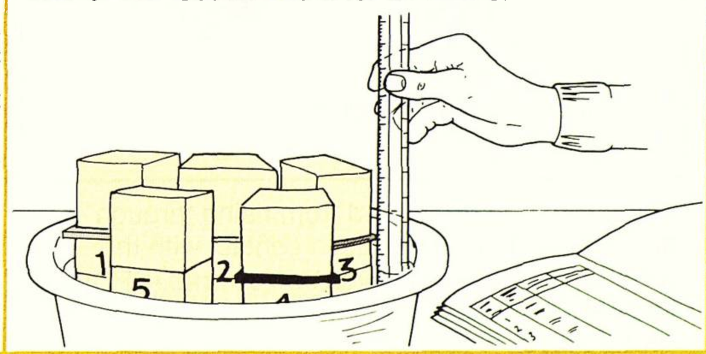
B Put a sheet of lead on brick 1. Cover brick 2 with polythene, brick 3 with felt, and brick 4 with bitumen felt. Leave brick 5 uncovered.



C Put a second half-brick on top of each of the 5 bricks. Pour water into the bowl to a depth of 2 cm. Do not pour water over the bricks. Watch the bricks to see the water rising.



D Fill in the first 2 columns of your table. Measure the height the water has reached at the end of the lesson and after 24 hours.



Q7 In which brick pair did the water rise most?

Q8 Explain what happened in the brick pairs 1 to 4.

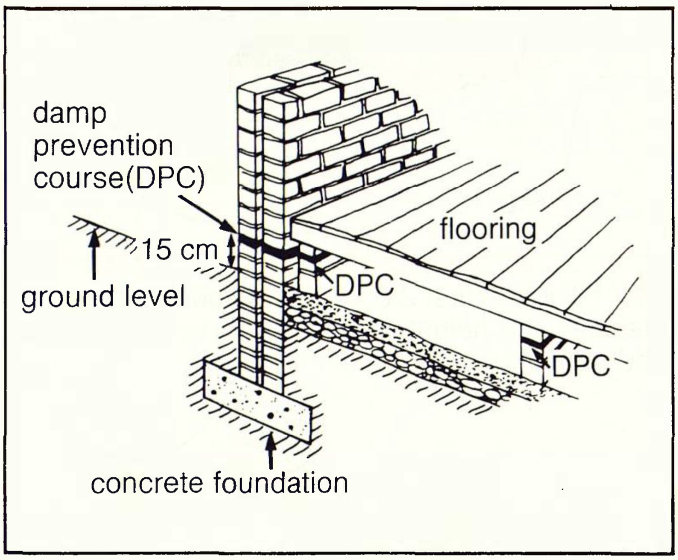
Q9 What might happen to a brick house built on very wet soil?

Q10 Suggest ways of stopping damp rising in a brick house.

Information: Damp and its prevention

Water can pass through building materials and make the building damp. When houses are damp, living organisms start to feed on the materials and make them **rot**. The wood in the picture has been damaged by **wet rot**.

Damp prevention course

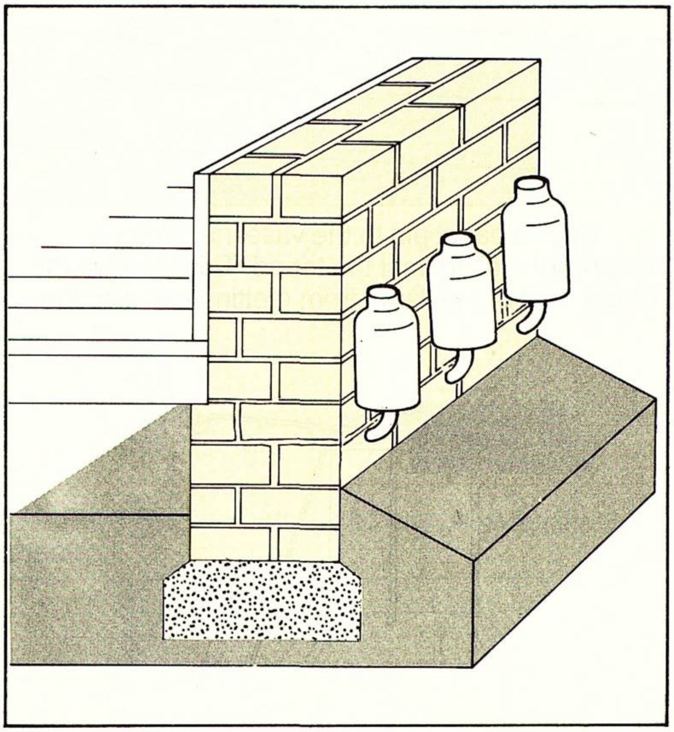


Water must be prevented from rising through bricks and other materials in contact with the ground. So a **damp prevention course** (DPC) is laid between bricks and timbers 15 cm above ground level.

In older buildings a layer of felt coated in bitumen was used. In modern buildings the DPC is polythene sheeting.

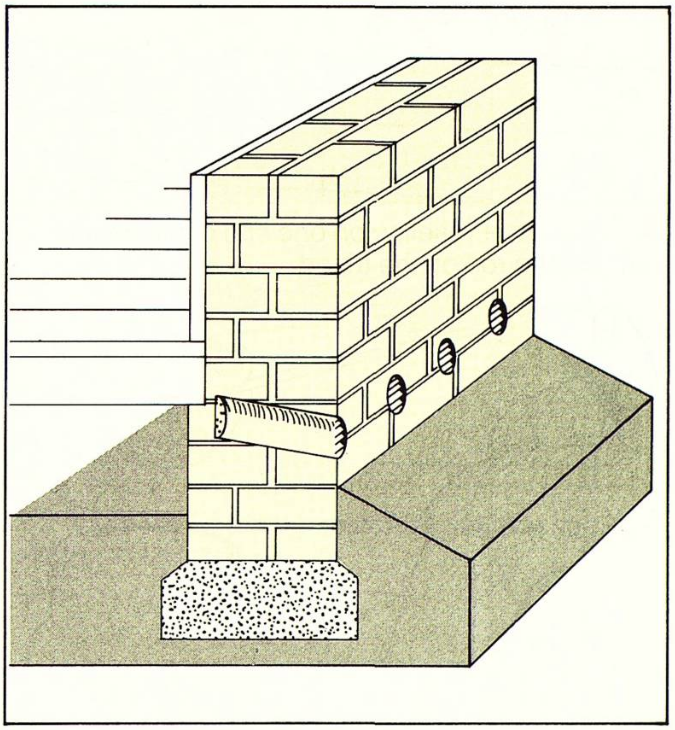
The building materials of a house can be seriously damaged by damp. Rotten wood is very weak. This could lead to the collapse of floors and ceilings. If the walls of a house become damp, the wallpaper and plaster may fall off. A damp house is uncomfortable to live in. For these reasons damp-prevention is important in building. Two more ways are shown below.

Silicone penetration



Holes are drilled along the wall at DPC level. The holes are 23 cm apart. A waterproof liquid is poured into the holes from small bottles fitted to the holes. The liquid is silicone-latex solution which becomes a DPC when it sets.

Syphonage



Hollow pipes about 5 cm across are put into holes drilled in the wall. The pipes are fitted so they slope. Rising moisture reaches the pipes and is dried out by the flow of air.

Q11 What is wet rot?

Q12 What does DPC stand for?

Q13 Where is a DPC found?

Q14 What is the 'DPC level'?

Q15 What can be used as a DPC in houses that are damp?

Q16 Try to find other ways in which dampness can be treated.

6 Heat loss and gain

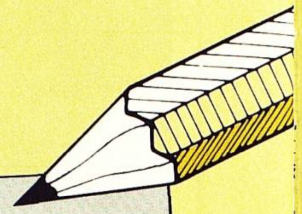
Heat travelling through materials

Apparatus

★ Bunsen burner ★ 2 heatproof mats ★ vaseline ★ tripod

★ 5 panel pins ★ 1 rod each of copper, brass, iron, glass, aluminium

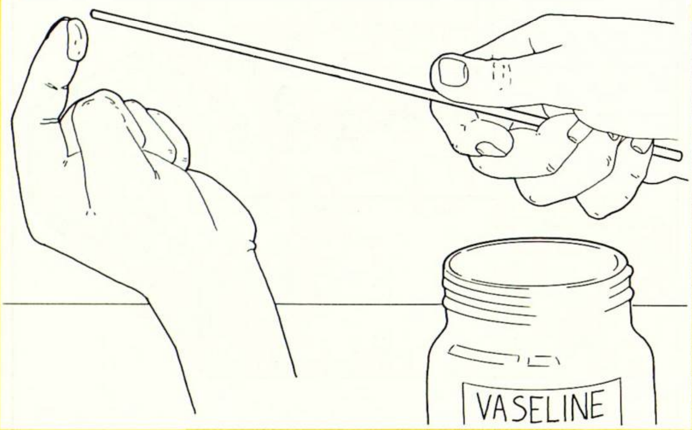
You are going to find out which materials let heat go through them easily.



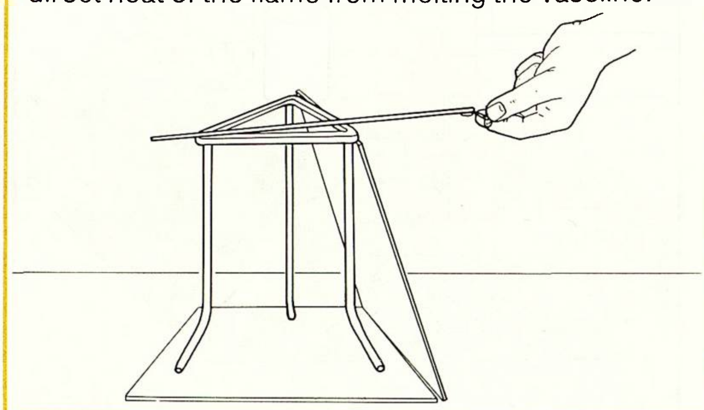
Q1 Copy this table.

Rod	Order of melting
Copper	

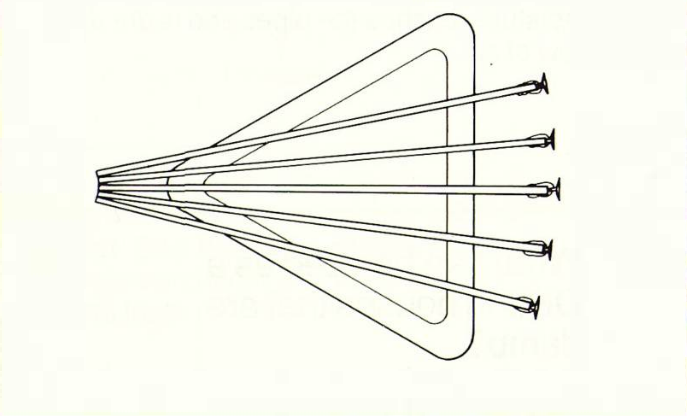
A Put some vaseline on one end of the copper rod. Put the rod on the tripod.



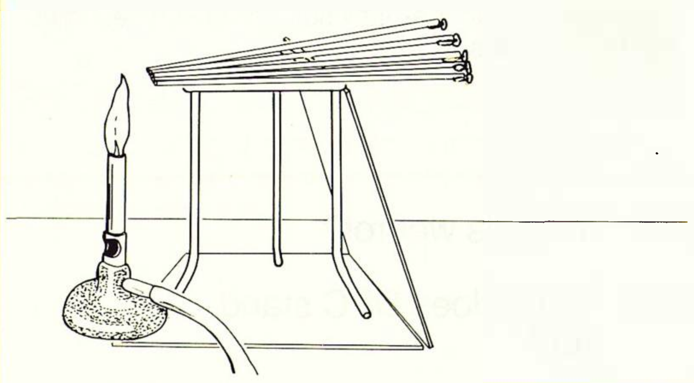
B Stick a panel pin to the vaseline. Place a heatproof mat against the tripod. This will stop the direct heat of the flame from melting the vaseline.



C Repeat steps A and B for the other rods. Place the ends of the rods close together.



D Put a bunsen with a wide flame under the rods. When the heat reaches the vaseline it will melt. Record the order of melting.



Materials which let heat through them easily are good conductors of heat. Materials which do not let heat through easily are good insulators.

Q2 Which material was the best conductor?

Q3 Which material was the best insulator?

Energy and surfaces

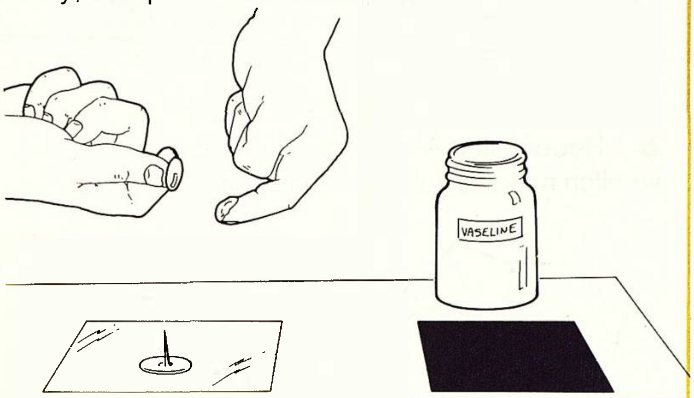
Apparatus

★ one sheet each of shiny metal and black-painted metal ★ 2 drawing pins ★ ruler

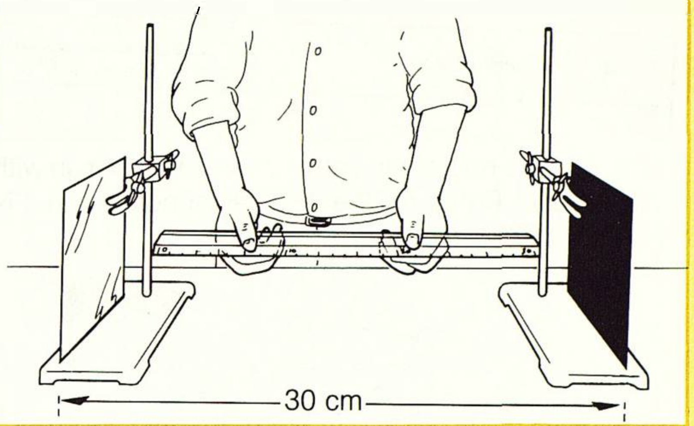
★ candle ★ 2 clampstands ★ Bunsen burner ★ heatproof mat

You are going to find out if a black surface absorbs heat better than a shiny surface.

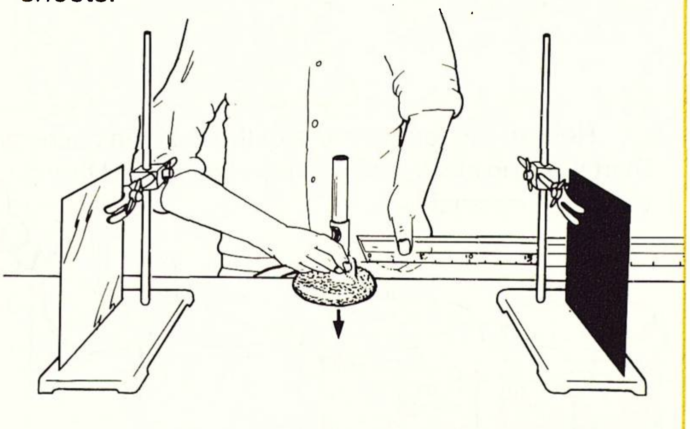
A Put vaseline onto one drawing pin. Fix the pin in the centre of the sheet of shiny metal. In the same way, fix a pin to the black sheet.



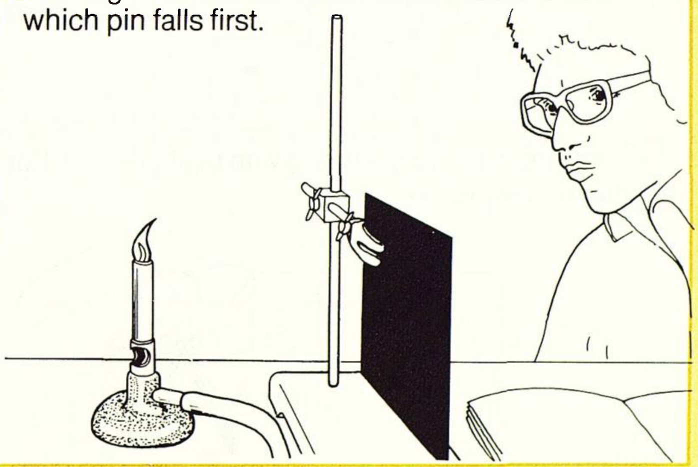
B Clamp the 2 sheets of metal 30 cm apart. The pins must be on the outside surfaces.



C Put a Bunsen burner half way between the 2 sheets.



D Light the Bunsen burner and watch to see which pin falls first.



Q4 When the pin fell off, what must have happened to the vaseline?

Q5 From which sheet did the pin fall first?

Q6 Why do you think the pin fell from this sheet first?

Q7 Why do electric fires have shiny metal behind them?

Q8 When a laboratory is 'blacked-out' on a hot sunny day, it gets very hot inside. Why does this happen?

Keeping the heat in

Apparatus

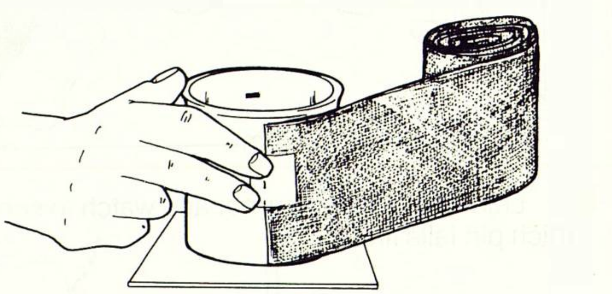
- ★ 3 metal cans
- ★ 3 thermometers each in a polystyrene lid
- ★ 3 heatproof mats
- ★ sticky tape
- ★ thin cotton material
- ★ woollen material
- ★ stop clock
- ★ kettle of boiling water

You are going to find out if some materials can stop heat leaving water.

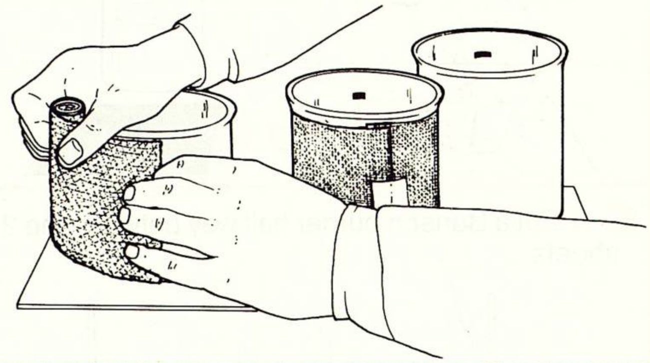
Q9 Copy this table.

Material covering can	Temperature (°C)	
	at start	after 20 minutes

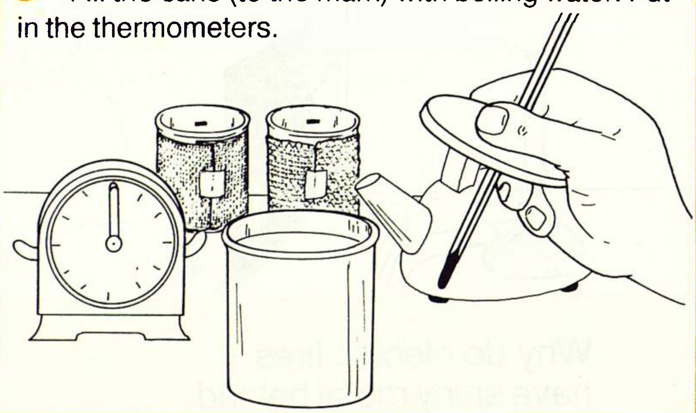
A Fix one end of the cotton material to the can with sticky tape. Tightly roll the material round the can. Fix the other end with tape.



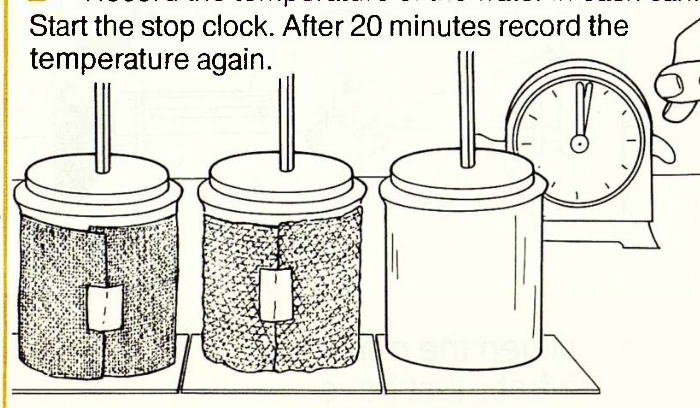
B Repeat step A with the second can and the woollen material. Leave the third can uncovered.



C Fill the cans (to the mark) with boiling water. Put in the thermometers.



D Record the temperature of the water in each can. Start the stop clock. After 20 minutes record the temperature again.



Materials which reduce (slow down) heat loss are insulators.

Q10 Were the wrapping materials insulators?

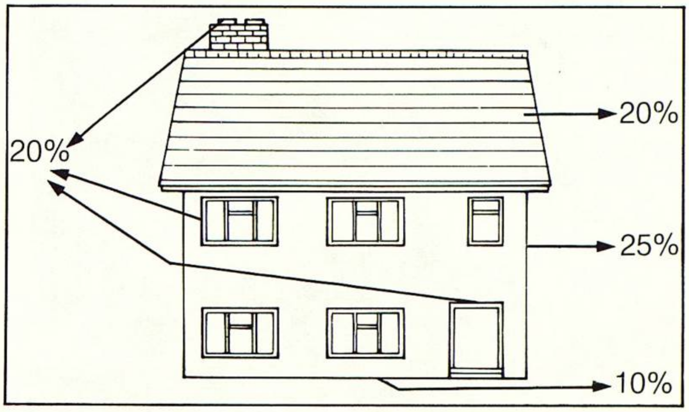
Q11 Which was the best insulator?

Q12 Which of the 3 cans conducted most heat away?

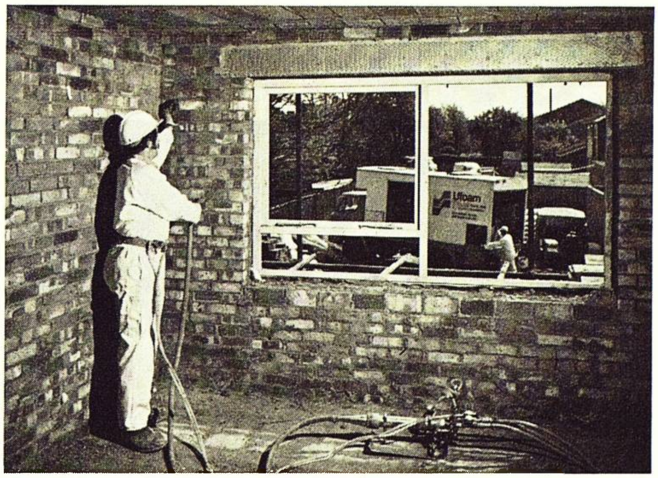
Q13 Which material would you use to insulate under a floor? Give reasons for your answer.

Information: Insulating houses

Houses and other buildings are heated during the winter months. Up to 75% of this heat can be lost if the house is badly insulated. The picture shows where the heat from the house is lost.

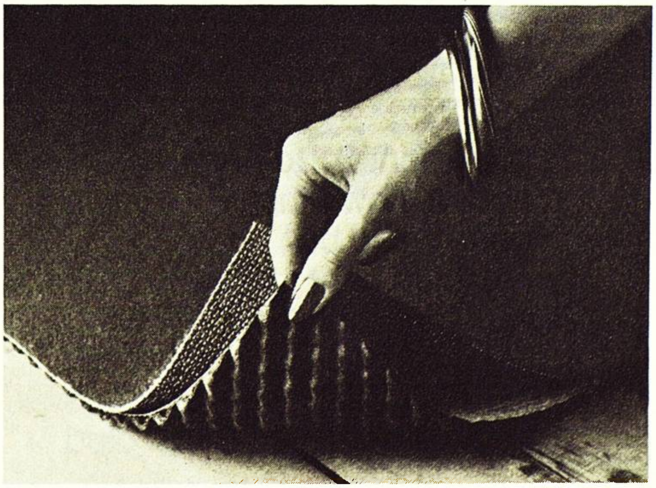


Heat loss from the windows can be reduced by fitting two layers of glass with a small air-gap between the layers. This is **double-glazing**.



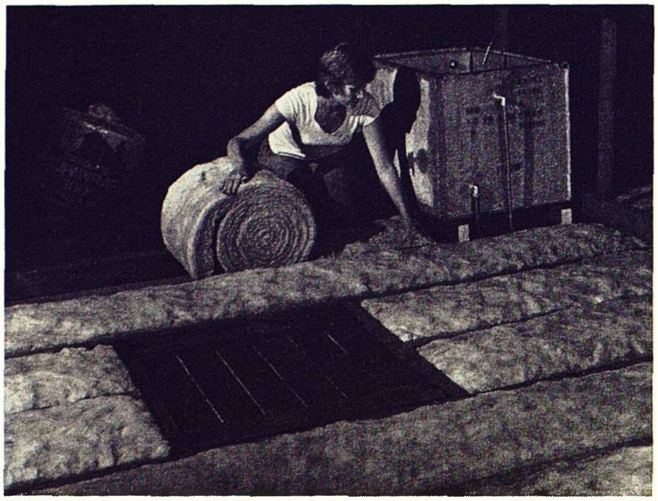
Cavity-wall insulation stops heat escaping through walls Here foam is being injected into the space between the 2 layers of bricks.

New houses can have **under-floor insulation.** This is a layer of polystyrene foam covered by chipboard.

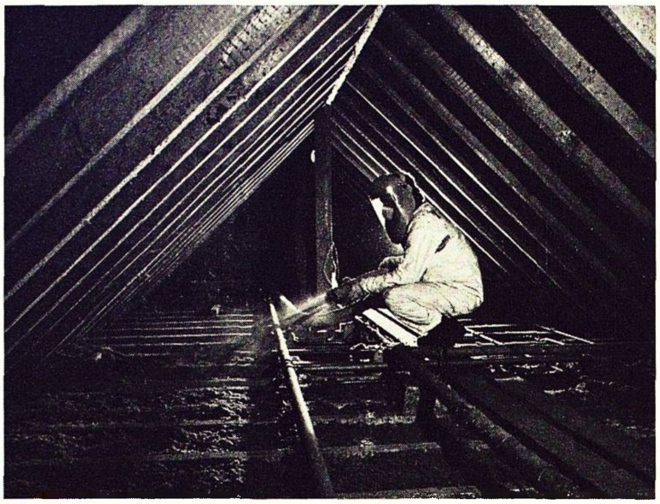


A carpet with good **underlay** beneath it will also cut down heat loss through the floor.

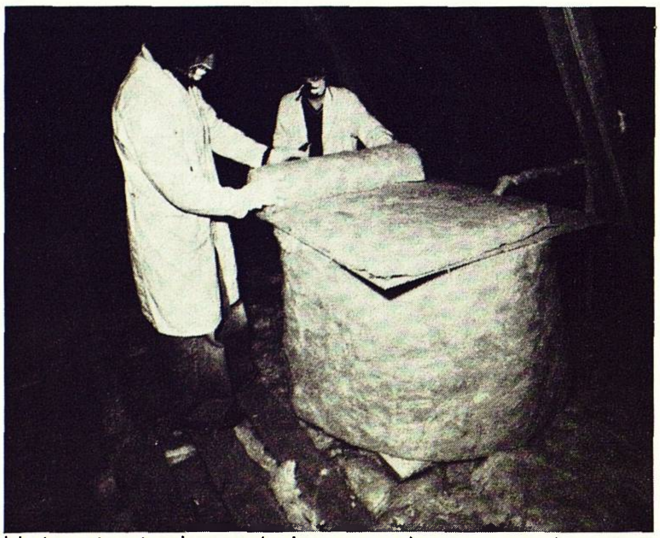
Heat loss and gain



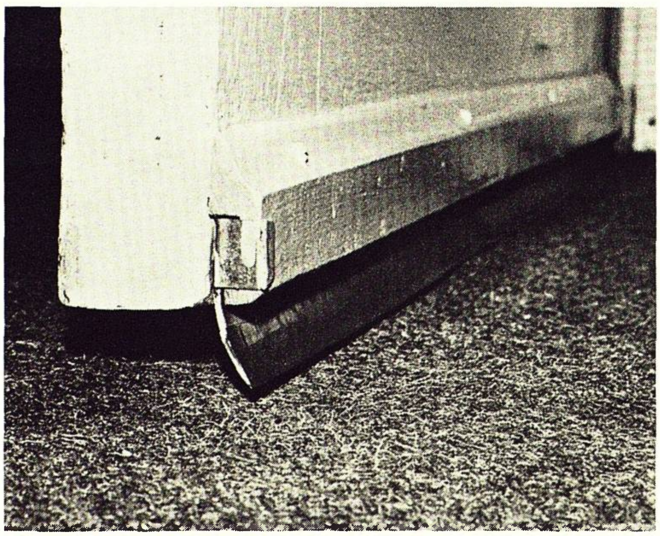
Different materials can be used to stop heat loss through roofs. Here glass fibre is being laid.



This photo shows mineral fibre being 'blown' into place.



Hot water tanks and pipes can be wrapped to **conserve** (save) heat. This is called **lagging.**



Heat can escape through the gaps round a closed door. A **draught-excluder** will help prevent this.

Q14 If you spent £1 to heat a house, how much money could be wasted on heat lost through the roof?

Q15 What is double-glazing?

Q16 How can heat loss through walls be reduced?

Q17 What material would you use to insulate a loft? Give reasons for your answer.

Q18 List all the ways of conserving heat that could be built into a new house.

7 Solar energy

Trapping light energy

Apparatus

★ solar cell ★ ammeter ★ ruler ★ light source ★ electric motor

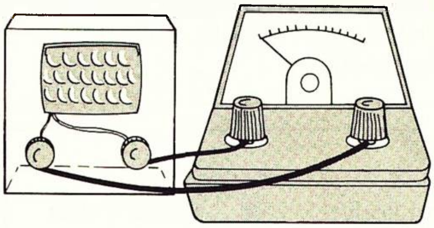
★ 2 wire connectors

You are going to find out if light energy can be changed into other forms of energy.

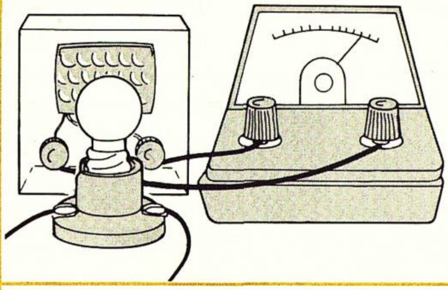
Q1 Copy this table.

Distance of solar cell from light bulb (cm)	Reading on ammeter

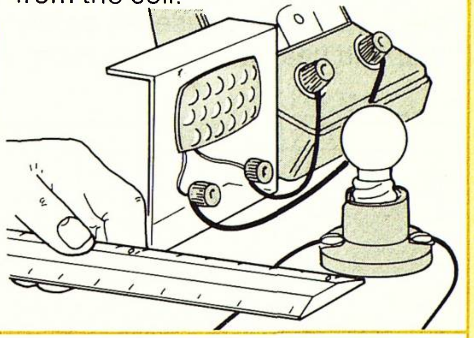
A Connect the solar cell to the ammeter.



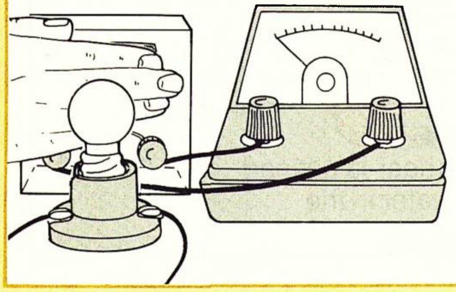
B Put the light bulb next to the solar cell. Turn on the light. Record the reading on the ammeter.



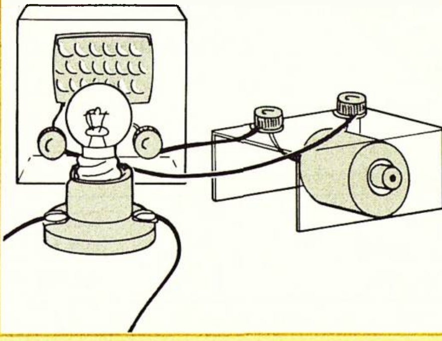
C Repeat step B with the bulb 5, 10, 20 and 40 cm away from the cell.



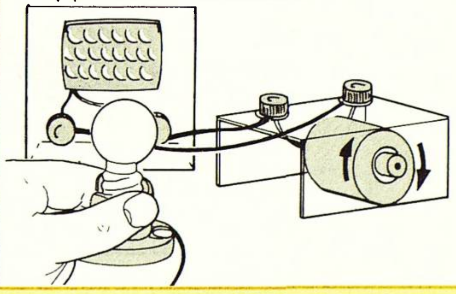
D Record the reading on the ammeter when the solar cell is covered by your hand. Disconnect the apparatus.



E Now connect the solar cell to the motor.



F Move the lighted bulb towards and away from the solar cell. Record what happens to the motor.



Q2 What other types of energy was light energy changed into in these experiments?

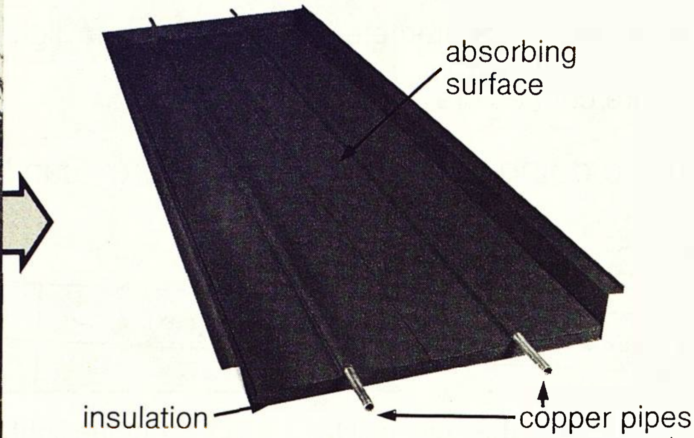
Q3 What was the reading on the ammeter when you covered the solar cell with your hand?

Q4 What was the link between the reading on the ammeter and the distance of the light bulb from the solar cell?

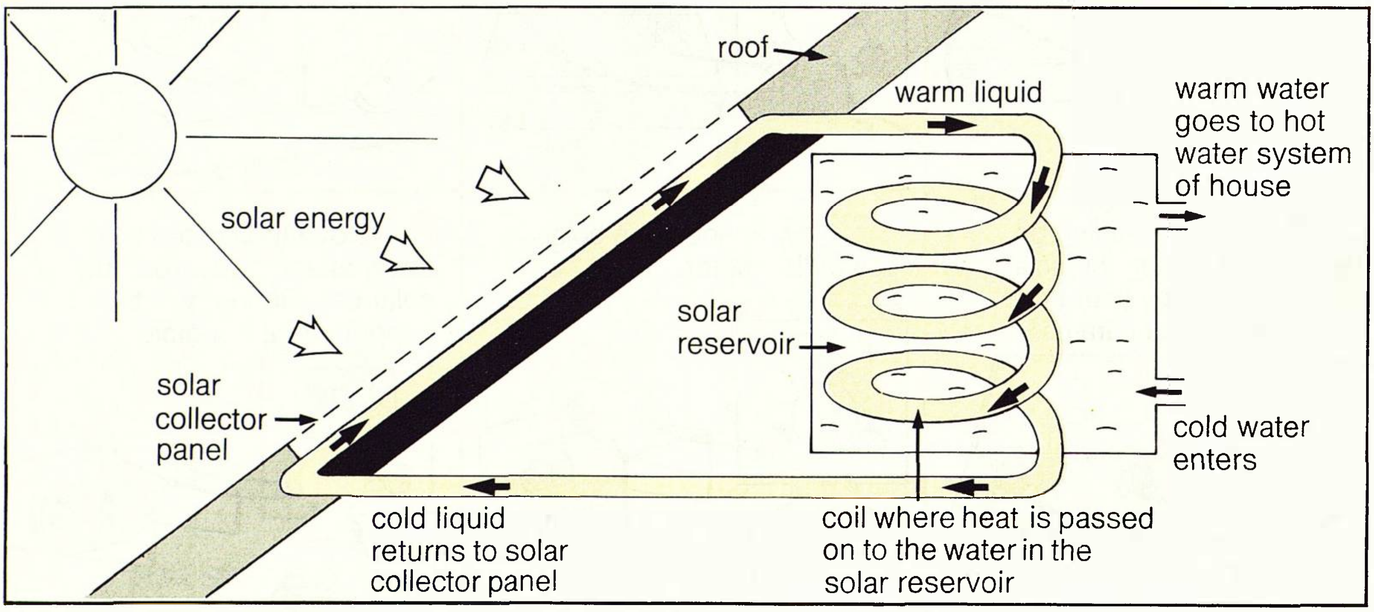
Q5 If we could trap light energy from the sun, how could we use it?

Information: Solar houses

When **solar energy** or light energy from the sun falls on a black object, it is absorbed and becomes heat. In a solar house the **solar collector panels** trap the heat and use it to warm water.



The glass cover has been removed from this solar collector panel. The absorbing surface is black. The base is an insulating layer of hard foam. Copper pipes carry the liquid. Solar collector panels should face south.



The liquid travels slowly round and round. It absorbs heat in the panel and gives up the heat in the solar reservoir. The liquid is a very thin oil or water mixed with anti-freeze. The warm water produced must be heated some more, but even so fuel is saved.

Q6 What is solar energy?

Q7 Why is the absorbing surface black? (Hint: look at page 23)

Q8 How can solar energy be used to heat water?

Q9 What is the disadvantage of relying on the sun for energy?

8 Plastics

Testing plastics with light

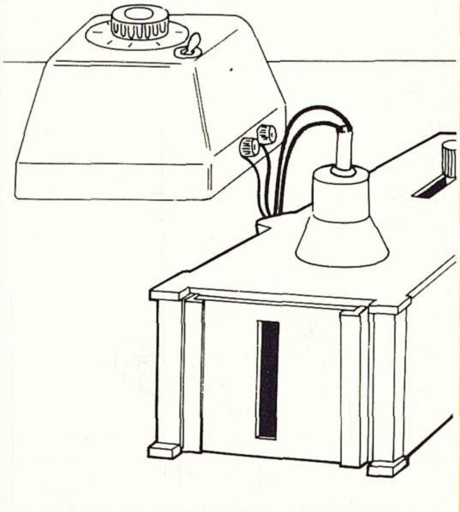
Apparatus

★ low voltage d.c. power supply ★ 2 wooden clamps ★ corrugated plastic ★ mica

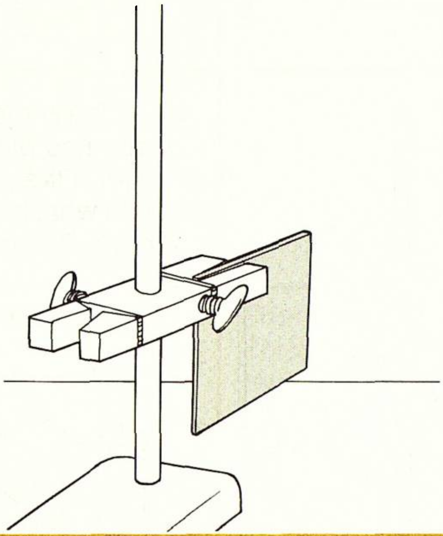
★ white card screen ★ 2 polaroids ★ lamp in lightbox ★ rule ★ base clamp

You are going to find out how stress in plastic can be shown by using **polarised light.**

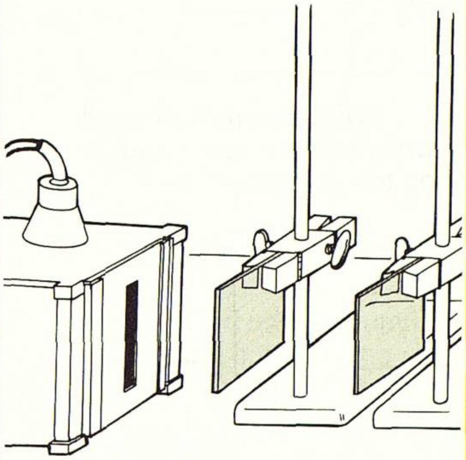
A Connect the lamp to the low voltage power supply.



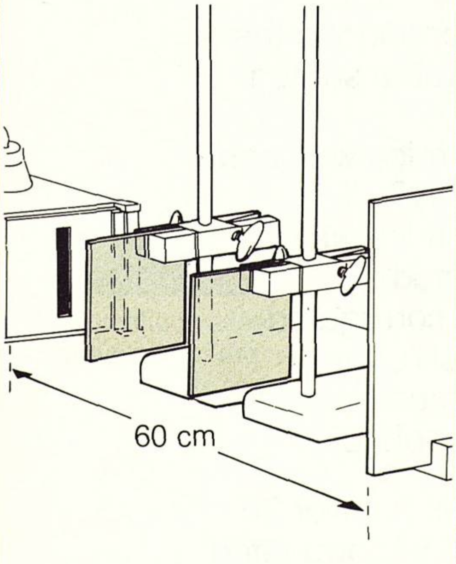
B Fix the polaroids into the wooden clamps. Ask your teacher to 'cross' the polaroids.



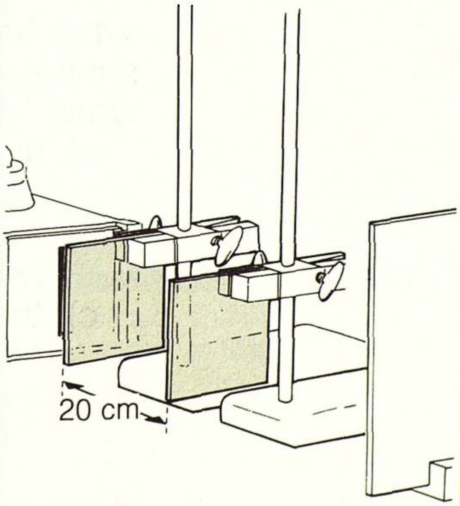
C Adjust the height of the polaroids, so that they and the lamp are in line.



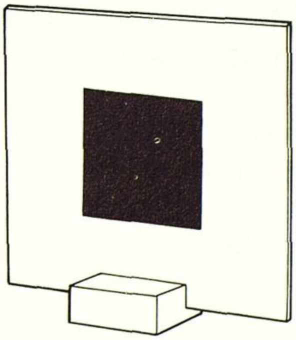
D Put the screen 60 cm away from the light source.



E Put one polaroid near the lamp. Put the second about 20 cm away.

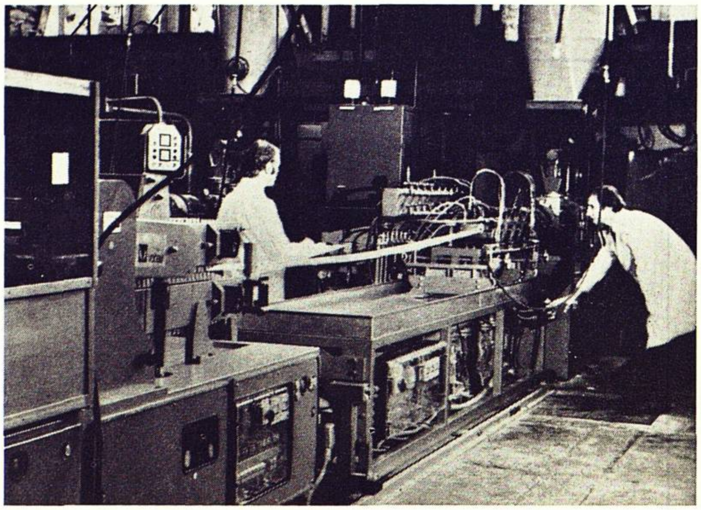


F Turn on the light. Move the second polaroid until there is a sharp square on the screen. Record the colour of the square.



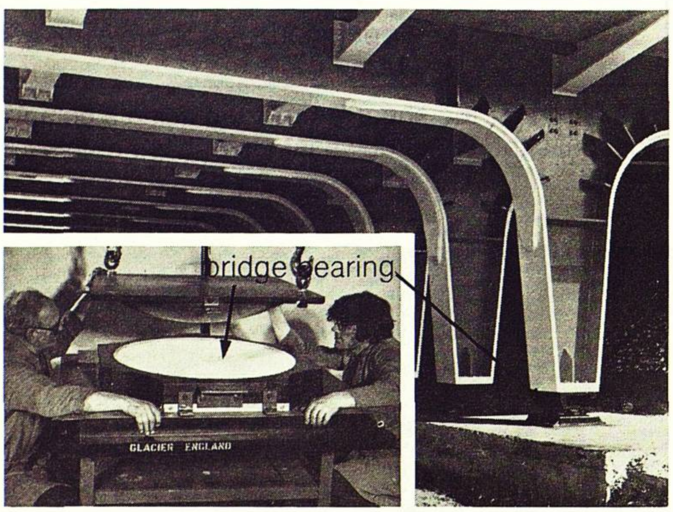
Plastics

Making plastic tubing

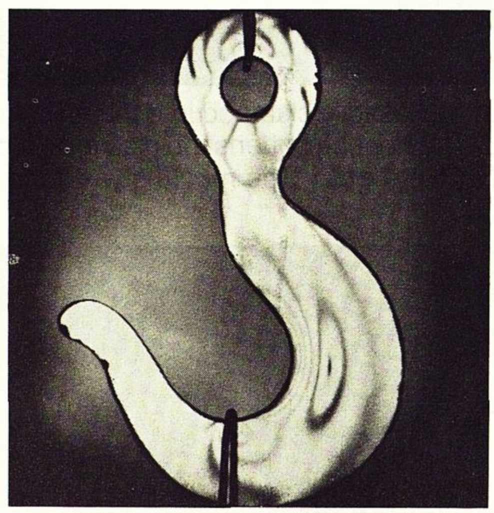


Plastic tubing is made by **extrusion**. The plastic is heated, squeezed through a nozzle of the right shape and then cooled. Pipes, the plastic covering for wires and curtain rails can all be made by extrusion.

Plastics and stress



A bridge **expands** (gets bigger) as it warms up during the day. It may also carry enormous loads. These forces put the bridge under great **stress**. It could bend or snap if fixed firmly to the ground. So bridge bearings coated with PTFE are used. The bridge can slide over this strong, smooth plastic as it expands. A ceiling made from PTFE would be too slippery for a fly to land on and PTFE can be used to line 'non-stick' pans.



The **stress patterns** in the hook above are caused by the weight hanging from it. They show up when polarised light is shone through the plastic. The stressed areas of a bridge can be discovered by making a plastic model of it and testing with polarised light.

Q8 Name one plastic item made by extrusion.

Q9 Give 2 uses for PTFE.

Q10 Look around the laboratory or your home. List all the things made from plastic.

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