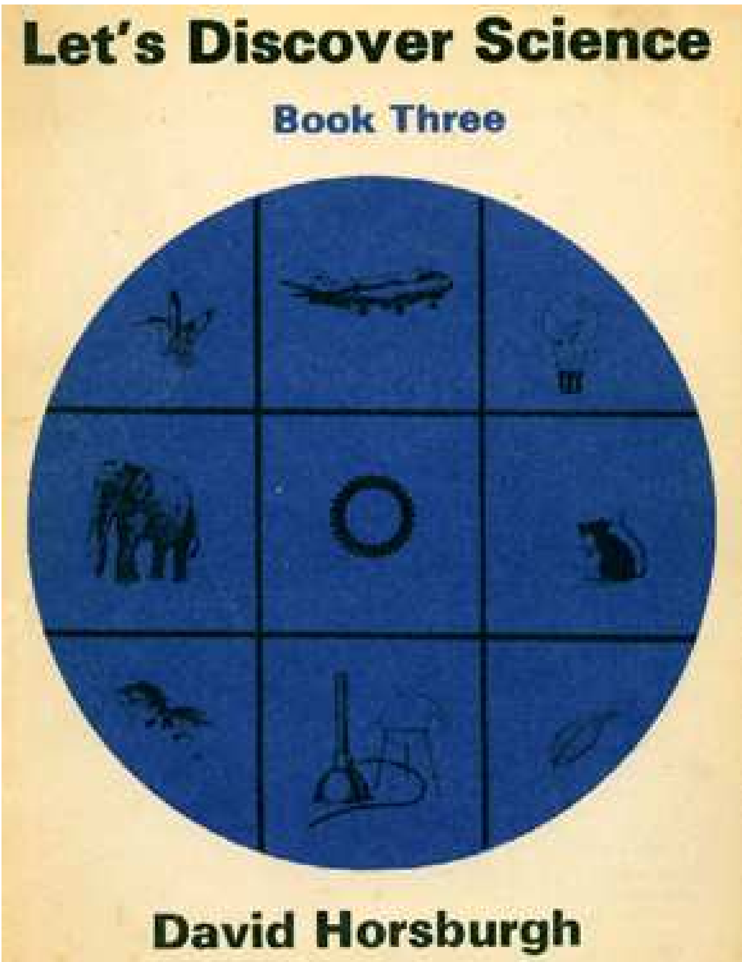


Introduction

The purpose of the *Let's Discover Science* books is to give the children sufficient basic skills to learn for themselves what they want to learn. The child should, as far as possible, be given those ideas which form the basis of scientific thought. Competition and grading can well be dispensed with in a course of this nature: the children should be encouraged to cooperate with each other in experimenting and in enjoying the beauties of scientific discovery and learning from their peers should be a normal part of everyday classroom activity.

Before the child can be led to any important concepts of science, it is important to *break down* certain concepts which already, perhaps, are making their way into his mind through other aspects of his education.

The first is the idea that the textbook is some kind of divine writ, to be accepted without question, swallowed without digestion, and regurgitated in the examination.

The next: that to every question there is one correct answer and only one correct answer, and that this correct answer must always be given in the words of the book.

The next: that every effect is due to only one cause and not, as-so often happens, to a multiplicity of causes.

How can the teacher break down some of these fallacious concepts? By encouraging the child to ask questions, to conduct experiments *for himself,* and to make guesses. By giving children plenty of practice at suspending their judgment and being prepared to wait and observe rather than to jump to quick conclusions; and even by the teacher and pupils occasionally saying together, 'We don't know'; followed by, 'Let's find out'.

The five books in the series are designed to give children a number of skills and concepts. While the text deals, of course, with scientific matters, the emphasis must always be on learning the skills and concepts and not on learning the information contained in the text.

Observing, recording, the analysis of such recordings, and the practical applications of such analyses, are all introduced from the earliest stages. In addition a number of practical skills have been taught: learning to draw, to copy and to trace; learning to use language accurately; learning to guess with reasonable accuracy; learning to work from printed instructions.

The pages of the book should form only the beginning of the child's quest for scientific knowledge. Children should be encouraged to apply the skills and concepts they acquire from the book to every aspect of their environment and life.

A few notes for the teacher with regard to certain pages of the text have been printed at the back of the book.

David. Horsburgh

Notes for the Teacher

(Notes are only given for those pages where some difficulty may be found, either in the interpretation of the page or in the work preceding or following the work of the text.)

Page 1: The names of the birds are as follows:—bulbul, crow, robin, swallow, pied wagtail, sunbird, parakeet, flamingo, kingfisher, owl and bee-eater, A good and simple book of Indian birds is Salim Ali's *The Book of Indian Birds* published by the Bombay Natural History Society.

Page 2: Encourage children to find more examples of their own.

Page 4: Group work, if individual equipment is impossible.

Page 6: Group work.

Page 8: If mirrors are not available, flat tin, well polished with metal polish, makes a useful substitute.

Page 9: Make sure they experiment with different angles, and record the results of their experiments.

Page 14: Get the children to write a number of things felt by their senses, e.g. wet, dry, rough, smooth, slimy, hot, cold, moving, etc. for *touch.*

Page 15: What different sources of power do the children know? Examples?

Page 16: Bring a torch if possible, and get those children who can to bring one too. Differences ? Advantages ?

Page 17: Shadows: make their own figures for their own plays. Group doing different plays. Scenery.

Page 20: Making fire in this way is difficult, but it can be done!

Page 21: If no sandpaper is available, glue a piece of cardboard and sprinkle on dry sand. Brush off surplus sand when dry.

Page 23: The leaf books should continue to the end of the year. Alternatively, groups can work together on separate pages. Exhibition on classroom walls group by group.

Page 27: A very simple paper aeroplane is illustrated. Children can experiment with designs of their own, from which they learn a great deal. Launch them gently (no throwing) into the wind.

Page 28: An important concept.

Page 33: Make sure that (a) they write down their own system (for individual letters or for words) and (b) they try it out, with their friends.

Page 34: They may have manufactured ones of their own, but the making of the new ones is important. You may have to spend time on the use of the protractor.

Page 37: More examples from the blackboard.

Page 39: The next problem is how to get the egg out. Is there any solution apart from breaking the bottle?

Page 41: Acids must be tested by the children and results written down from actual observation, *not* from the blackboard. Group work? Each individual could bring *one* of the liquids.

Page 45: Plenty of scope for experiment with different sizes of cardboard: observation, recording; then, why?

Page 47: Children can make different maps and indeed different games (e.g. cars) on the lines of this one.

Page 49: All to be made.

Page 51: Group work if possible.

Page 54: Children can devise more balancing experiments of their own. Discussion may produce a general principle.

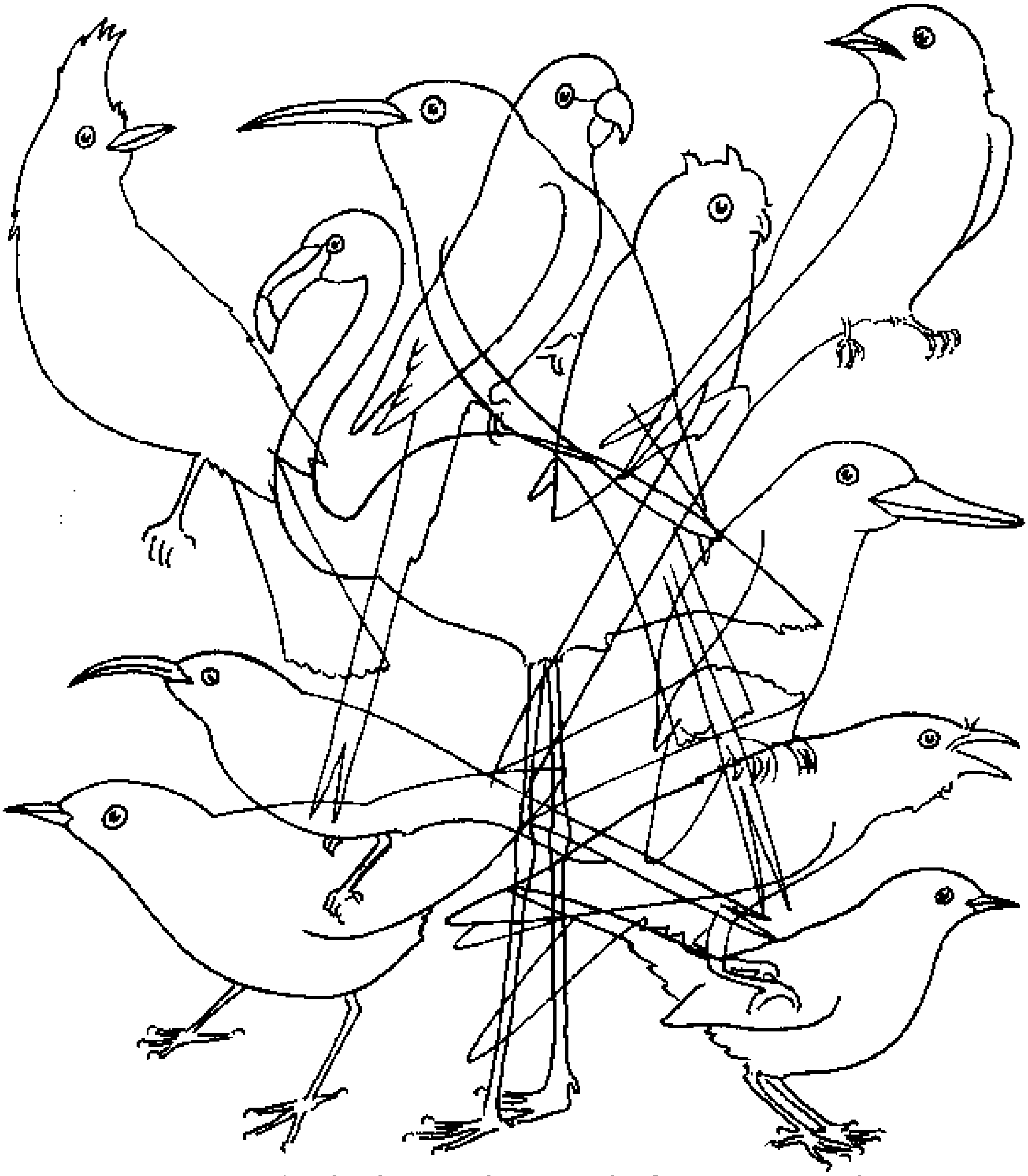
Page 55: Different figures?

Page 63: A visit to a lathe if possible.

Page 65: The flower book can continue. See note on page 23 above.

Birds

Can you say which birds there are in the picture?

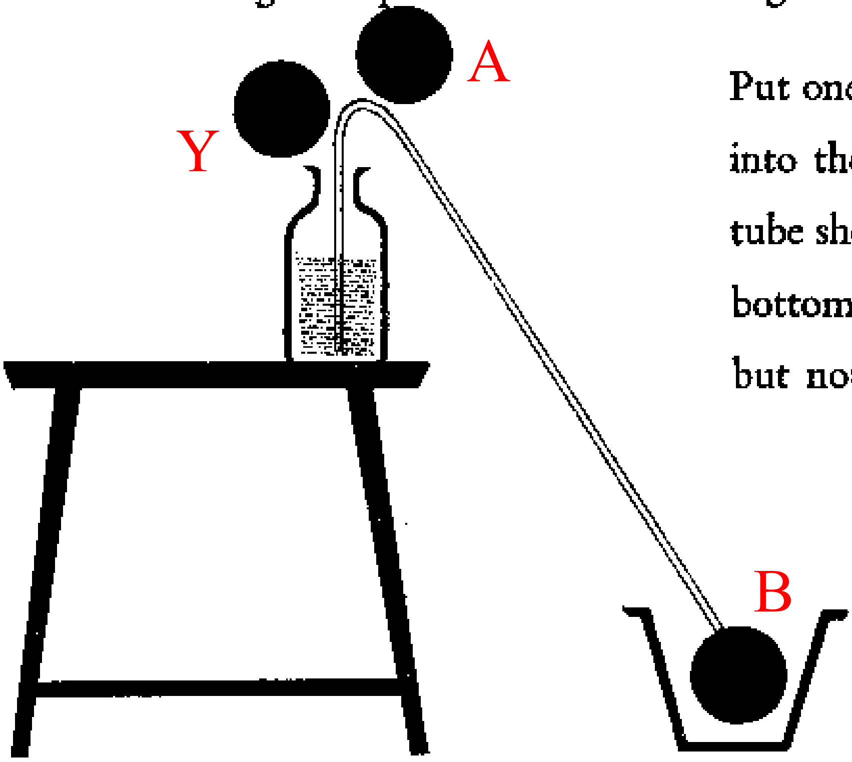


How many more birds do you know which are not in the picture above? Make a list of them.

The Syphon

Fill a bottle three-quarters full with water, and put it on a desk or chair.

Use a short length of plastic or rubber tubing.



Put one end of the tube into the bottle. The tube should be near the bottom of the bottle but not touching it.

Suck some of the water into the tube, by putting your lips to B. When there is some water in the tube, put your finger over B. What happens? Hold the end B over a bucket, and take your finger off the end. Now what happens?

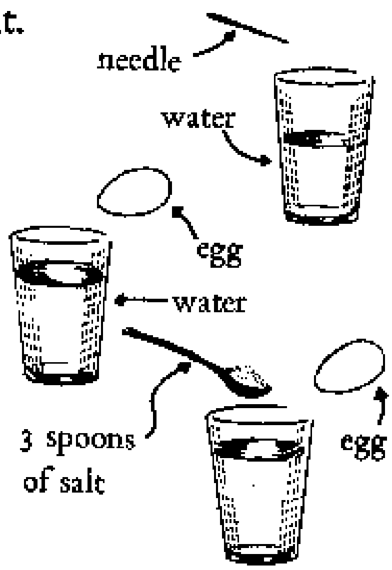
Pour the water back into the bottle, and do the experiment again: but this time do not suck, but blow at Y into the bottle. What happens?

Floating

How many of the following can float in water:
a wooden ship, an iron ship, a stone, a pencil,
a comb, you, an empty matchbox, a small bottle,
a needle, an egg, a stamp, a dog, a watch?

Two experiments

Use the boxes at the bottom of the page. Guess first, then carry out the experiments and see if you were right.



A Take a needle and place it slowly and carefully on some water in a glass.
Will it float?

B Take an egg and put it in a glass of water.
Will it float?

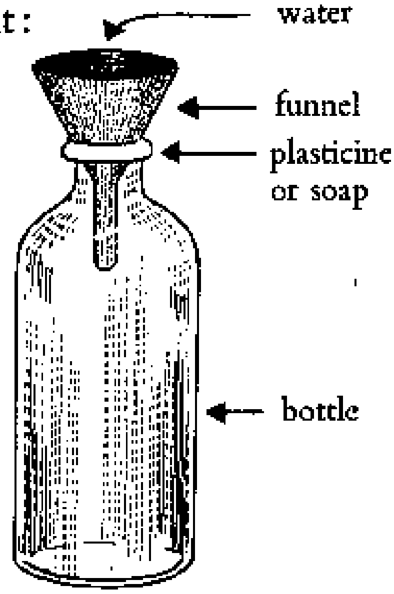
C Fill the glass with water and then put in 3 teaspoons of salt. Put the egg in.
Will it float?

Answers		GUESS	CORRECT
A	It will float.		
	It will not float.		
B	It will float.		
	It will not float.		
C	It will float.		
	It will not float.		

Air

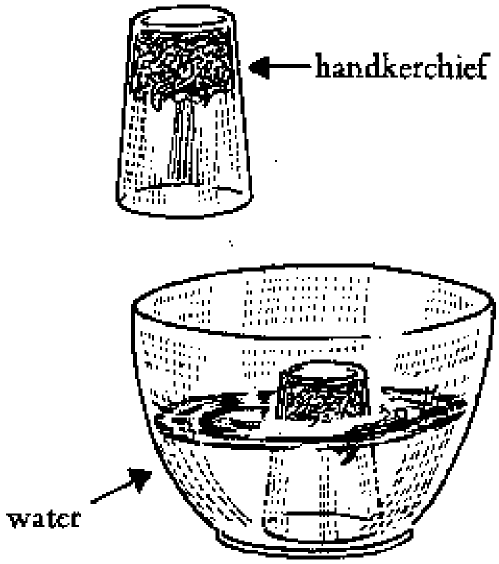
Air takes up space.

Even though you cannot see air, it takes up space. Take a bottle: can you see the air in it? You can find out whether it is full of air by doing the following experiment:



Put a funnel in the top, and seal up the join between the top of the bottle with plasticine or soap.
Now pour water quickly into the funnel. What happens if you make a hole in the plasticine with a pin?

Another experiment.



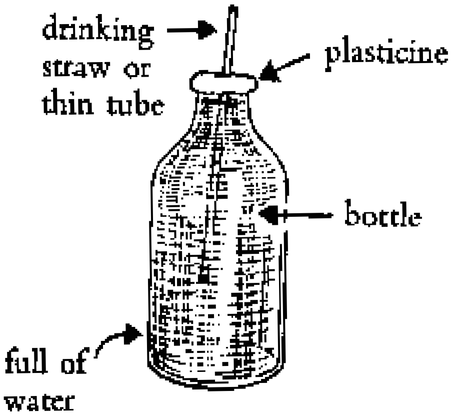
Take a handkerchief and push it down into a glass.
Make sure it will not fall out of the glass upside-down.
Now push the glass into a bowl of water.
Why does the handkerchief remain dry?

Air Pressure

If you squeeze a balloon full of air, the balloon will change its shape. If you squeeze it all over, the air will break the rubber and the balloon will burst.

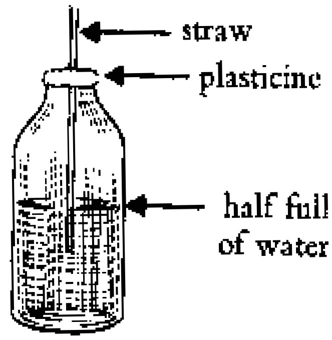
If the container full of air is very strong, the air will take up less space when we press it. We say that the air is compressed.

How many uses of compressed air can you think of?



Fill a bottle full of water. Put a drinking straw or any thin tube down into the water. Seal the opening of the bottle with plasticine or soap.
Can you blow air down the straw?

Now fill the bottle half full of water.
Can you blow down the straw?
What happens when you take the straw out of your mouth?
Why does it happen?



Mirrors

Take a small mirror and look at it. Hold it with one hand and touch your right eye with a finger of the other hand. Which eye is the person in the mirror touching?

Look at this word by holding the page in front of your mirror. What does it say?

TAƎHW

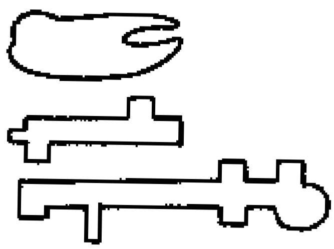
Guess what the following will say in the mirror.

Then test with your mirror. Which words are correctly spelt?

	Guess	Check with mirror
ƎЯUƧƧƎЯꟼ	....	....
ИOOJJAꓭ	....	....
ЯƎHƧIꟻǤИIꓘ	....	....
ƎJTTOꓭ	....	....

How would these shapes look in a mirror?

	Guess	Check with mirror

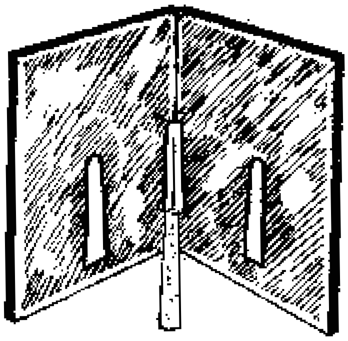


Write a sentence of your own which can be read in a mirror.

Make more shapes like those above and get your friends to guess what they are like in a mirror.

Reflection

What we see in a mirror is called a reflection. It is also called an image. The boy in the mirror is the image of you. Put two mirrors together (a friend can hold them for you or you can put plasticine at the bottom of each) and then put a piece of chalk or small pencil upright between them.

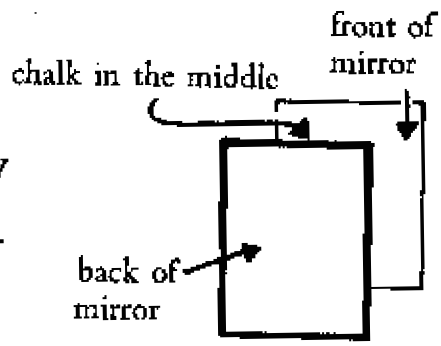


How many images can you see? ....

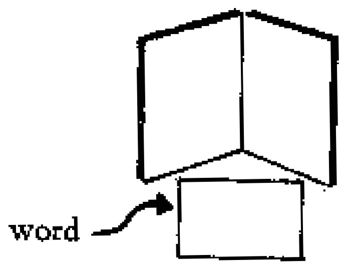
What happens if you make the angle between the mirrors smaller? ....

What happens if you make the angle bigger? ....

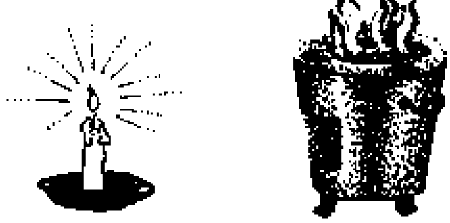
Now put two mirrors opposite each other and the chalk in between. Look over the top of one mirror. How many images can you see? ....



What happens if you write a word on a piece of paper and put it in front of the two mirrors used in your first experiment?



Heat

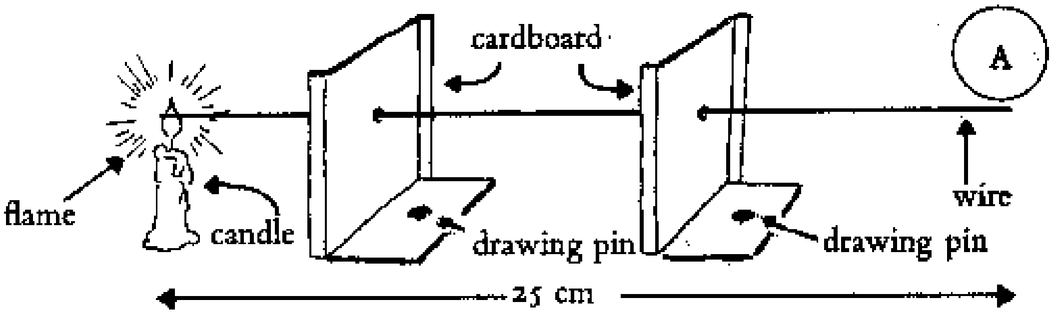


Heat travels

Try to see how far it travels. Use your cooking stove or fire at home, and a candle. You will need a ruler. Then fill in the chart below with the distances in cm from your hand to the heat.

	CANDLE	FIRE
	Distance	Distance
Too hot for your hand to stay there		
Hot		
Warm		
No feeling of heat		

Take a piece of wire, two pieces of thin cardboard (an empty cigarette packet will do) and set up the experiment shown below.



Make a chart of your own, similar to the one above, showing the time in seconds (pulse beats) the wire at A takes to get warm, hot, very hot, too hot to hold. If possible try the experiment again with thinner wire, then with thicker wire. Make new charts.

Water and Heat

What happens when things get hot?

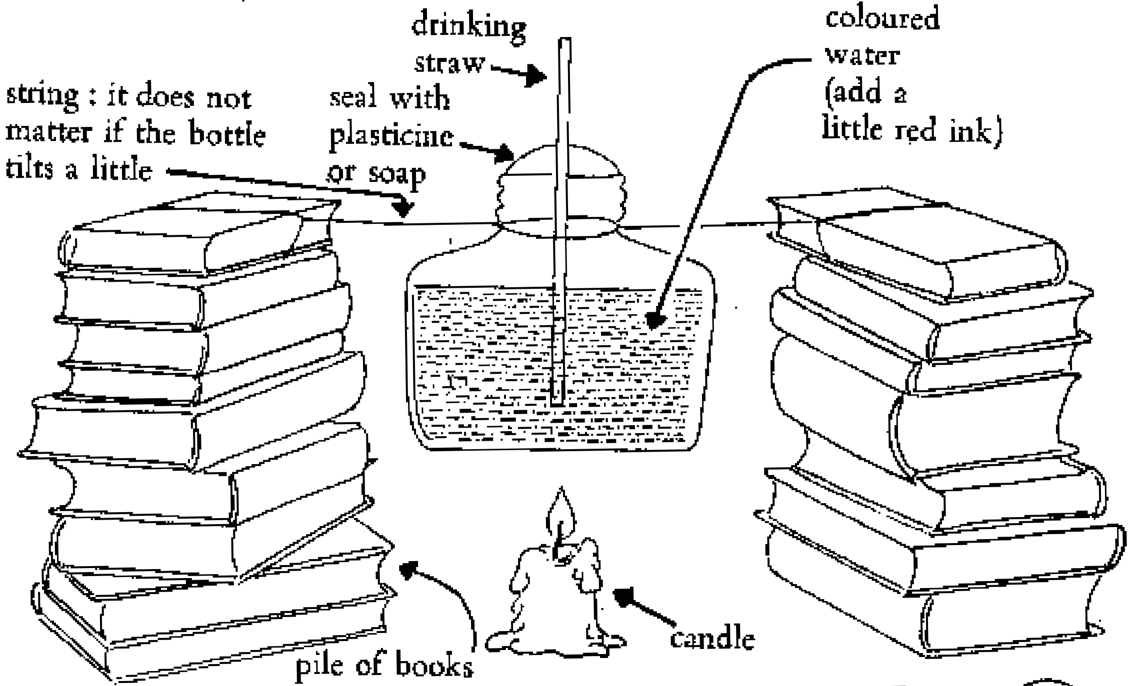
Some things melt. Write down five things that melt.

Some things burst into flame. Write down five things that burst into flame.

Some things get bigger. For example, water.

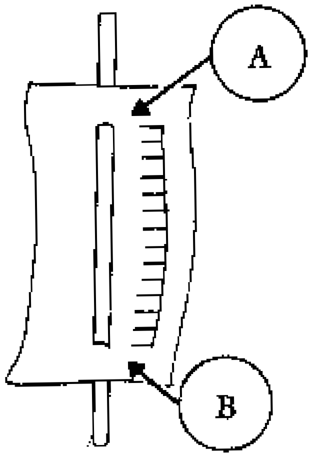
When things get bigger we say they <u>expand</u>.

Set up the experiment shown below:



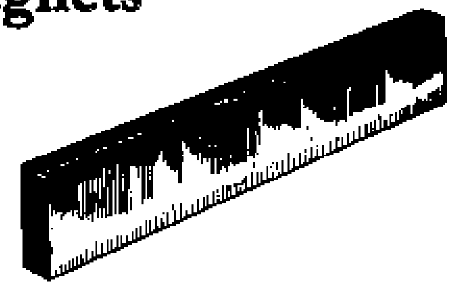
What happens when the water gets hot?

You can make a scale with a piece of paper, and put the straw through a slit at A and B.

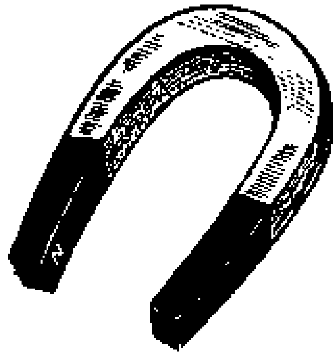


Could you use this idea to show you the temperature each day? or at night?

Magnets



a bar magnet



a horseshoe magnet

Ask your teacher to show you a magnet. If there is no magnet in the school you can make a small one of your own,

a) by borrowing one for a night (see p. 13), or

b) by using batteries and a coil (see p. 50).

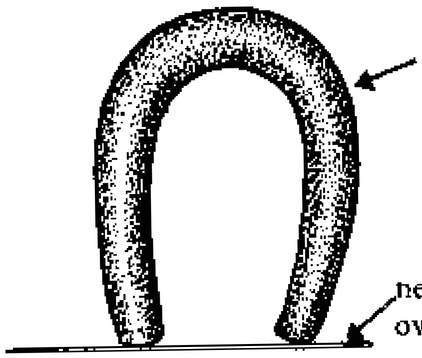
Collect the following if you can:

some pins some thin nails some drawing pins some matches some paper clips some pieces of chalk bits of wood pieces of plastic small pieces of paper a needle a pencil a piece of wire

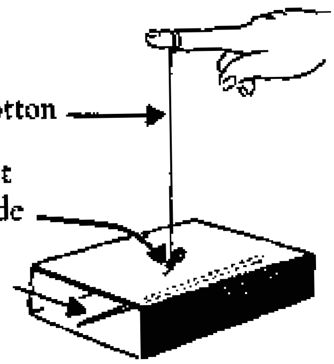
Make a chart like the one below. Guess first, then use the magnet and check your answer.

	GUESS	CORRECT
Material	I think the magnet will pick up	The magnet does pick up
pins	some	
matches	two	
etc.	four	
	(etc.)	

Making a Magnet and a Compass



If you can borrow a horseshoe magnet, you can make a small magnet of your own, out of a needle, or a thin nail, or a piece of wire. Leave it in position all night as shown above: in the morning you will have a magnet of your own. If your magnet-needle is left free to move, it will always point in a certain direction.



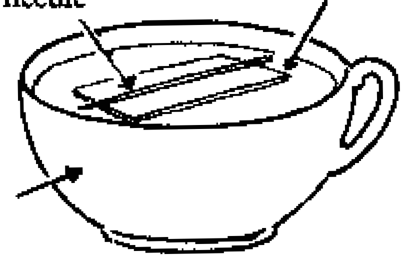
Put the needle lengthways in a matchbox, and make a small hole in the cover of the box. Thread a piece of cotton through the hole, and make a knot.

Hold the thread and let the box swing. You have made a compass.

Which direction does it always point to?

How would it be useful? What kind of people could use it?

You can make another compass with the same needle.



Break up an empty matchbox and take a small piece of the thin wood from it. Put the needle on the wood and float it on some water.

Your Body

You learnt about some parts of your body in Book 2 (p. 14). They were all parts you can see, such as the wrist, ankle, elbow. Do you know what there is inside your body, things you cannot see? Ask your teacher to tell you a little about each of these:

stomach	brain	heart	lungs
blood	bones	muscle	

Breathing Like all living things we need air. We breathe through our noses, and the air goes into our lungs. Breathe deeply and put your hand on your chest. What happens?

Eating We eat food, and it goes into our stomachs.

Thinking We think with our brains. Our senses send messages to the brain.

We have five senses. Write them under the pictures.

. . . .

(sight, smell, touch, taste and hearing)

Write five things for each sense; e.g. five smells, five tastes, etc.

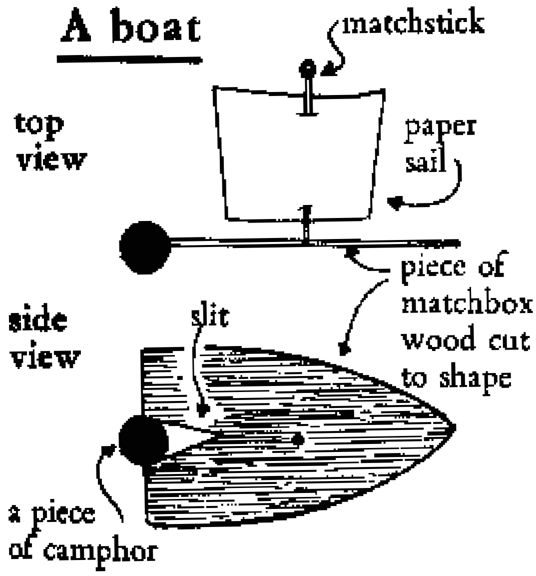
Power

Power makes things go.
The power that makes you go is called energy.
What power makes the following things go:
a motor car   a bus   a windmill   a bullock-cart   a jet plane
a bicycle   a rowing boat   a sledge   a sailing boat
a box on wheels on a steep hill
How do you get energy in your body? Mark ✓ at the side of each source of energy for your body in the list below:
the sun   the ground you walk on   air   food   sunlight
work   drink   poems   music   fruit   toothpaste   vegetables
school books   heat.
Ask your teacher to help you with the answers.

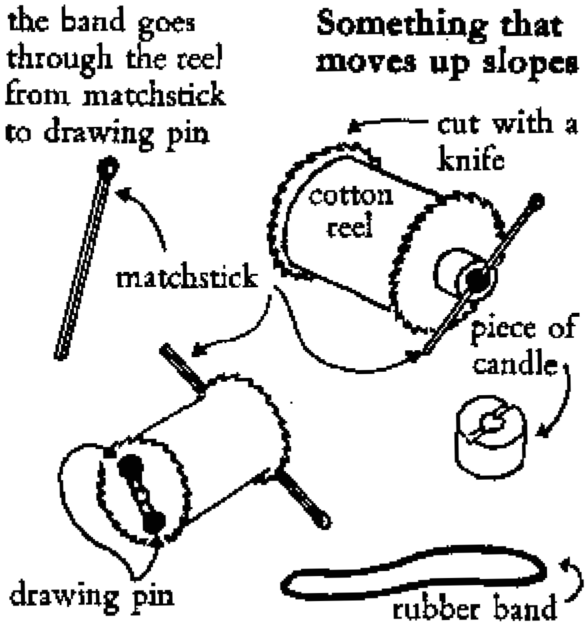
Think of 3 things   that move from place to place,
3 things   that move but stay in the same place.

Power models

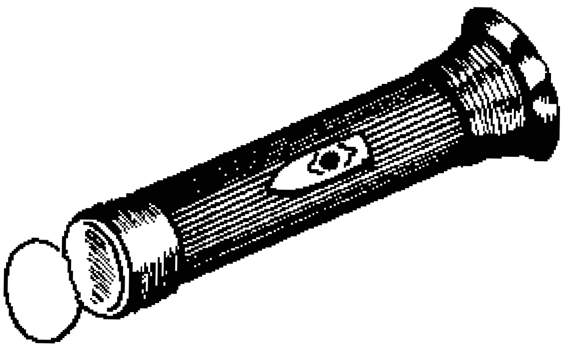
A boat



Something that moves up slopes



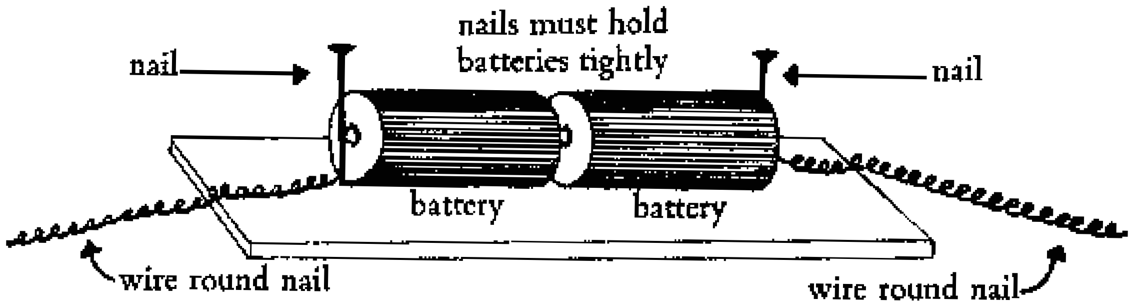
Electricity



Have you ever seen an electric torch? In a torch the electric power is in the batteries. The electricity passes from the batteries to the bulb, and then back to the other end of the batteries, like this:

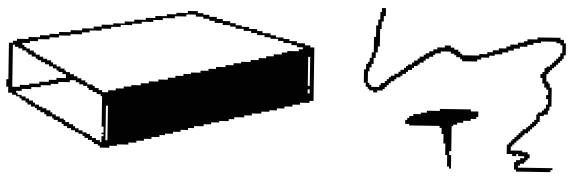
Ask your teacher to show you a torch.

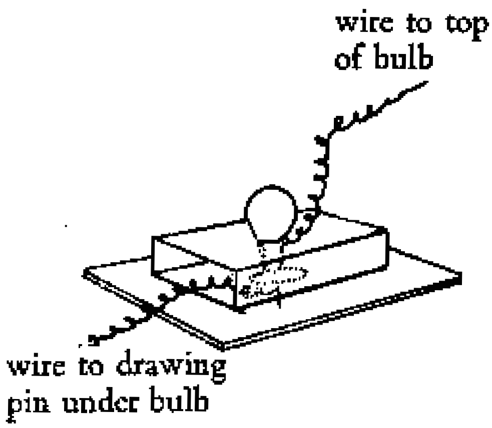
Make a holder for batteries and a bulb-holder:



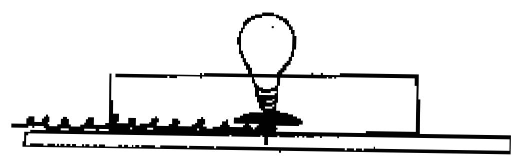
A battery-holder

Take a matchbox cover





and a drawing pin and some wire. Put the wire round the pin and put wire and pin through the bottom of the box on to a piece of wood. Make a hole in the top of the cover for the bulb.

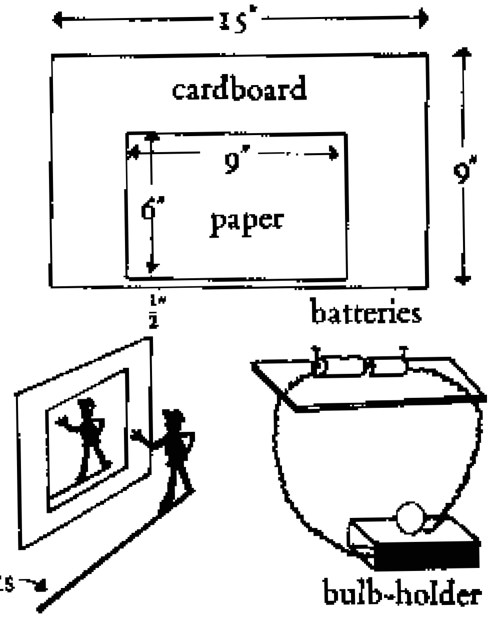


Shadows

What causes shadows ? How long is your shadow ? Does the length of your shadow change during the day ?

You can use the battery-holder and bulb-holder to make a shadow-theatre.

Get a piece of cardboard (an old file cover will do, or the side of a cardboard box). Cut it as shown in the diagram. Cover the front opening with thin paper. Paint the surrounding cardboard black.



Do the shadows change size if they are nearer or further from the screen ?

Make figures out of thin card : stick them on very thin bamboo sticks : when you put them between the bulb and the screen the audience will see the shadow. Here are some figures for you :

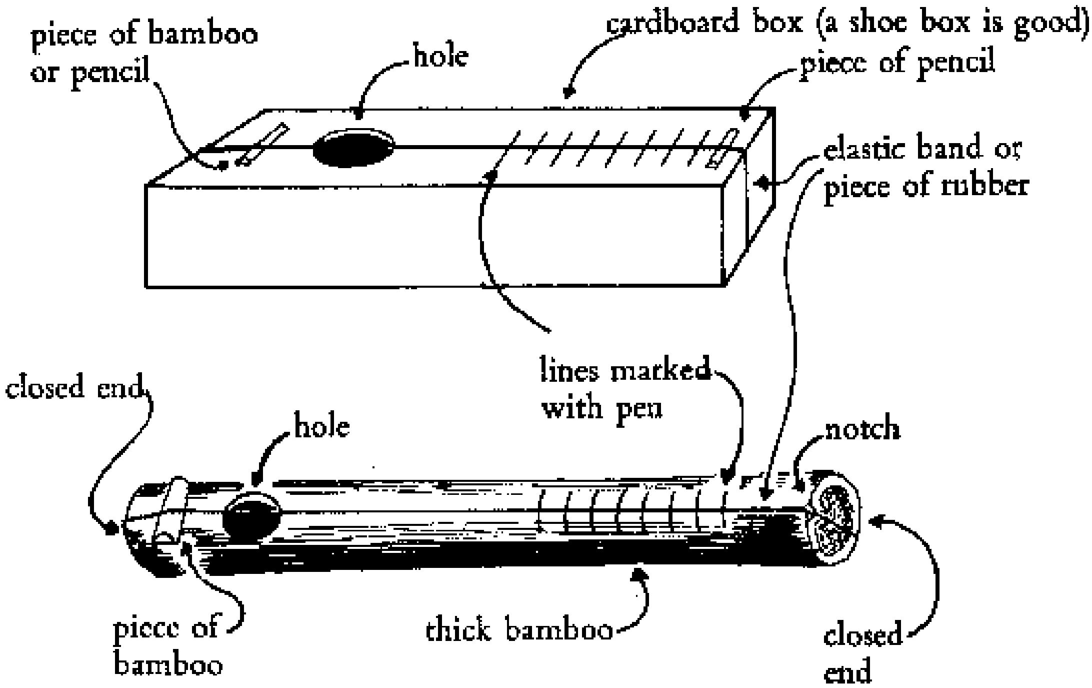
Make more of your own.

Sound

Do you remember the musical instruments you made in Book 2 (pages 30 & 31)?

Do you remember the word vibrate?

Here are some more musical instruments for you to make:



What happens if you pull the elastic band where it crosses the hole?

What happens if you put one finger on the band over the pen line nearest the hole while you pluck the string?

(Pluck means pull.)

What change in the note do you hear if your finger is on a line far away from the hole?

Can you play tunes on these instruments?

Sound

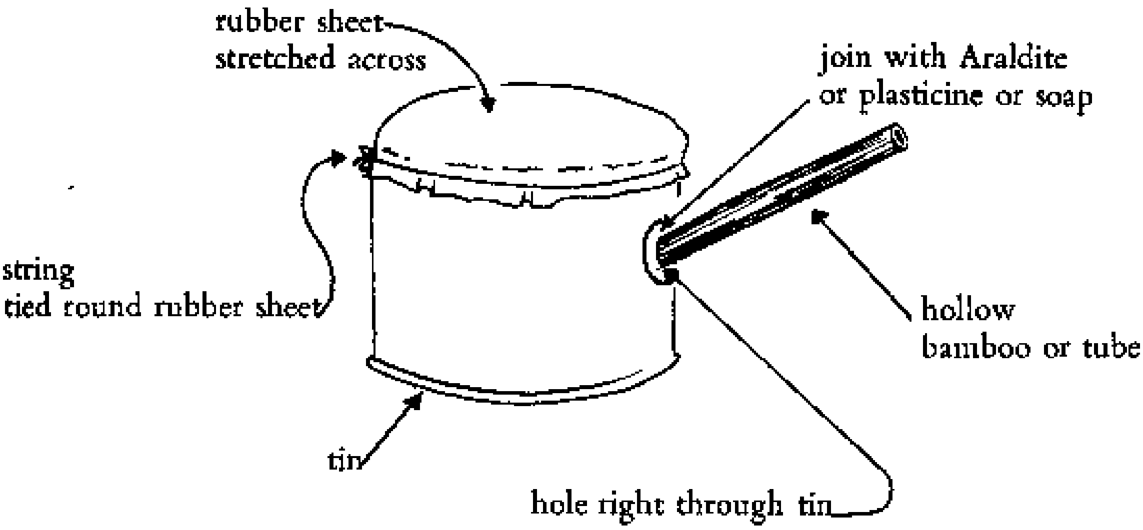
Have you ever seen patterns made by sound?

You can make an eidophone. The first part of this word, eido, comes from Greek, and it means to see. The second part, phone, comes from another Greek word meaning voice.

(What is the meaning of these words:

telephone microphone megaphone?)

An eidophone



Use a piece of inner-tubing cut from an old inner tube of a car or lorry. (You will find plenty in the market.) Stretch it tightly across the tin. Now put some fine powder (flour, sugar, talcum powder) on the rubber. Sing down the tube. What happens when the note gets higher or lower, louder or softer?

Draw pictures of the powder patterns in your book.

Friction

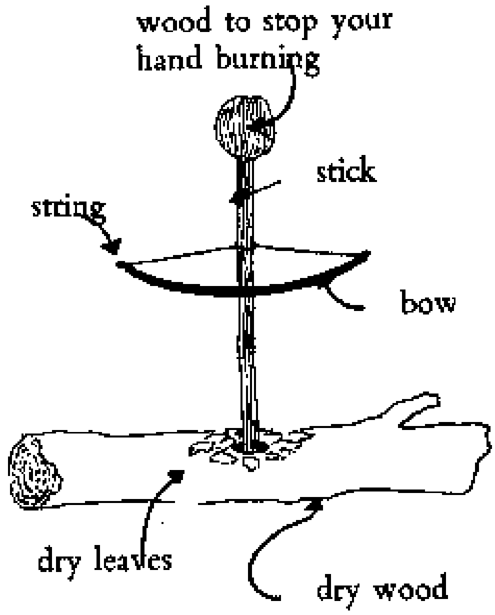
Friction means rubbing.

Rub your hands together, quickly. What happens?

Do they get hotter or colder?

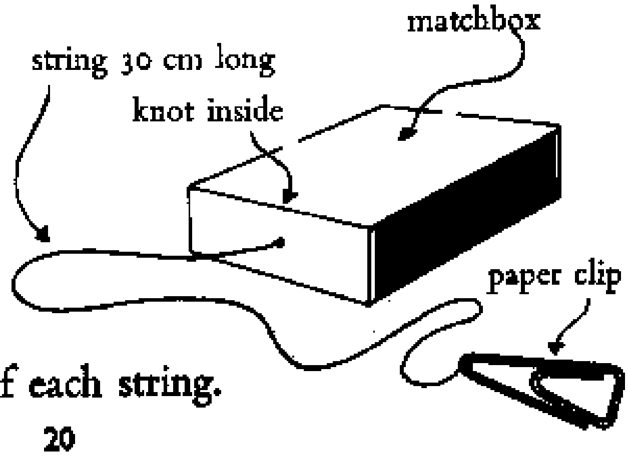
Sometimes great heat is made by two things rubbing together.

Many years ago in some parts of the world, men made their fires by rubbing two sticks together very quickly. Try it by using the things shown in the diagram. The wood at the top will stop your hand burning. Push the bow backwards and forwards and the stick will turn very quickly; the leaves will catch fire. Making a fire like this is not easy.

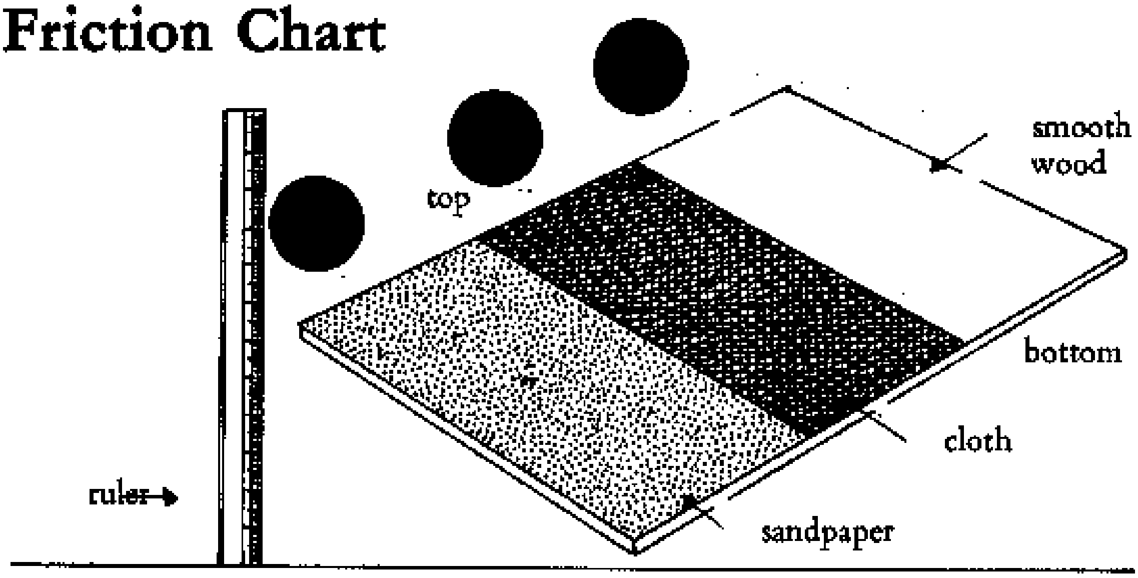


For the work on page 21 you will need three empty matchboxes. Put a string in each, with a knot at the end. Put nothing in the first box. Put a marble or stone in the second. Put two stones in the third.

Put a paper clip at the end of each string.



Friction Chart



Cover a piece of wood, or stiff cardboard, or your desk, as shown above. You need a strip of sandpaper and a strip of cloth, and a ruler. You need the three matchboxes you prepared (on page 20). Call the matchboxes A, B and C.

Call the surfaces 1, 2 and 3 (as shown above).

Put A at the top of 1. See how many cm you must raise the board before the matchbox slides off. Then put A on 2: then on 3. Now put B on 1, 2 and 3. Then C.

Now put a weight on each string of A, B and C and start again. Fix the weight to the paper clip.

Make a chart

Make your own chart to write down all these results. How will you do it?

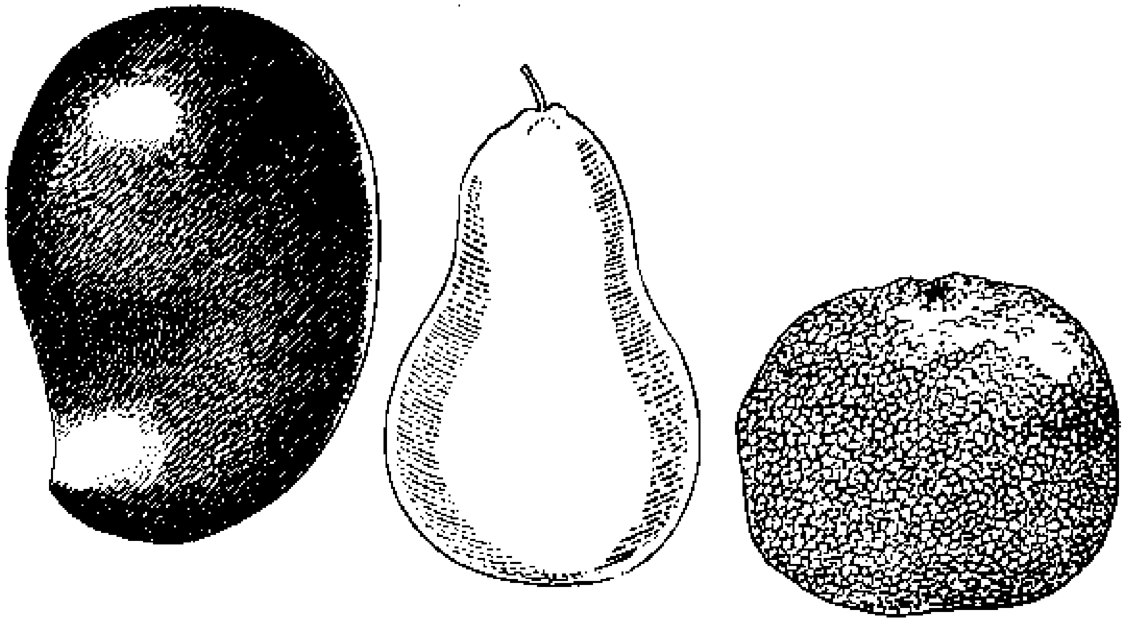
Look at some of the charts on other pages of this book. Try.

Get your teacher to help you if it is too difficult.

Plants

Most plants have

leaves stalks roots flowers fruit seeds



What kind of trees do these fruits grow on?

Describe each tree.

Say something about the roots, the trunk or stalk, the flowers and the seed.

Find some more fruits and describe them.

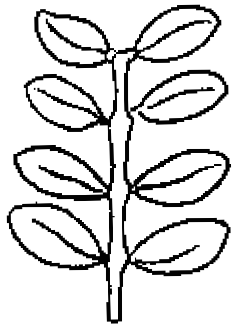
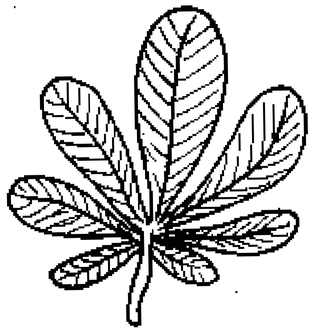
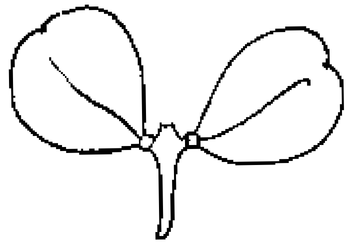
Do they all have seeds?

Find two or three vegetables. Describe them and draw a picture of each one in your exercise books. Do they have seeds? What are the seeds like?

Try drying some of the seeds and planting them in a tin.

Write about what happens to the seeds. Keep a day to day chart.

Plants

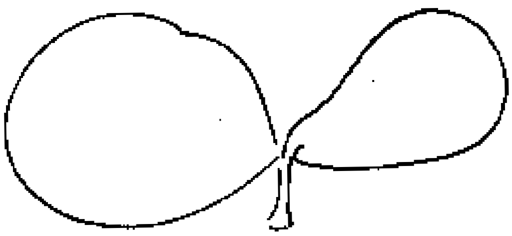
Copy the leaves here.

In each of the illustrations above, notice that each stem has more than one leaflet. They are called

compound leaves.

Find more compound leaves of your own.
Make pressings of them, or prints (Book 2, page. 11).
Then put them in your notebook and add details:

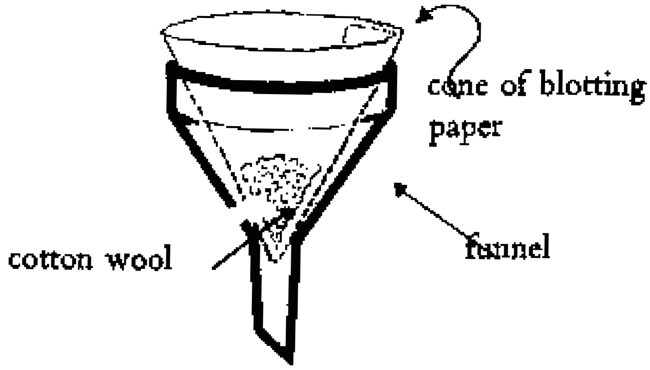
name of tree or flower
where found
month
colour
any other details.



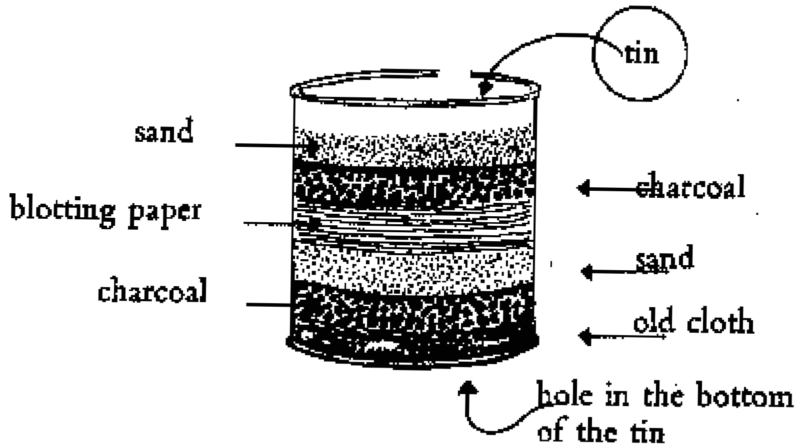
Cleaning Water

Very often we find that water is dirty, or muddy. There are a number of ways of cleaning it. One way of cleaning water is to filter it.

A simple filter
A



Another filter
B



Try liquids 1–4 below, in filter A and then in filter B. Look at each sample carefully before and after filtering. Taste each sample with your tongue. Write down any differences. Which filter makes most difference to the liquids? Which liquids are the same before and after filtering?

1 muddy water
2 salty water (sea-water if possible)
3 sandy water
4 lime juice and water mixed

Machines

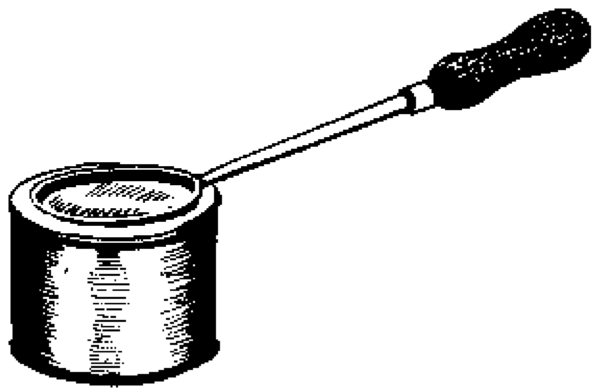
Do you remember what you learnt about levers and pulleys and gears in Book 2? (pages 28, 29, 42, 43)
All these things are used in

machines.

Machines are used: to help us to work faster.
to make our work easier.
to change the direction of a **force.**

Try to open the tight lid of a tin with your fingers.

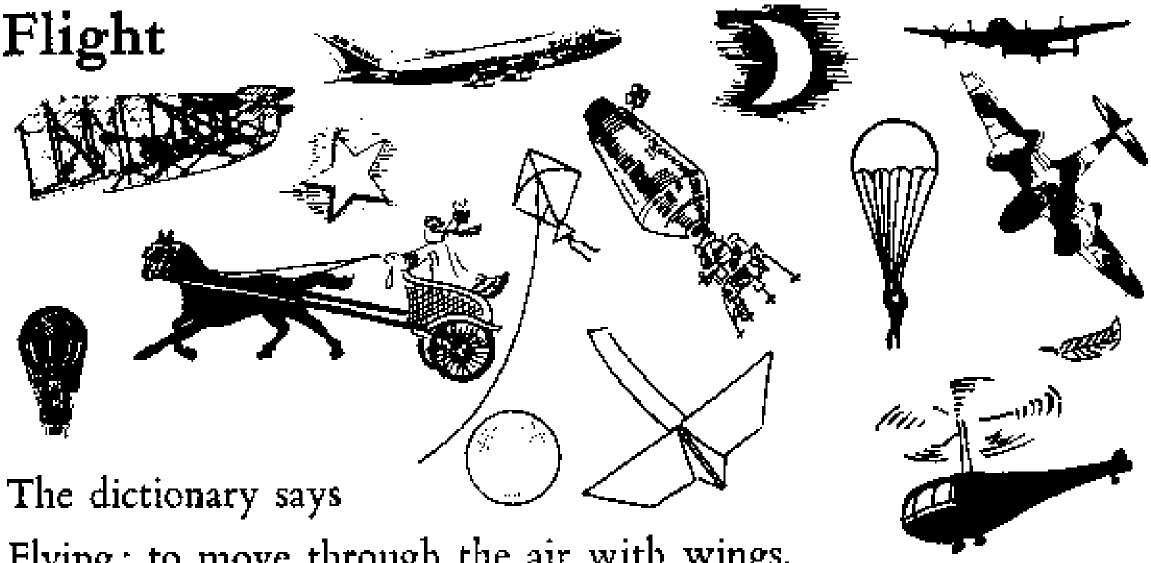
Now use a lever.



It makes our work faster.
It makes it easier. It changes the direction of the force.
Which way do you push down when you open the tin?
How is the force changed?
Where does the force come from and how is it changed in direction in these:

a bicycle   a well-rope   a sewing-machine?

Flight



The dictionary says

Flying: to move through the air with wings.

Is this a good definition*? Do all the things in the picture above fly? How many have you seen? What are they made of?

Write one or two sentences about each, e.g.:

A kite flies.

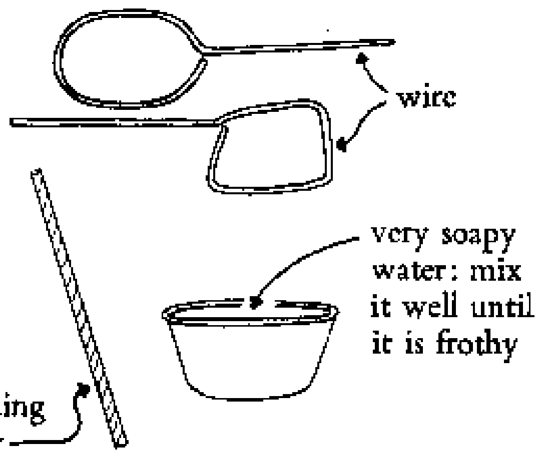
It is made of wood and paper and string.

I have seen a kite.

I have flown a kite.

Bubbles

Make some shapes of wire,
or take a straw.
Dip one end in soapy
water and blow bubbles.
How big a bubble can you make?
Why does it burst?

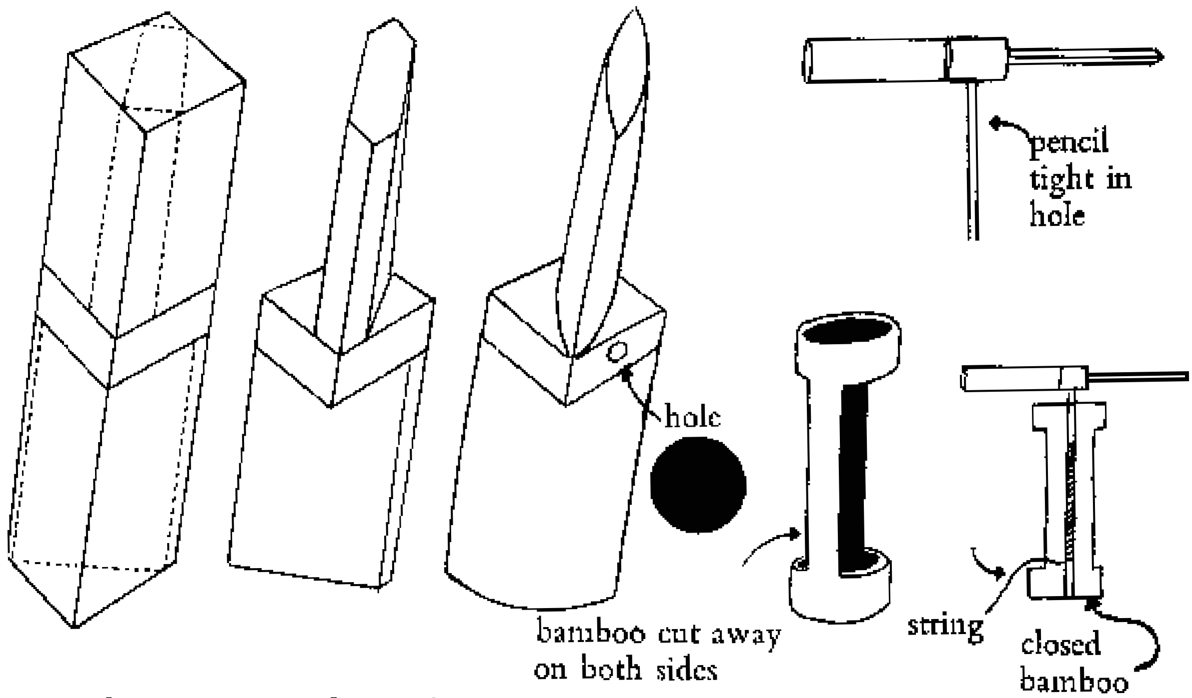


*Ask your teacher what this means.

Flight

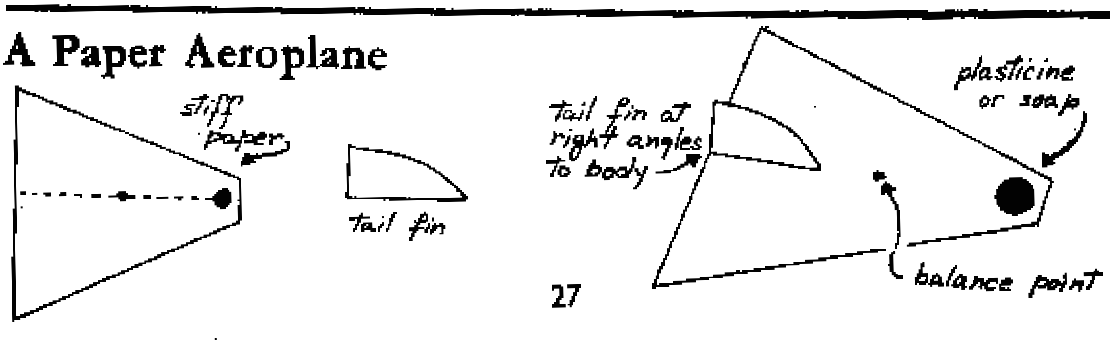
Make a flying machine. (Did you find out how to make a parachute in Book 2, on page 55?)

You need a pencil, a piece of soft wood about 20 cm by 4 cm by 2 cm, a piece of string, and a short length of hollow bamboo 20 cm long. Shape the soft wood as follows:



Wedge the pencil firmly in hole A. Then put it into the bamboo tube, wind string round it and pull sharply. The flying machine will sail upwards. Use light wood.

A Paper Aeroplane



Chemistry

In chemistry we study

what things are made of ———— substances.
what substances are like ———— their properties.
what happens when substances
come together ———— their effect
on each other.

Have you ever watched your mother
making chapatis? She takes

flour
salt
water

These are the substances of a chapati.
Write two things about each substance.

Flour is ....
Salt is ....
Water is ....

These are the properties of three substances.
Then she makes them into dough: she mixes them together.
The water makes the dough wet.
The salt makes the dough salty.

Each substance has changed. The dry flour has become different; the salt has changed: you cannot now see the water.
Each has had an effect on the others.

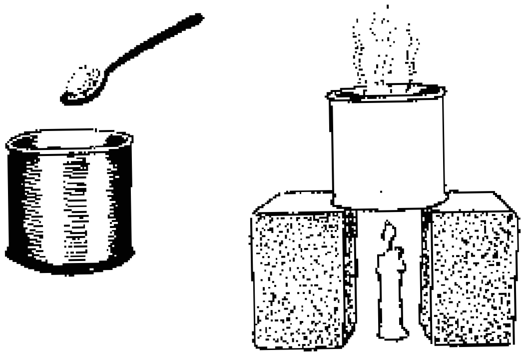
Chemistry

What substances are used in making the following ?—

a biscuit	a glass of lime-juice	a cup of tea
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....

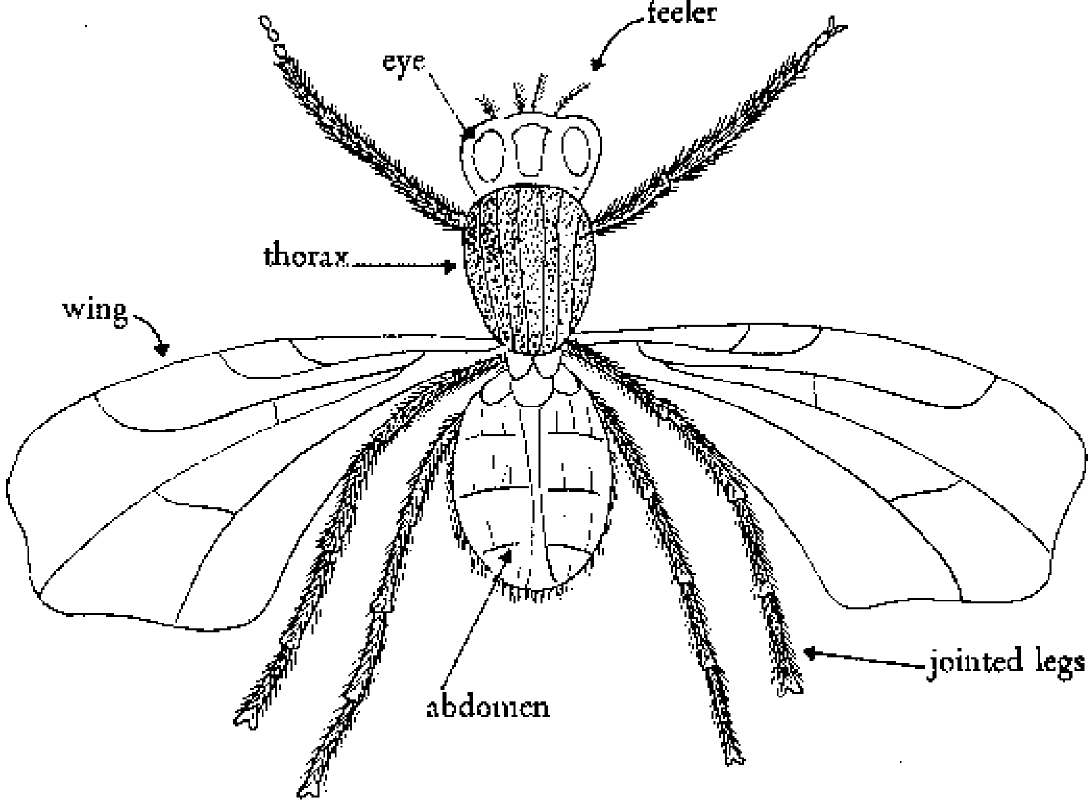
Sometimes substances have a different effect on each other when they are heated.

Put some sugar in a small tin of water. What happens to the sugar ? Now heat the water. What happens to the sugar now ?



What other things are changed by heat ? Make a list of five things which are changed by heat, and say how they are changed. (Sometimes people have a different effect on each other if they get heated.)

The Fly



This is a drawing of a house-fly.
Copy it into your books.
The fly is quite small, and even if you catch one you cannot see all the details of its body without a magnifying glass.

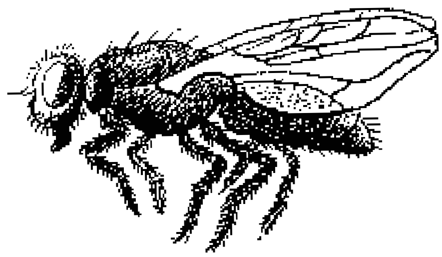
Try to catch a cockroach.
Look at it carefully and try to draw it.
Write down the differences between a cockroach and a fly. Are the following the same or different in the two insects:

size	colour	number of wings	number of legs
size of feelers		shape of wings	shape of thorax?

Flies and Cockroaches

Flies and cockroaches bring disease. They are both insects, and they lay eggs. They live in dirty places, and then, if they walk over any of our food, their legs bring dirt to the food. When we eat dirty food we get ill.

A fly lives for about a month or two, and lays about 2000 eggs. In about 10 or 11 days the full-grown flies come out. This is what happens:

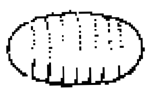


The fly sits on some manure.

It lays eggs, like this:

The eggs turn into maggots.

Each maggot becomes a pupa.



In a few days a new fly appears.

See if you can find some cockroach's eggs.

They can be found in a small case, brown and shiny.

Cut one open and look inside. How many eggs are there?

Look at another case for some days. What happens?

Signs

Sometimes we communicate with each other by signs. Many years ago American Indians who lived in very wild country had ways of communicating without writing. Here are some of the ways they used:

A Stones, grass or trees.

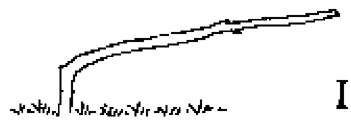
This is the right trail.

Turn right.

What signs did they use for

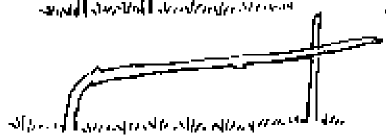
Turn left ?

B Pieces of twig and bent branches

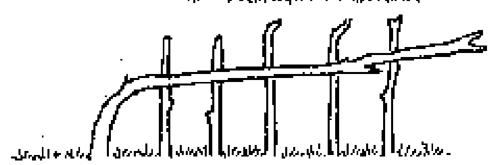


I am going right.

I have not gone far.



I have gone a long way.

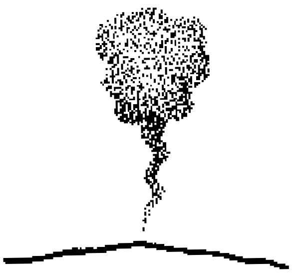


I have gone five days' journey.

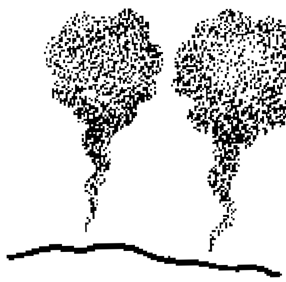
Make up four more new signs of your own, using branches.

More Signs

North American Indians also used to send signals by smoke. Here are some:



The camp is here.



I am lost.

Good news.

Sometimes they made a series of puffs of smoke, like this:

Design some signals of your own, using puffs of smoke.

How would you make smoke rise from a fire in puffs?

Write down a series of your own signals, using the following methods:

(a) by tapping. (Make your own code: do not use Morse Code. What advantages does your code have over Morse Code?)

(b) by using your hands and fingers.

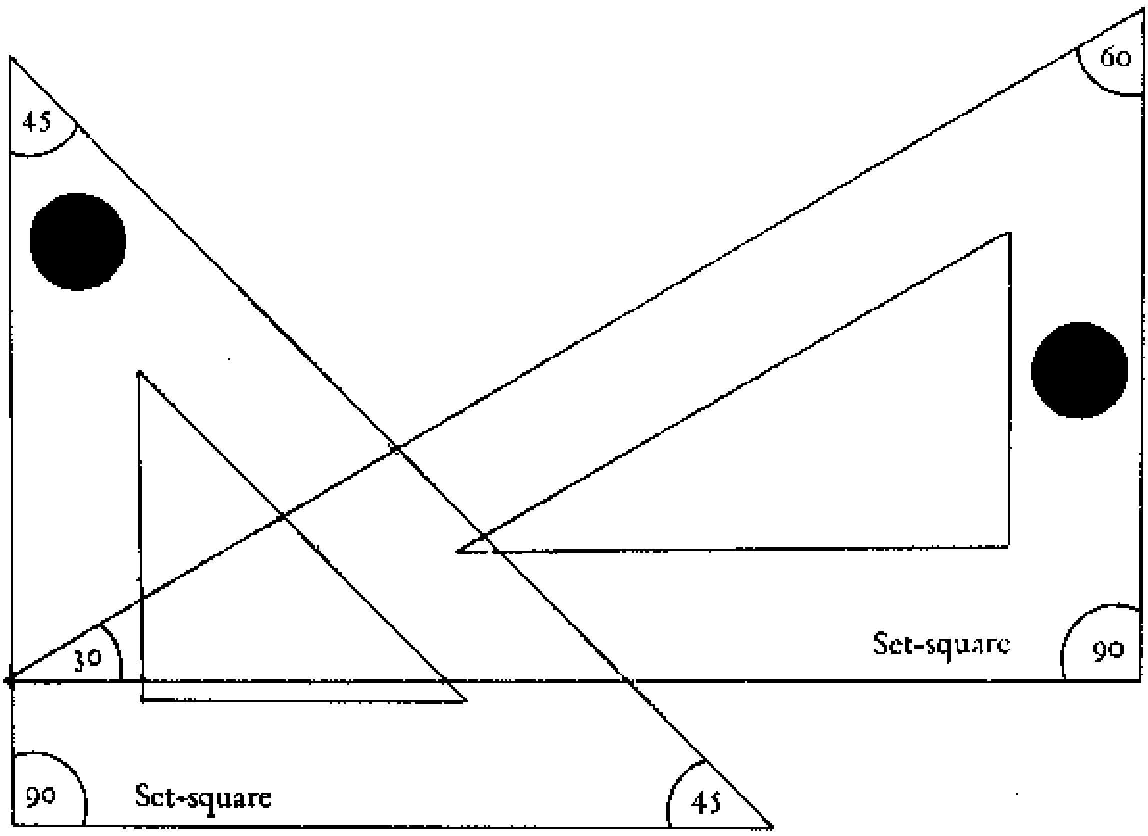
(c) by using your arms like the arms of a clock.

Try to send messages to a friend using the signals you have designed. How far away can your friend be using method (a), (b) or (c)?

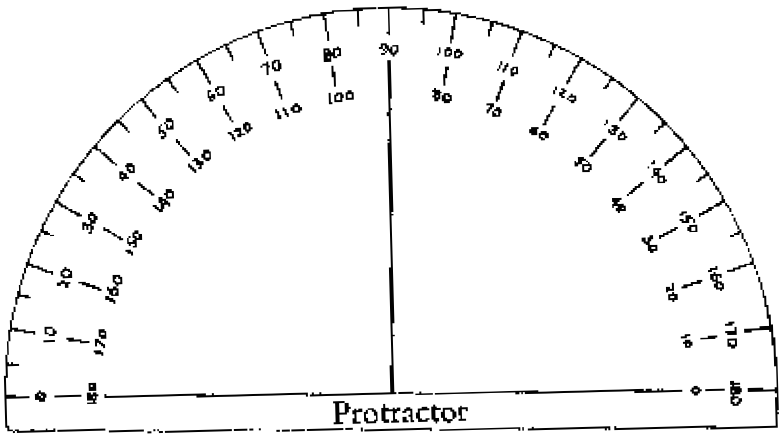
Drawing Instruments

The dictionary says an instrument is a tool. You have learnt about tools which people use (e.g. a carpenter, a blacksmith, etc.), and a drawing instrument is something which helps us to draw accurately. The most important drawing instruments are a ruler, set-squares, a compass and a protractor. You can make these for yourself.

Trace A and B below on to thick card, and cut them out carefully with a sharp knife. They are both set-squares. How are they different? How can we use them when we are making an accurate drawing? What are the numbers in each corner?



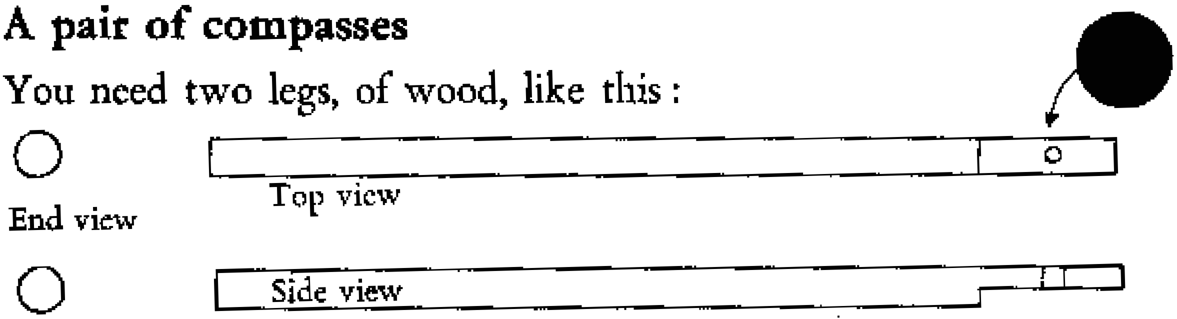
Drawing Instruments



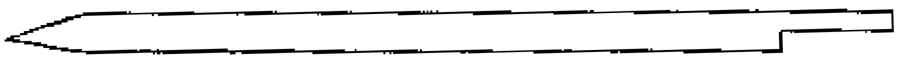
Copy the protractor carefully on to card (use tracing paper) and cut it out. Why does it have two sets of numbers? What do the numbers tell us? Why have some numbers been left out?

A pair of compasses

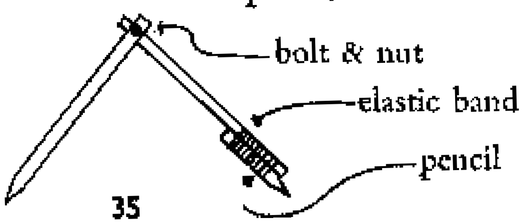
You need two legs, of wood, like this:



Put a hole in both pieces at A. Buy a thin bolt and nut, made of brass, from an electrical stores.
Make a point at the end of one of the pieces of wood like this:

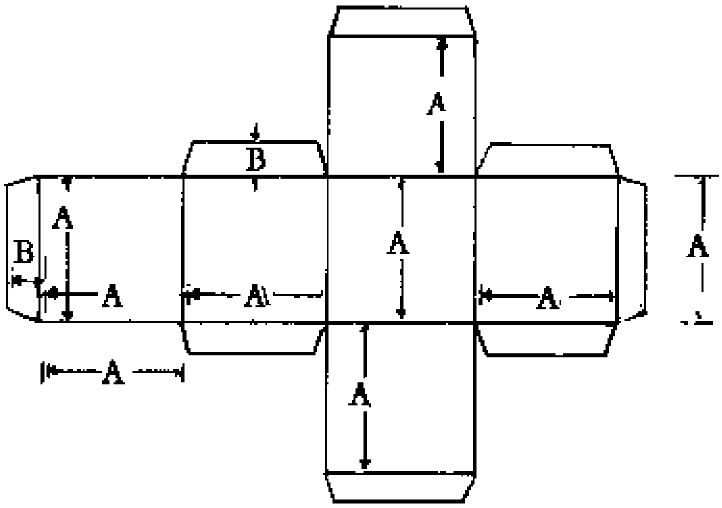


Fix a small piece of pencil to the other piece, and bolt the two pieces together, like this:



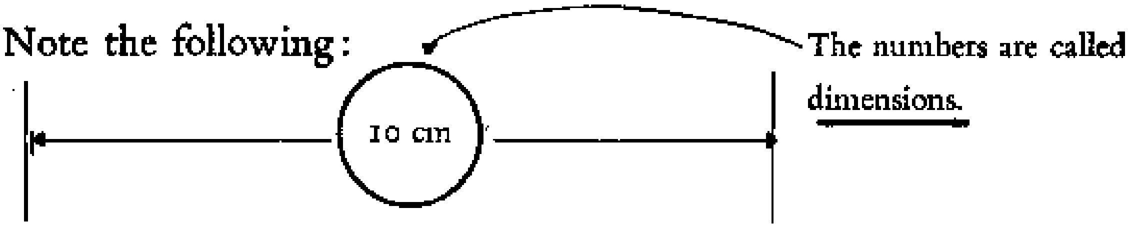
Technical Drawing

Very often in science we need to describe something to someone. A drawing will make our description easier to understand. Sometimes a map will help if we are telling a friend how to get somewhere: a drawing is like a map. If it is accurate it will be even more useful. In Books 1 & 2 you were asked to 'read' the drawing below:

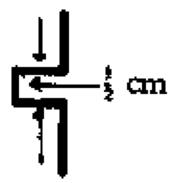


Copy this drawing into your exercise books. Make A—5 cm and B—1 cm. Use a set-square. (Which set-square will you use ?)

Note the following:



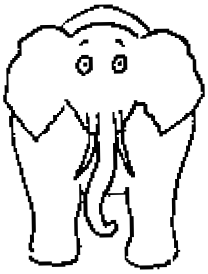
The lines and arrows are important, as they show the exact place where dimensions start and finish. Sometimes there is not enough room on the drawing and the arrows are put like this:



Make a plan of a matchbox and put in accurate dimensions.

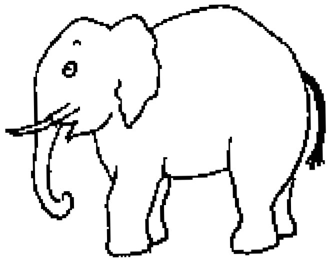
Technical Drawing

Mr Elephant



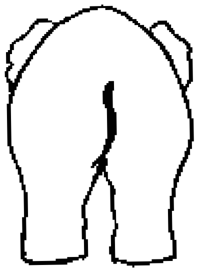
Front view

A



Side view

B



Back view

C

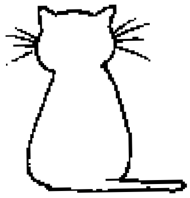
Top view (This is called a plan.)

D

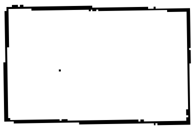
In order to get a clear idea of a thing we sometimes need all four views of it. Try to draw the other 3 views of the following. (One has been done for you in each drawing.) Put in the measurements, or dimensions, which you think would be suitable.

A matchbox
View A

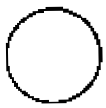
A cat
View C



A table
View D



A ball
View B

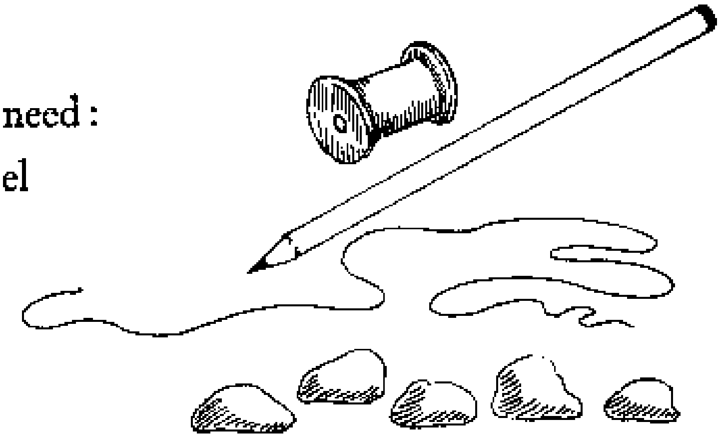


Make more drawings of your own. Make four views (A, B, C & D) of each.

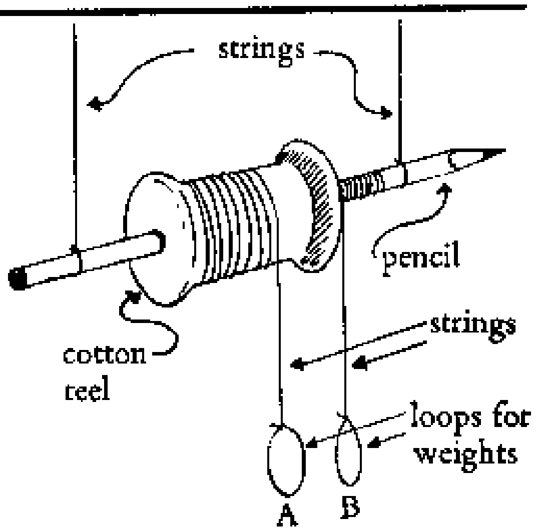
Pulleys

For this experiment you need:

an empty cotton-reel
a pencil
some string
some weights
(stones will do)



Take the cotton-reel and push the pencil half-way through.
Hang it on two strings.
Wind a string round the pencil <u>anticlockwise.</u>
Wind a string round the reel <u>clockwise.</u>



Put an equal weight at A and B.

1 Which will go up, A or B?

Now make B heavier, but only a little.

2 Now which will go up?

Now make A heavier, but only a little.

3 Now which will go up?

Guess first, then try.

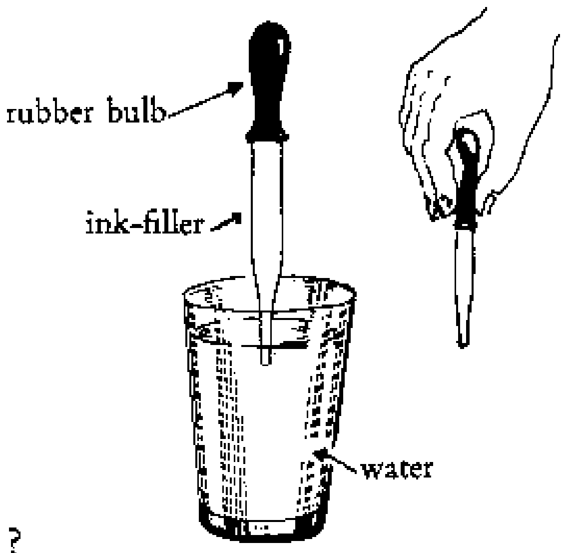
	Guess	Check
●		
●		
●		

Air

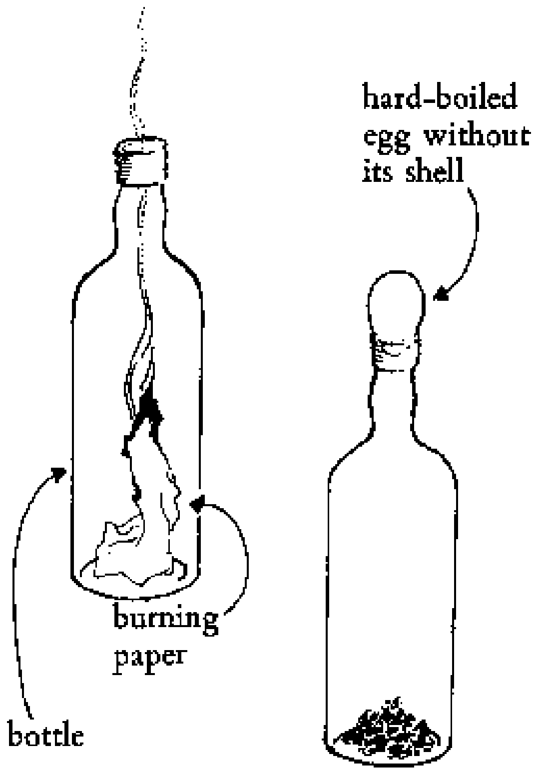
Do you remember one of the things you learnt about air in Book 2? Air presses down in all directions. We say it exerts pressure in all directions.

Two experiments

A Take an ink filler, put it in water, and press the rubber bulb. What happens? What happens when you stop pressing the bulb? Why?



B Ask your mother for a hard-boiled egg. Take off the shell. Get a bottle, and put a little lighted paper inside it. As soon as the flame dies down, put the egg on top of the bottle. What happens? Why?



What is the next problem?

Water

Air exerts pressure in all directions.

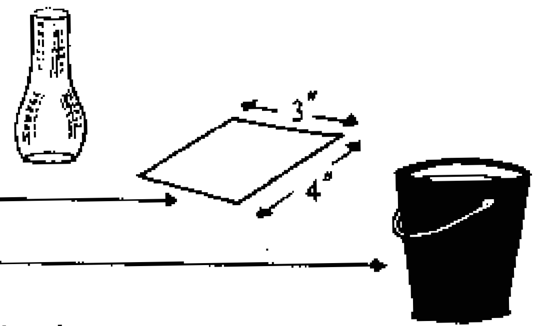
So does water. Can you think of an experiment to show this? (A balloon full of water; a tin with a hole in it; a drinking straw: you might be able to use any of them for such an experiment.)

Another experiment

You need a lamp glass

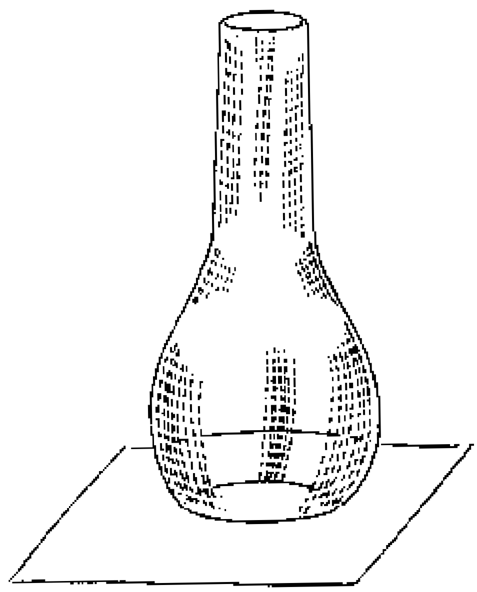
and a piece of cardboard

and a bucket of water.



Put the piece of cardboard at the bottom of the glass, covering the opening. Hold the card on to the opening and plunge the glass and card into the bucket of water. Remove the hand which holds the piece of cardboard, and it will remain in position: the water presses it upwards.

Now pour water gently into the lamp glass. Does the cardboard leave the glass immediately? When does it fall off? Why does it fall off?



Acids

Do you know what an acid taste means? If you eat a green mango or a piece of tamarind you get a sour taste. All acids have a sour taste, but many acids are poisonous. They will also burn if we touch them, or if they fall on our clothes.

If we want to know whether something is acid or not we use a test liquid. This is called an indicator.

Take 2 or 3 slices of beetroot. Put ½ a cup of water into a tin, and boil the beetroot slices for 5 minutes. You now have an acid indicator. Make the following liquids:

1 tamarind water
2 washing soda and water
3 lime (*chunam*) and water
4 lime-juice (*nimbu*) and water
5 vinegar and water

Put a drop or two of indicator into each liquid. If it gives a red colour the liquid is an acid.

What other colours does it give?

What colour does it give in 2 above?

Try a drop or two in milk. What colour does it give?

Metals

Do you know the words expand* and contract?

Expand means to get bigger.

Contract means to get smaller.

Use these words in 3 sentences of your own, e.g.

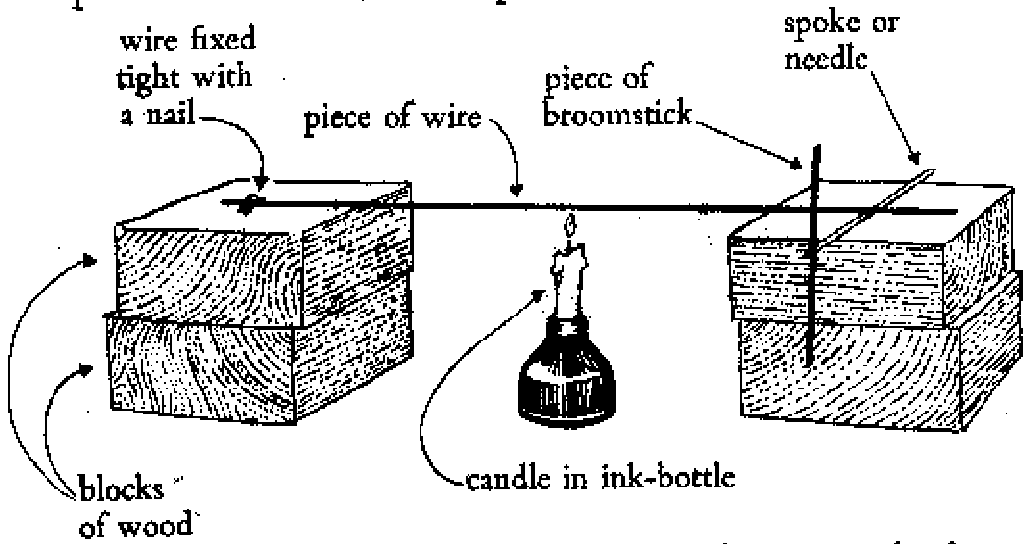
1. When I breathe in, my chest expands.

2.

3.

What happens when you heat metal?

Let's see. You need a piece of wire about 30 cm long, an old cycle spoke or a needle, and a piece of broomstick.

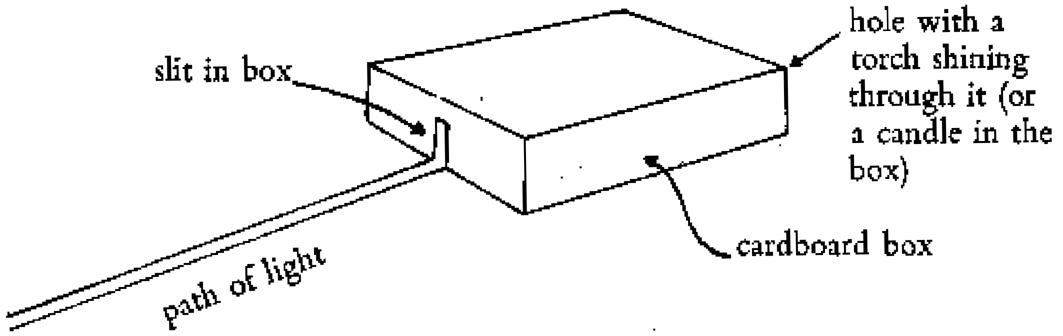


Glue the piece of broomstick on to the spoke, or push the needle through the piece of broomstick. Which way will the broomstick turn if the wire expands? Which way if the wire contracts? What will the wire do when it gets hot, expand or contract?

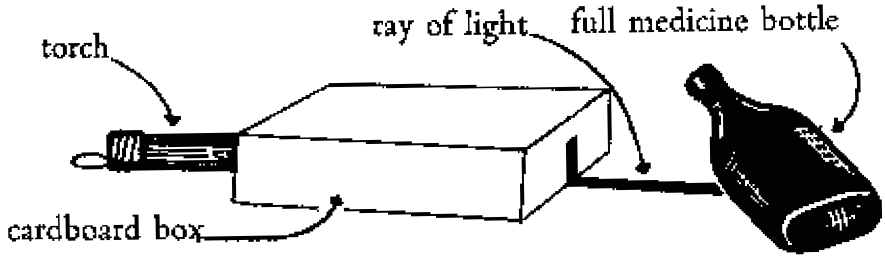
*We used this word on page 11.

Light

Light travels in straight lines. If you shine a torch on a dark night it makes a straight beam, not a curved one. You can see more clearly that light travels in straight lines with the following things:



If light shines through something transparent* the rays can bend. Get a flat medicine bottle and fill it with water and a drop or two of milk. Use the box above and shine the ray of light through it, like this:



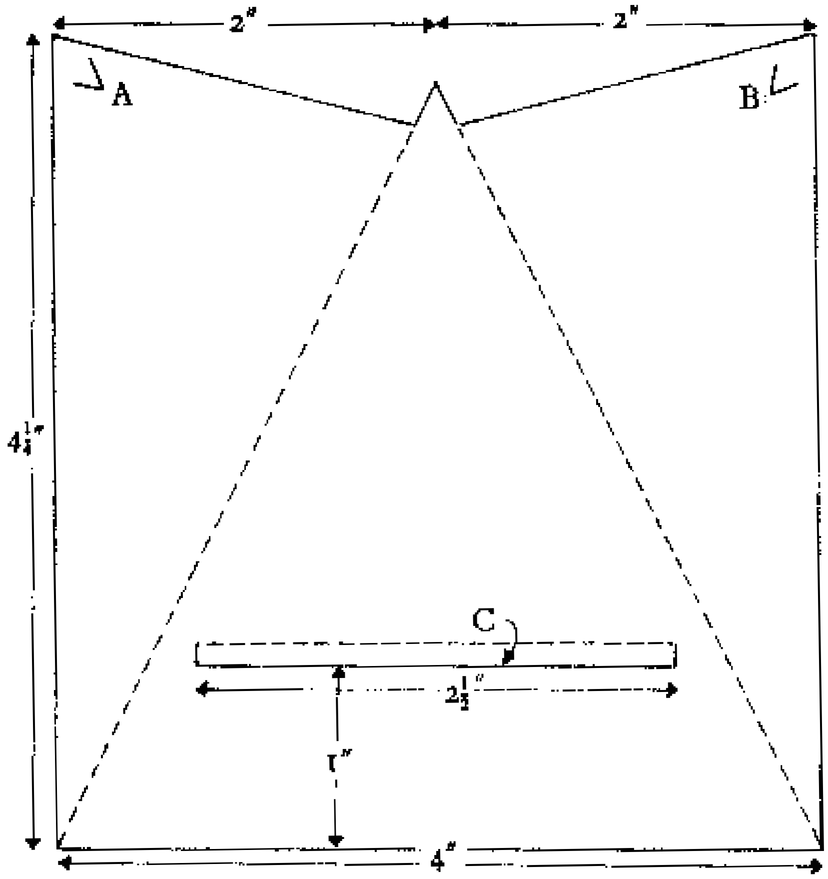
What happens to the ray of light? Finish the drawing above when you have done the experiment. What happens if, instead of the bottle above, you put:

(a) a round bottle of milk and water (b) an empty bottle
(c) a mirror (d) a piece of wood?

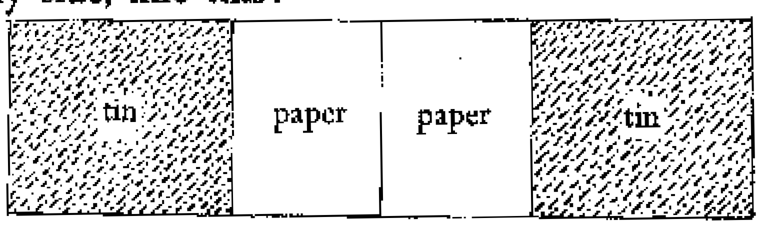
*transparent means you can see through it.

A Kaleidoscope

A kaleidoscope is something which helps you to see beautiful patterns. It is easy to make one.

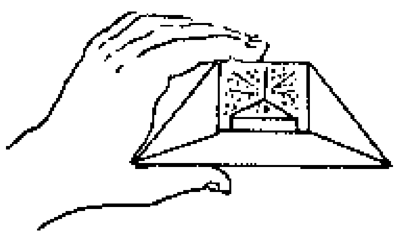


Trace this diagram on to white card. Then cut along the solid lines and bend along the dotted lines. Cut two little nicks at A and B. Lightly press with a knife along the back of the dotted lines, and they will bend more easily. Next we need two mirrors. There is no need to use glass: tin will do perfectly well. Cut two pieces of tin 3" × 1½". Make sure the pieces of tin are quite flat, and then polish them carefully with metal polish or tamarind, until they shine like mirrors. Then paste a paper hinge on the non-shiny side, like this:



A Kaleidoscope

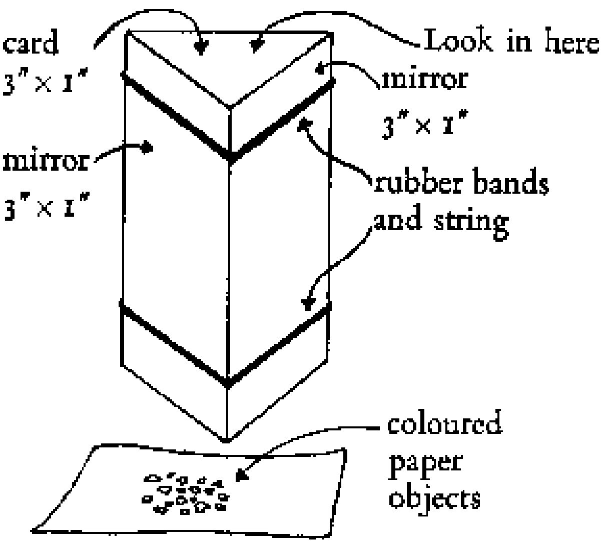
Now place the card on the table and turn up the flap C. Turn up the two triangular pieces of card to form the sides. Now take the two hinged pieces of tin and open them at about 60°; put them in the case so that the small flaps at A and B hold them in position. The flap at C will keep them open. Now hold the kaleidoscope as shown and put some small pieces of coloured paper between the mirrors.



Shake them about and you will get different patterns. What happens if you make the angle between the mirrors greater? or smaller?

See if you can copy some of these patterns into your books.

Another Kaleidoscope



What happens if you make the piece of cardboard

$3'' \times 1\frac{1}{2}''$?

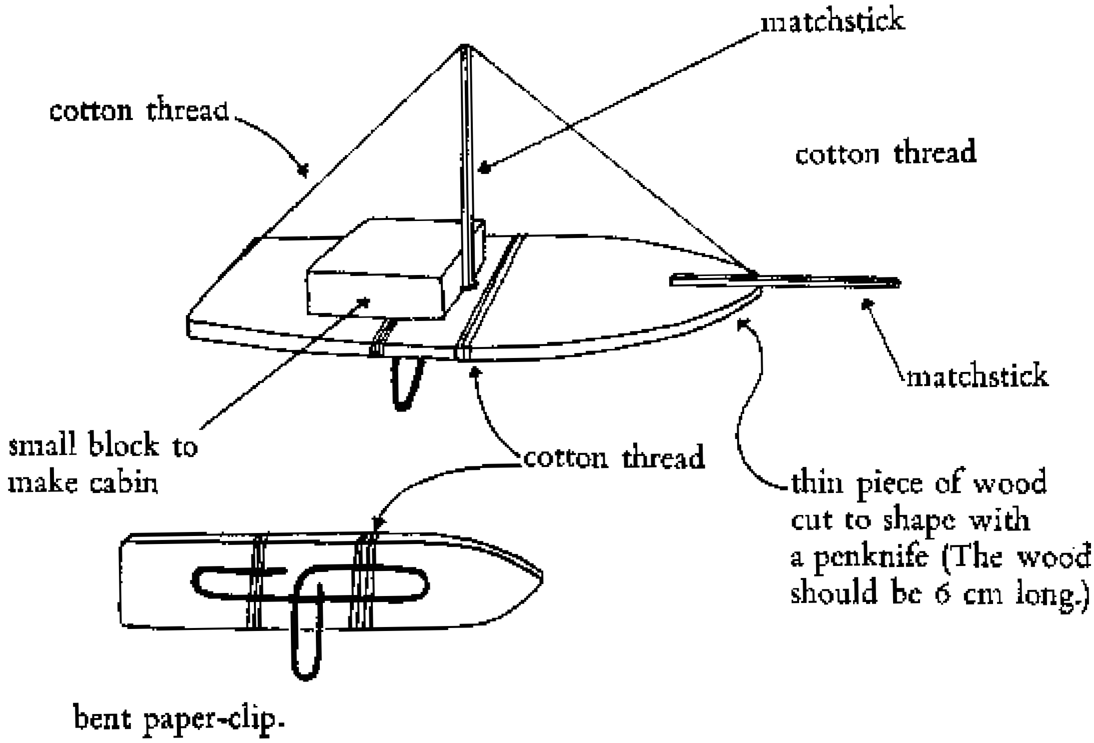
or $3'' \times 2''$?

or $3'' \times 2\frac{1}{2}''$?

Try each size and write about what differences you find.

Magnets

Do you remember what you learnt about magnets on page 12?
Here are some games you can play with magnets.
Make some boats, like this:

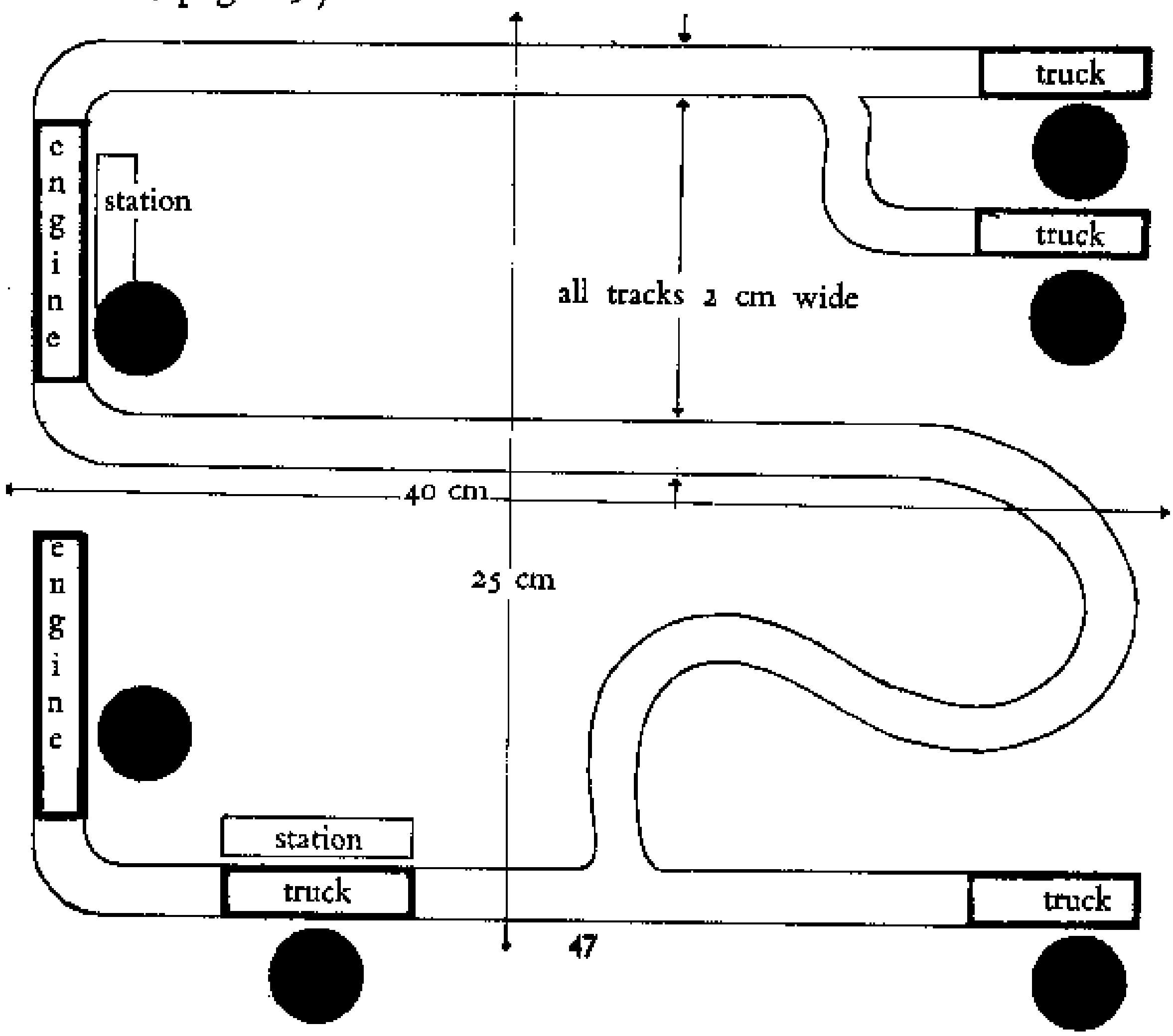


Put two or three boats in some water in a plastic bowl. The water should be deep enough to let the boats float with the paper clip about 1/8" from the bottom. Put your magnet under the bowl and move it about: the boats will go wherever you want them to go.

The train game

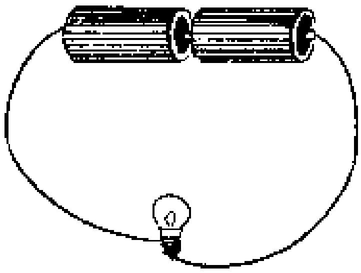
Copy the design on the opposite page on to a piece of white cardboard (or the cover of an old file will do). Put paper clips in place of the engines and trucks marked 1. Support the card on two books so that you can get the magnet under it. The object of the game is to move all the trucks (which are represented by paper clips) to the positions marked 2 in the shortest time: each truck must be pulled by an engine. If the engine or trucks go off the rails you have to start again. Time yourself, and then get your friends to try.

You will have to enlarge this plan to the dimensions shown. (See Book 2, page 19.)

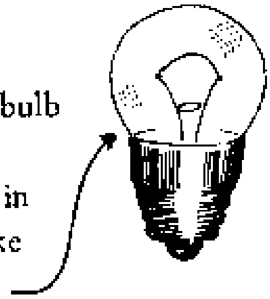


Electricity

Do you remember what you read on page 16?
Look at that page, and read it again.
On that page you made a circuit.
The electric current went from the batteries to the bulb and back again.



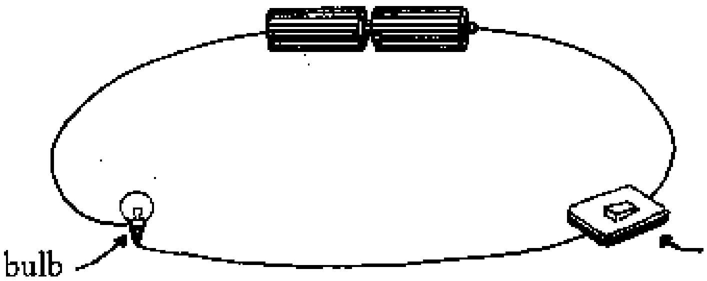
The bulb has a wire in it, like this:



When the electric current goes through the thin wire in the bulb, the thin wire gets white hot. This gives us light. The great heat would burn through the wire, but there is no air in the bulb, and this stops the wire from burning.

Switches

Switches are used for turning the electric current off and on. You can wire one into your circuit like this:

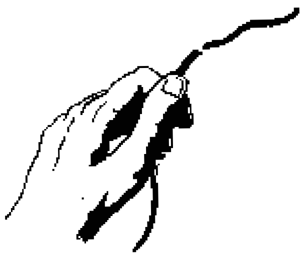


The battery holder and bulb holder have not been shown in this diagram (but see page 16).

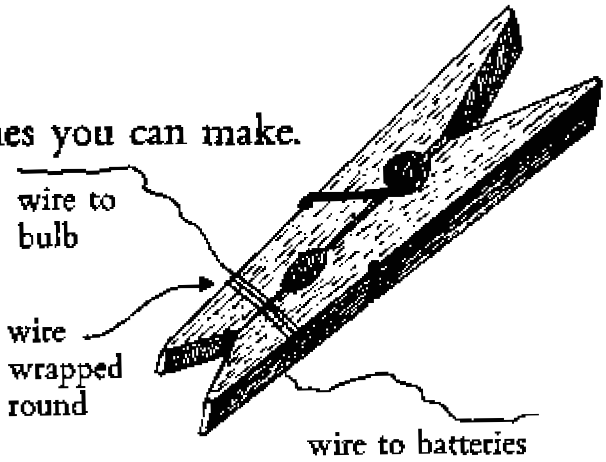
Electricity

Making switches

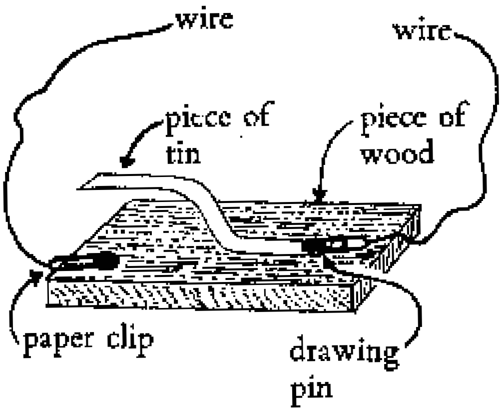
Here are some simple switches you can make.



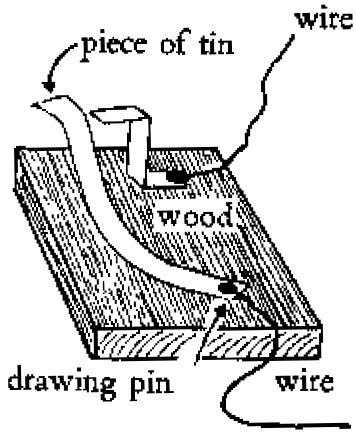
1 Hand switch



2 A clothes peg switch



3 A tin switch



4 On-off switch

What are the advantages of each switch? Which is easiest to make? Is the simplest switch the most useful?

Can you design two more switches of your own, using simple materials?

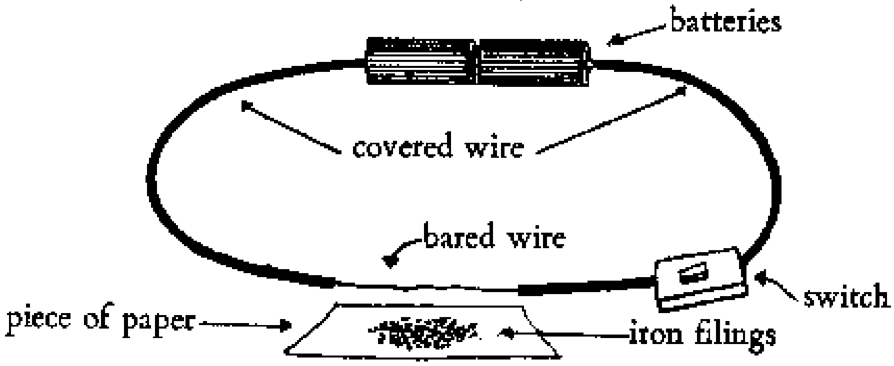
Draw a plan of each switch. (See page 37.)

How would you use a clothes peg for a bulb-holder?

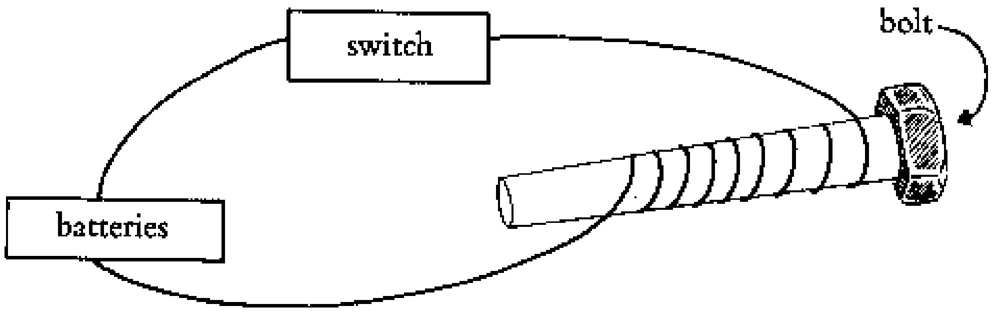
Draw a picture of your answer.

Electro-magnets

When electricity passes through a wire, that wire becomes a magnet. You can test this for yourself. Make your circuit (as on page 48), but bare an inch or two of the wire (that is, take off the plastic covering). If you switch on, and put some iron filings (made by rubbing a nail with a file) beneath the bare wire, you will see how it works as a magnet.



If you coil the wire, and put a large nail or bolt through the coil, magnetism will be greatest round the bolt. You do not need to bare the wire.



This will make a much stronger magnet. Do you get a stronger magnet if you have more turns of wire round the bolt ? How will you test whether one magnet is stronger than another ?

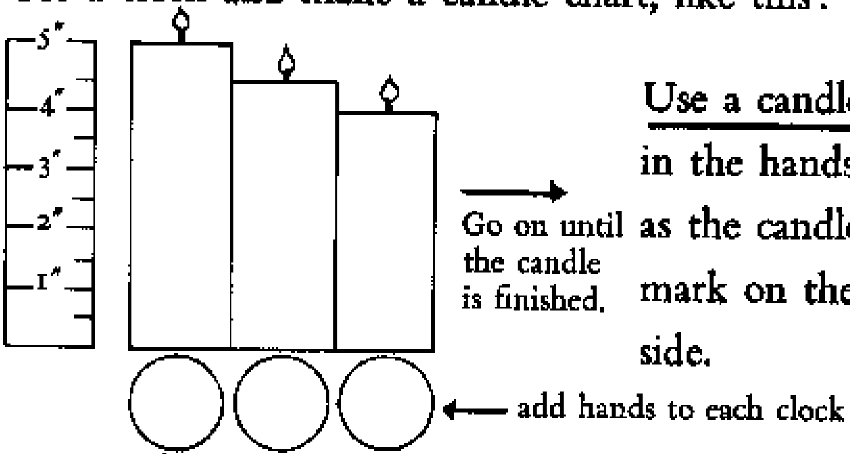
Time

Can you tell the time? Draw clocks showing the following times:

6.00	10.30	9.15	8.45	Easy
7.29	11.04	6.41	12.11	Difficult

Have you ever counted your pulse-beats? Try now. Look at a clock and see how many beats there are in a minute. Is there any difference in the number of beats if you count them after running a hundred yards?

Use a clock and make a candle chart, like this:



Use a candle, and fill in the hands of each clock as the candle reaches the mark on the scale at the side.

Now make a drip clock out of a tin. Take an empty tin and make a very small hole in the bottom. Fill the tin with water, which will then drip out of the hole.

How will you tell the time with it?

Is it better than, or not so good as, the candle as a clock?

Would sand in a tin work as well?

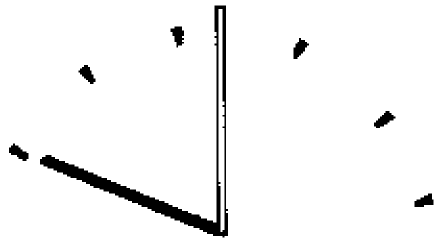
Which is the cheapest of these three clocks?

Can you think of another kind of clock which uses a tin?

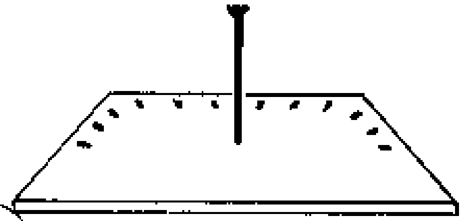
Time

The sun moves at the same speed every day. (Is this true or false ? Does the sun move ?)

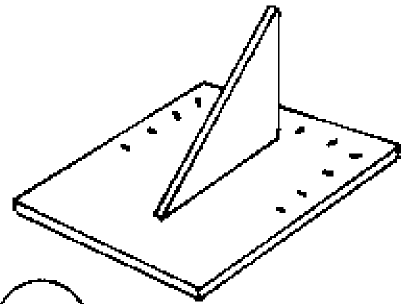
We can tell the time by shadows.



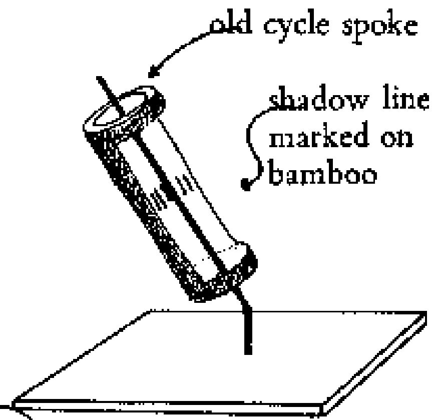
(1) a stick in the ground



(2) a nail in a piece of wood



(3) a sundial



(4) a bamboo shadow clock

Note that in No 3 the angle at X should be the latitude of your school—probably somewhere between 10° and 30°. (Ask your teacher.)

Make all the clocks shown above.

See if they keep the same time as each other.

Do they keep the same time as the school clock ?

Are they better than the clocks on page 51 ?

What are their disadvantages ?

Time

Draw designs for making the following clocks. Make sure your design can be made easily, and make sure that it uses things which are cheap and easy to get.

Clock 1 If something has a hole in it, it will sink slowly in a bowl of water.

Clock 2 Water drips from one bottle to another through a straw: a scale could be made of paper.

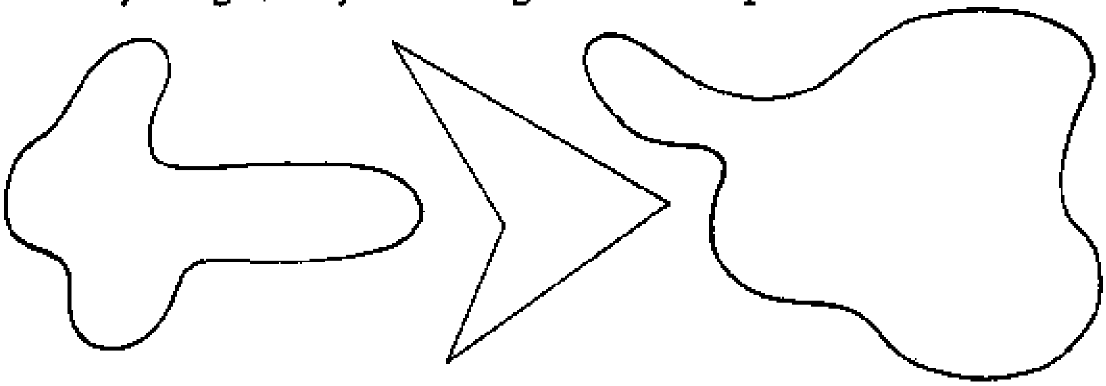
Clock 3 A piece of string is tied to something which floats. If the water drips out of a bowl, the thing floating on it will go down, and pull the string. The string could pull a pointer like a clock.

Clock 4 A small tin can, with a hole. A large tin can. The small can sinks slowly and pulls down a string.

Show your designs to your teacher.
Can you make them for yourself?
Which ones work well?

Balancing

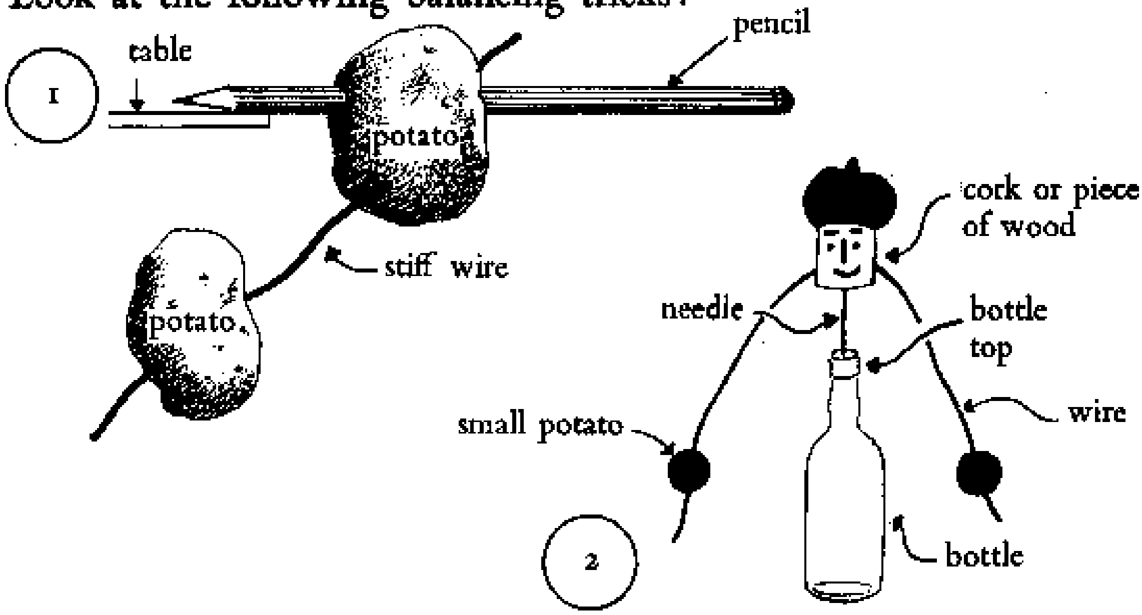
Do you remember what you learnt about balancing in Book 2 (page 21)? Here is a revision of what you learnt. Trace these on to thin card, and make them 3 times as big as they are here. Put an X on the point where you think they will balance: then check your guess by balancing them on a pencil.



The point at which anything will balance is called

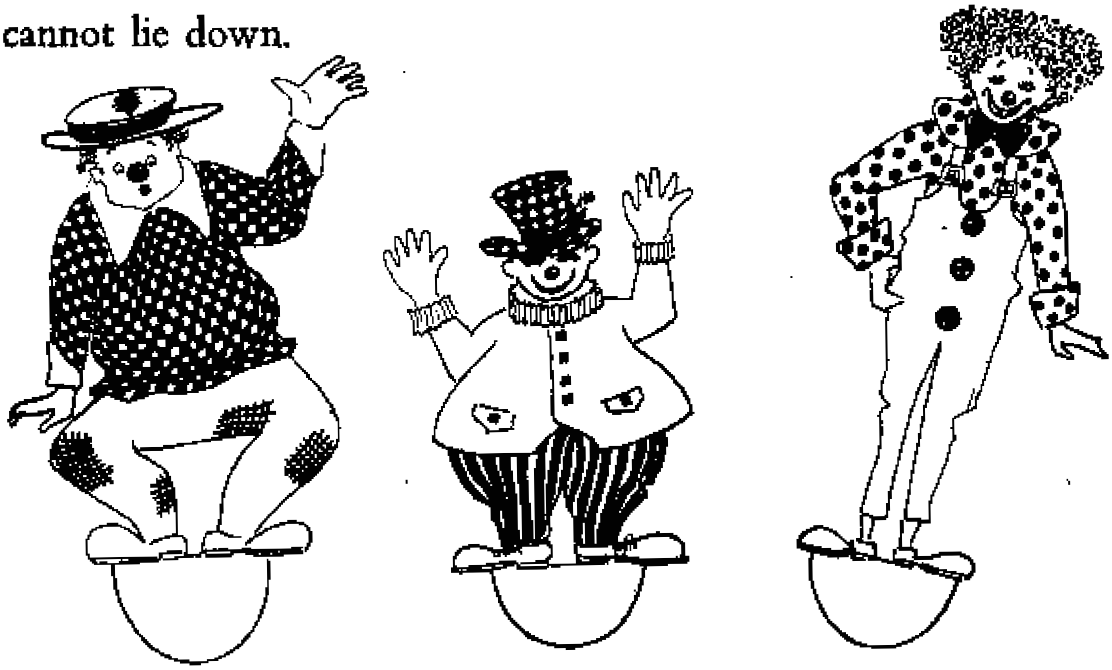
the centre of gravity.

Look at the following balancing tricks:

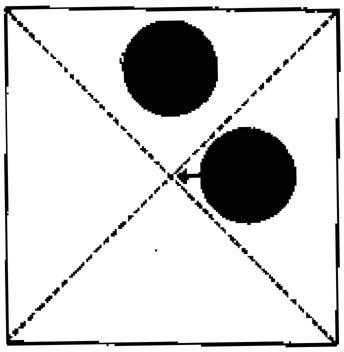


Balancing

Trace these figures on to cardboard, and cut them out carefully. Then stick the feet of each into half an eggshell, and fill the shell with mud. When the mud dries you will have figures which cannot lie down.



Where do you think the centre of gravity of these toys is? Is the centre of gravity always in the centre of a thing? Draw a square on a piece of stiff card. The centre of gravity will be where the diagonal lines cross at B. You can test this

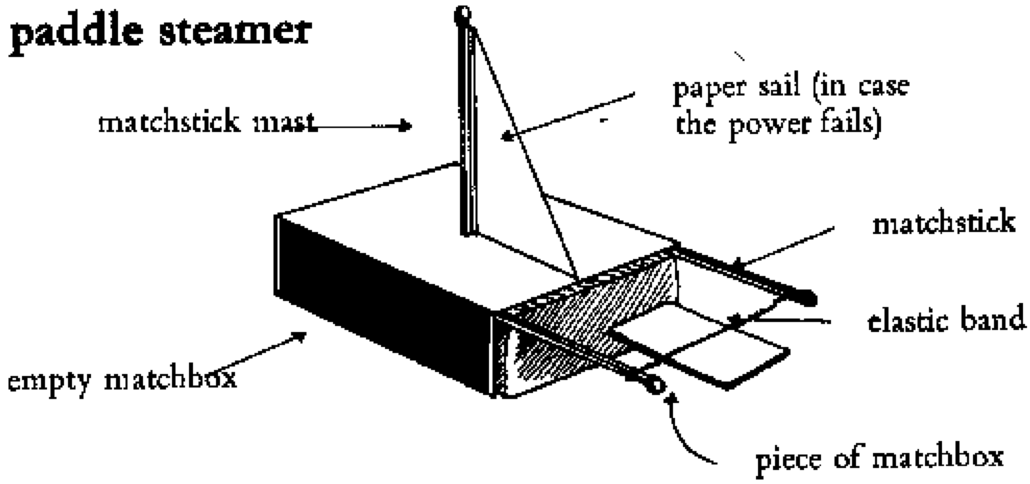


by balancing the square on a pencil point. What happens if you add some clay or mud at A? Is the centre of gravity still at B? Try different positions for the clay.

Elastic Energy

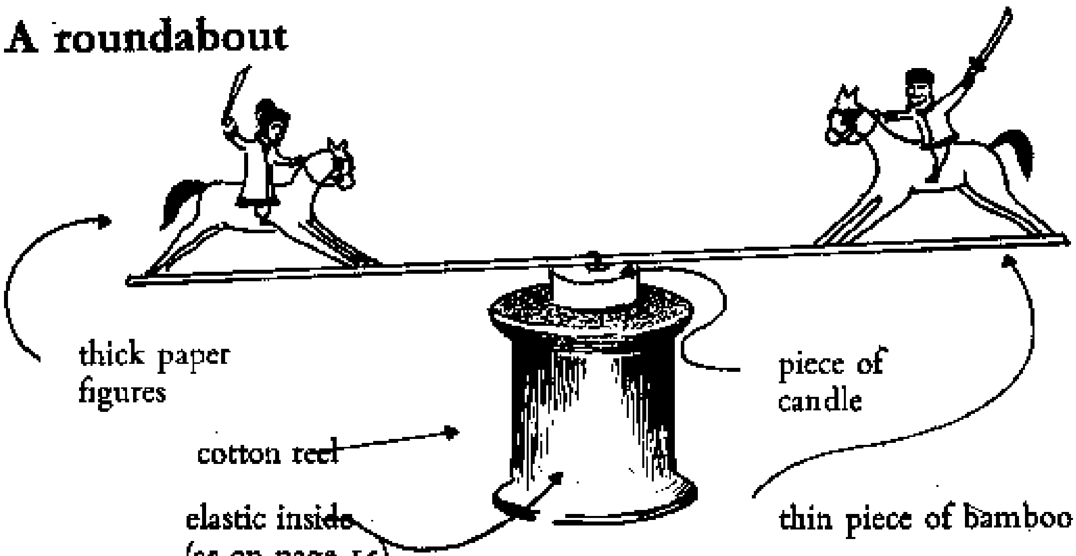
Do you remember the model you made on page 15? It was powered by a rubber band. Here are some more models powered by rubber bands.

A paddle steamer



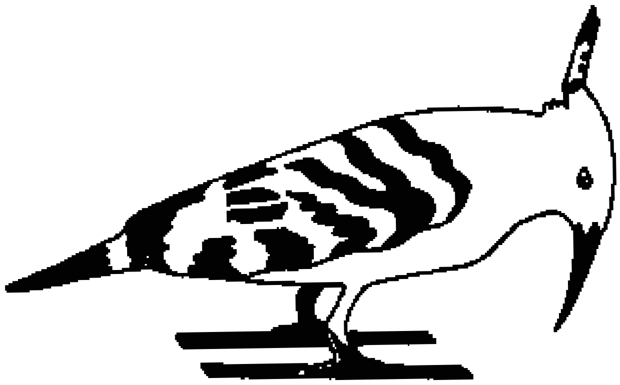
How could you use this idea to make a better-looking boat? Could you use a flat piece of wood? or a stick, cut to shape? or a piece of bamboo? Design another boat and then make it.

A roundabout

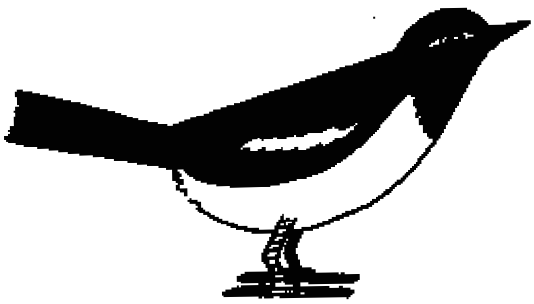


Bird Models

Do you remember the bird models you made in Book 2? They were:



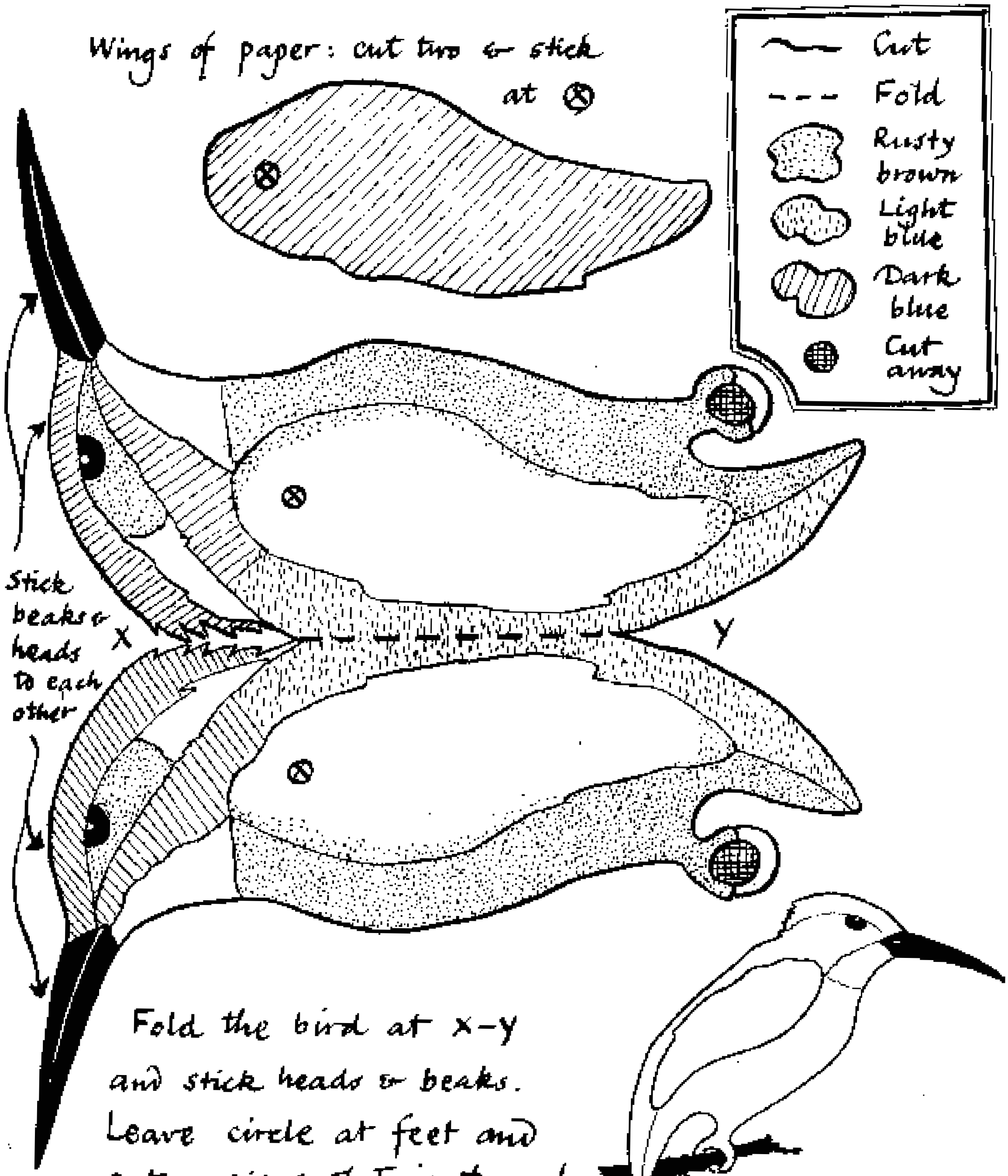
The hoopoe



The pied wagtail

On the next two pages are two more models to be made.
Trace the pictures. Do not cut the book.
Then make new pictures on clean white paper.
Do not trace the letters, or shading: the letters and shading are to tell you what colours to use and where to stick the models.
Follow this order:
Trace. Put on white paper. Paint with the correct colours. Cut out carefully. Stick where required. (Use paste or cooked rice.)

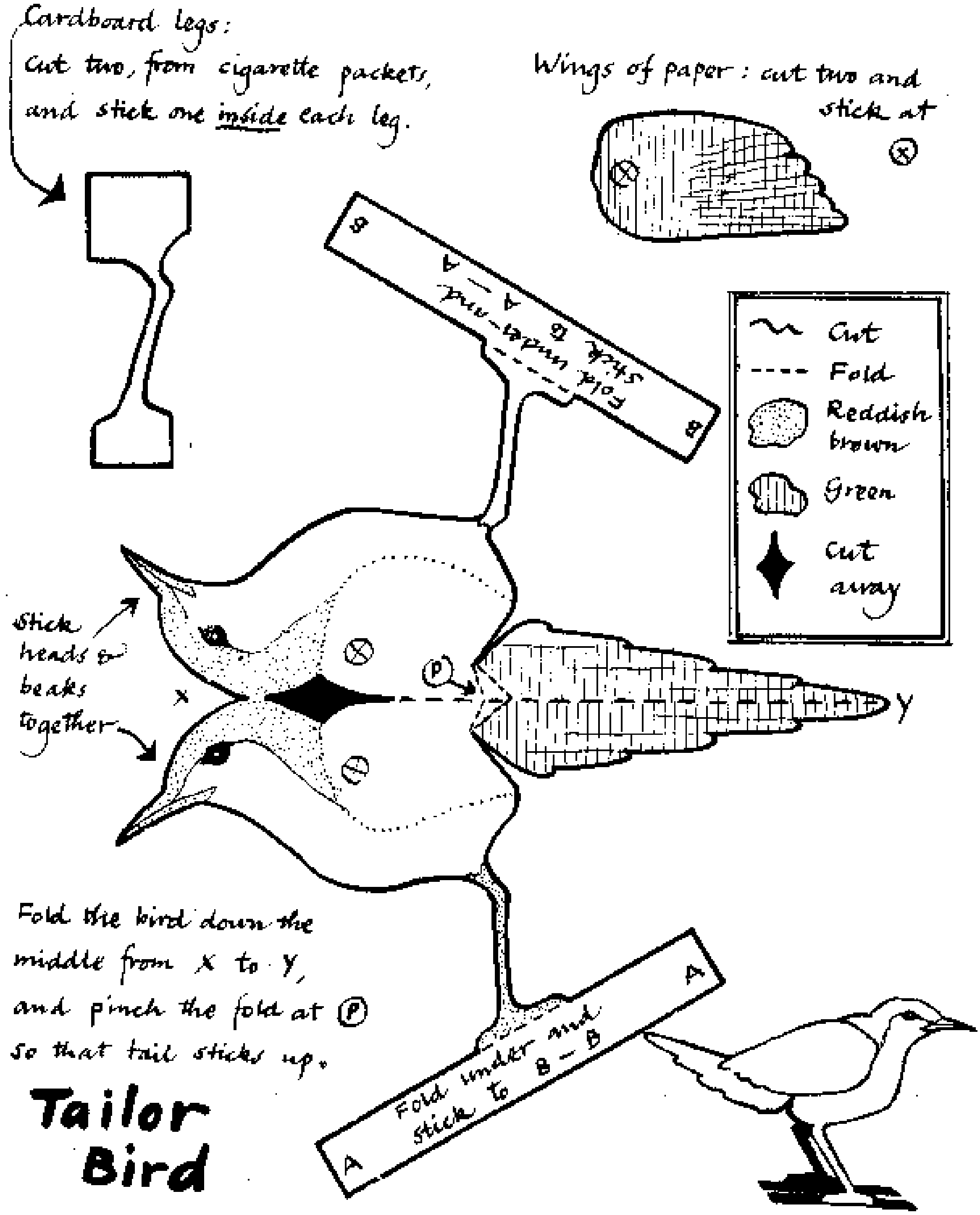
Bird Models



Fold the bird at X–Y and stick heads & beaks. Leave circle at feet and put a piece of twig through the hole. Keep feet 2 cm apart.

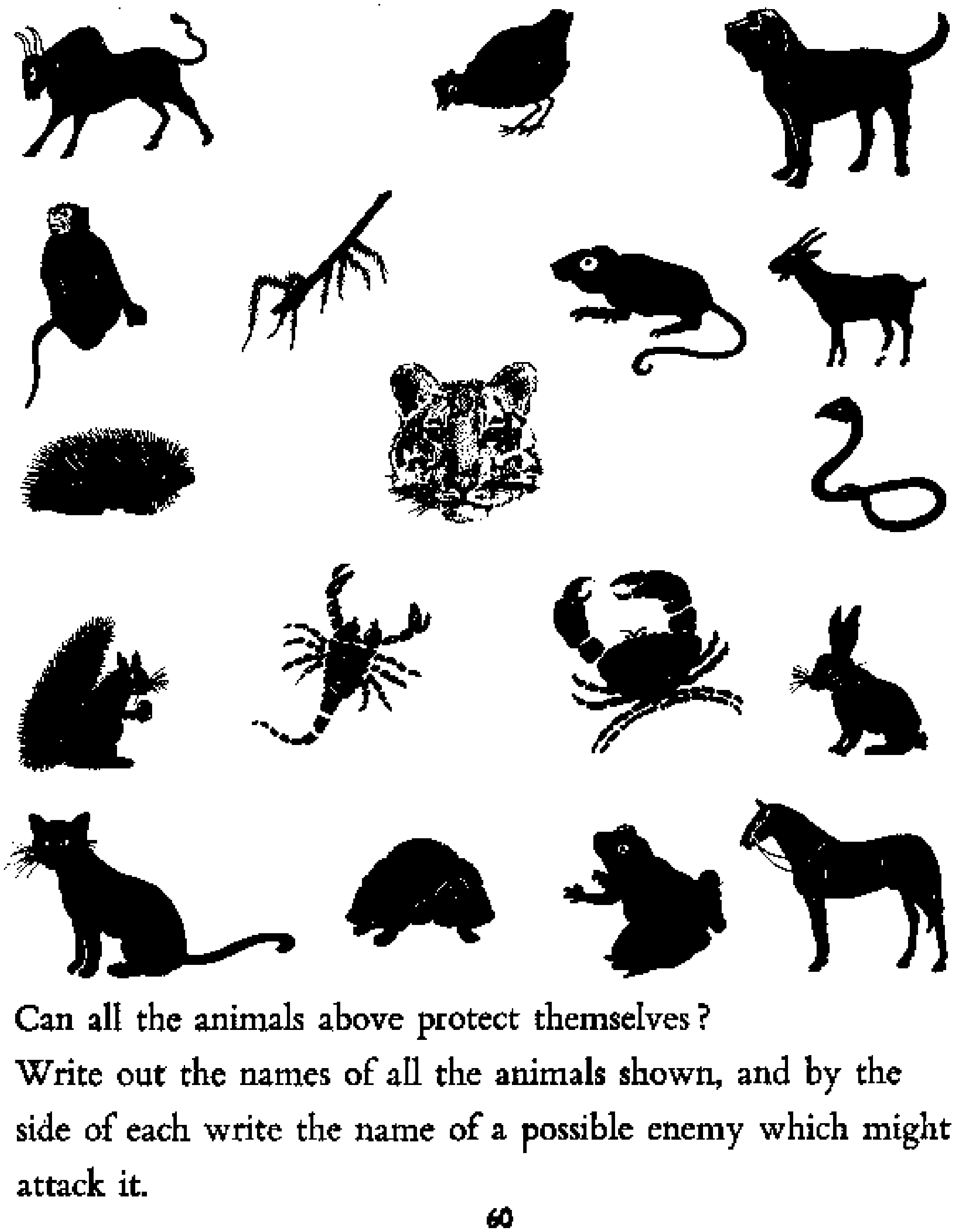
Kingfisher

Bird Models


Cardboard legs:
cut two, from cigarette packets, and stick one inside each leg.
Wings of paper: cut two and stick at ⊗
Cut
Fold
Reddish brown
Green
Cut away
Fold under and stick to A — A
B
B
Stick heads & beaks together
X
P
Y
A
A
Fold under and stick to B — B
Fold the bird down the middle from X to Y, and pinch the fold at P so that tail sticks up.
Tailor Bird

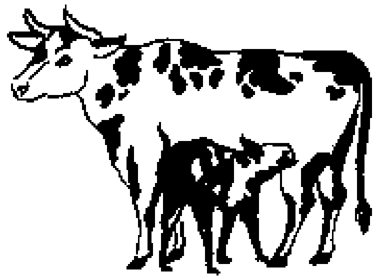
Animals

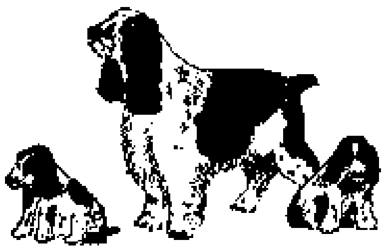
Animals protect themselves in **different ways.**
How do the animals below protect themselves?

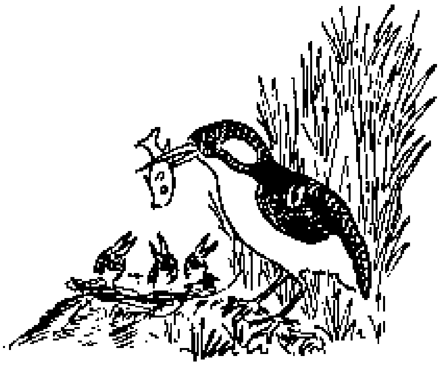


Can all the animals above protect themselves?
Write out the names of all the animals shown, and by the side of each write the name of a possible enemy which might attack it.

Animals and Birds







Write five questions about each of the birds or animals above.
Write different questions about each one.
Use the following:

How . . . **What . . .** **Where . . .** **Does . . .**

and ask questions about some of the following things (or anything else you can think of):

food, breathe, sing, talk, teach, move, drink, teach its children, make a house, fight, help others, help us.

Get one of your friends to answer your questions.

Machines

Do you remember what you learnt about machines on page 25 of this book? Please read that page again.

Most machines have many parts. Some of these parts are:

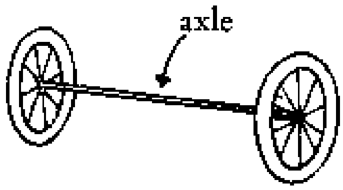
<u>an axle</u> <u>a shaft</u> <u>a crank</u> <u>a treadle</u>

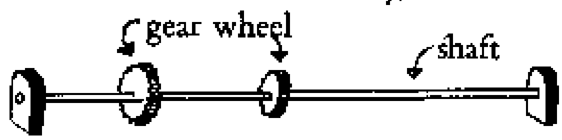
<u>An axle</u> is usually a round rod and carries two wheels. Write five things which have axles; describe each axle as accurately as you can, and say what wheels it carries.

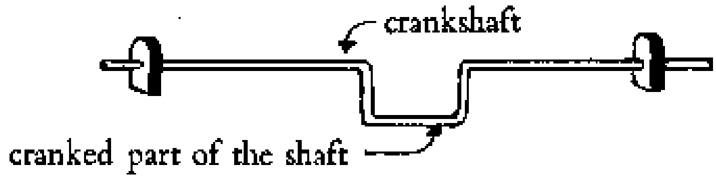
<u>A shaft</u> is the name given to an axle in a machine. It is usually a round rod of metal, and may carry gear or other wheels.

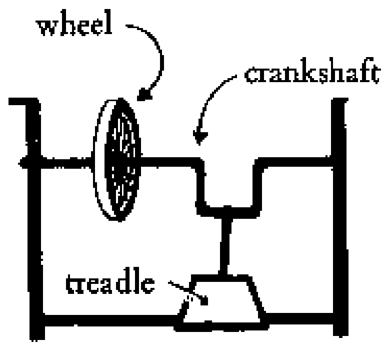
<u>A crankshaft</u> is usually a piece of shaft with a double bend in it. It changes the direction of force.

<u>A treadle</u> is a part of a machine which is worked by the foot.



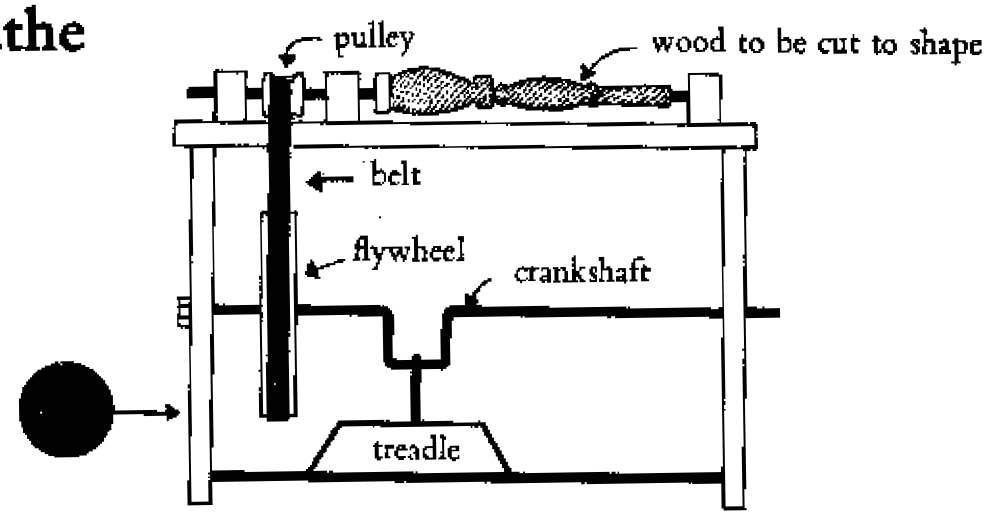




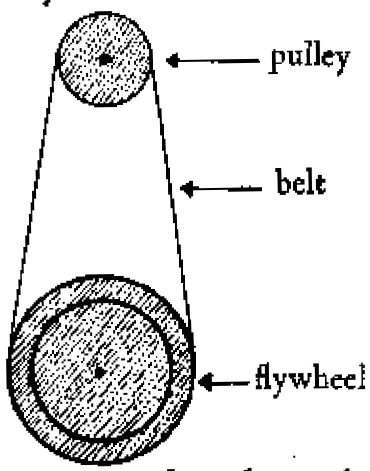


If your foot is pressed up and down on the treadle the crankshaft turns the wheel round and round. An up-and-down force changes to a round-and-round force.

A Lathe



A lathe is a machine in which something (wood or metal) is turned round very fast so that it can be cut to shape. If we look at the flywheel, pulley and belt from A they would look like this:



If the treadle is pushed up and down the crankshaft goes round and round. The flywheel goes round and round too because it is attached to the crankshaft. The belt then drives the pulley round. The piece of wood then goes round and can be cut by a chisel.

Which goes faster, the flywheel or the pulley? Give a good reason for your answer.

Think of six things which have been made in a lathe, three of metal and three of wood. Draw a picture of each and describe it and its uses.

Flowers

Do you remember the parts of a flower you have learnt about?

Stalk, leaf and petal.

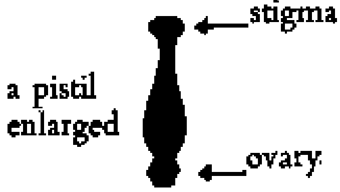
Draw any flower and show the stalk, a leaf and a petal.
Most flowers have petals and leaves, of different shapes.
Have you got a book of leaves? (See page 23.)

Most flowers have small green protections outside the petals. These are called sepals.

Inside the flower are the stamens. These make the pollen, which is often like fine powder.

In the middle of the flower is the pistil.

At the bottom of the pistil is the ovary. The ovary has seeds in it and later becomes the fruit. At the top of the ovary is the stigma.



Flowers

The <u>sepals</u> protect the young flower when it is in the form of a bud. The <u>stamens</u> produce <u>pollen</u>. When the stamens are ripe they open and the pollen is scattered.

The <u>pollen</u> is caught by the <u>stigma</u>. Sometimes the wind carries the <u>pollen</u> to the <u>stigma</u>. Sometimes insects carry the <u>pollen</u>.
The <u>ovary</u> produces the <u>fruit</u>.
The <u>fruit</u> contains the <u>seed</u>.

Find five different flowers.
Make a careful drawing of each, and a drawing of each part.
Label, with a little arrow, the following:

the petal, sepal, pistil, stigma, ovary

Choose the largest flowers you can. Small flowers are difficult to see clearly.

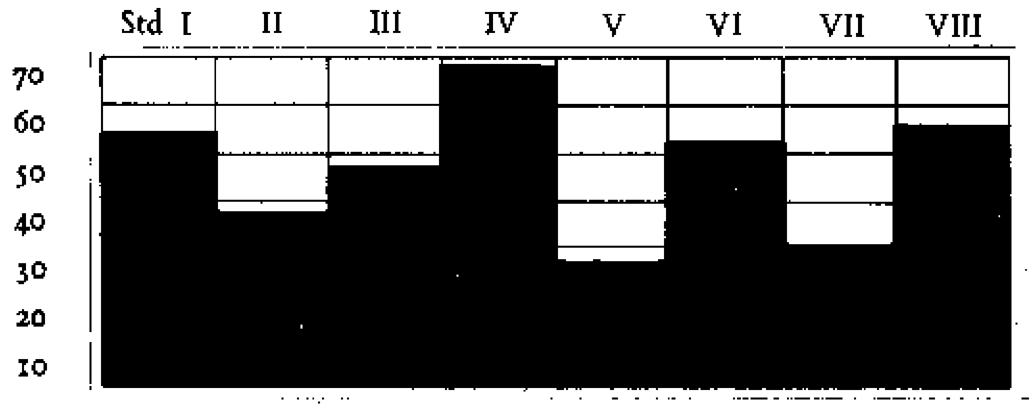
Collect as many flowers as possible. Press each between clean sheets of paper, then sheets of newspaper. Put a heavy book or two on top of them. Then stick them in your exercise books.
Try to find the name of each flower.

Numbers in Pictures

Very often, when you make some experiments, you get a collection of numbers. Sometimes it is difficult to see all the numbers at once, and we represent the numbers by pictures. For example, here are the numbers in each class in a school.

Std I	64	Std II	37	Std III	45	Std IV	72
Std V	27	Std VI	51				

These could be shown on a graph, like this:



How many children are there in Std VII and in Std VIII?

You could show this pictorially in another way, like this:

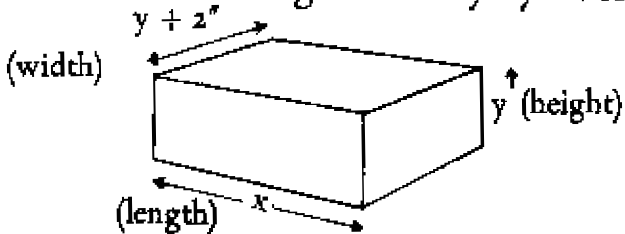
Fill in the space above for Std III. What do you think is the difference between  and  ?

Make a similar chart for your own school.

Show the number of boys and girls in each standard and in each section.

Symbols

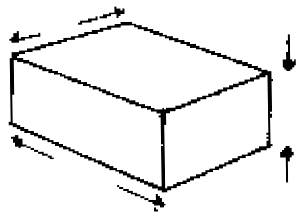
Do you remember what you learnt about signs and symbols in Book II (page 36)? Scientists use a great many symbols. Look at the following:



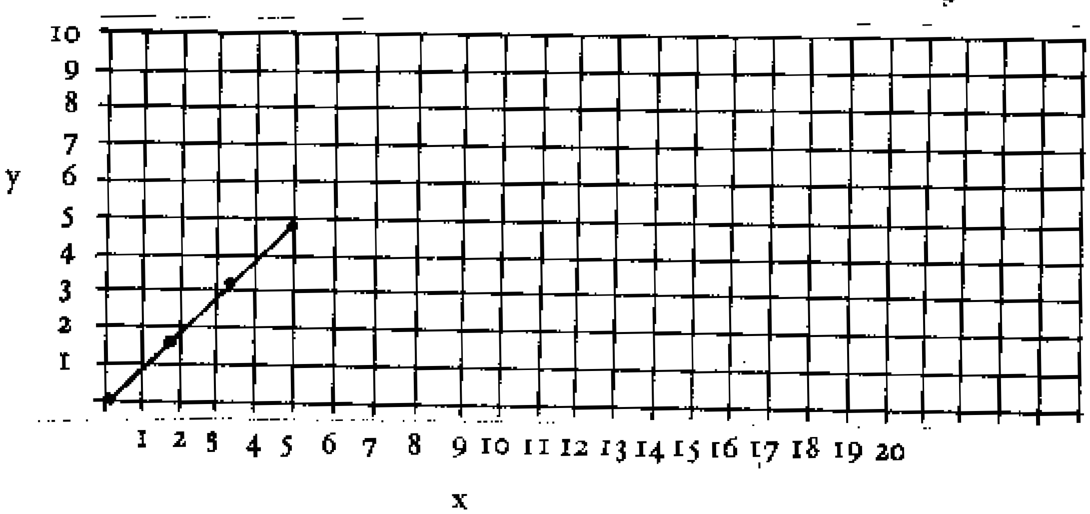
Imagine you have been asked to make a number of boxes, all different sizes.

The first box: x = 5", y = 2". What is the width?

If x is twice y, what are the dimensions of the box when x = 6"? Put them in this drawing:



If x is always twice y
we can make a graph, like this:



Fill in the remaining dots on the graph.

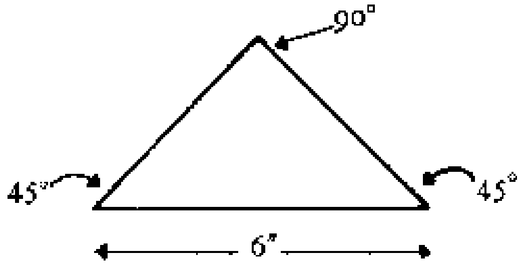
Write 5 questions about boxes with x = 2y (twice y).

Draw 3 boxes (x = 4, x = 8, x = 12) and put in the correct dimensions.

Drawing

Do you remember making the drawing instruments described on pages 34 and 35 ? This is how you can use your set-squares to draw a triangle.

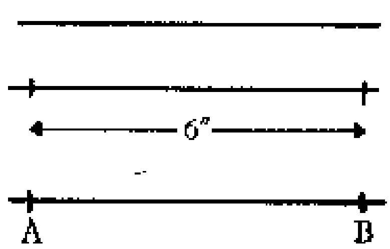
This is the triangle we want:



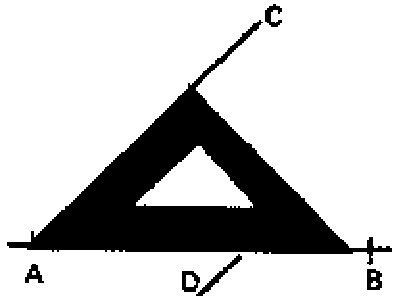
Steps

Draw a straight line with your ruler. Mark two points six inches apart.

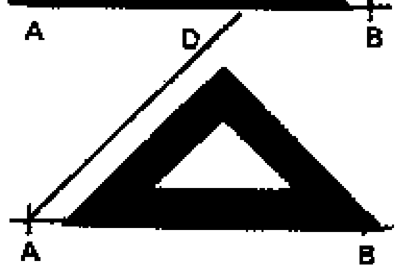
Mark them A and B.



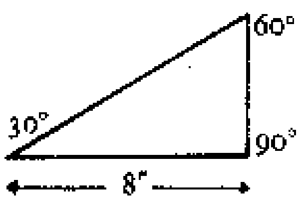
Put your 45° set-square on the line, with the point at A. The bottom of the set-square must be level with the line.

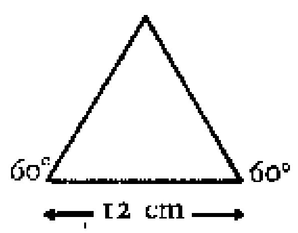


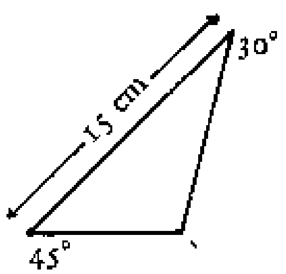
Draw a line from A to C. Turn the set-square and do the same from B to D.



Draw some more triangles, using the angles and dimensions given below:







The Train Game

On pages 72 and 73 you will find the board for the Train Game. Cut out these two pages and stick them on thin cardboard, so that the two pages join at the correct place. To play the game you need two dice, each numbered 1–6. (See Book 1, page 39.)

To begin the game

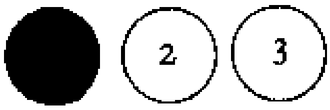
Any number of players can play, but up to four is best. Each player must have one of the small numbered discs near the bottom of this page. This is his train, and it will move along the track as he throws the dice.

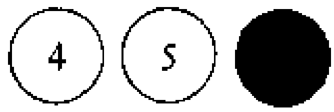
To begin with, each player throws one dice three times.

1 The first throw tells him whether he is a Passenger Train or a Mail Train. (Nos 1, 3, 5 make him a Passenger Train. Nos 2, 4 or 6 make him a Mail Train.)
2 The second throw tells him which station he starts from. (Each major station is numbered, 1–6.)
3 The third throw tells him which station he is going to (his destination). If he throws the same number as in Throw 2, he throws again.

Playing

Each player throws in turn, and moves according to the score of the dice. Passseger trains use one dice, Mail trains use both dice. If a player lands on a square with a letter on it he follows the instructions according to the letters below. If he falls on an intermediate station (a black square) he misses two moves. To finish his journey a player must get the exact number required.





The Train Game

If he goes past his destination, he stays where he is and throws again next turn. For numbers required less than 3 he may use only one dice if he wishes.

The winner is the player who reaches his destination first.

Instructions

A You have lost your luggage. Go back to the nearest station.

B Your train has speeded up. Move on four squares.

C FIRE! on the train. Go to the nearest station, but not to your destination, and miss three moves.

D You see an old friend in a passing train. Go back to the last station and meet him. Then start again.

E You have to move on to a Goods Train. Miss every other throw.

F Line repairs. Miss one throw.

G Total Rail Strike. Miss four turns.

H A train smash. Go back to last station and spend two moves in hospital.

I A train robber has stolen something. If your name begins with a letter from A to K, you are suspected. Spend two moves in prison.

J Go back to your starting station and start again; but now you have to go *via* Madras.

K Go back to your starting station and start again; but now you have to go *via* Delhi.

L Go back to your starting station and start again; but now you have to go *via* Bangalore.

M Go back to your starting station and start again; but now you have to go *via* Hyderabad.