

PREPARATION FOR UNDERSTANDING

HELPING CHILDREN TO DISCOVER ORDER IN THE WORLD AROUND THEM

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Drawings by Julia Warren

Introduction

Before children can understand a thing, they need experience: seeing, touching, hearing, tasting, smelling; choosing, arranging, putting things together, taking things apart. Experimenting with real things.

Old-time school teaching used only words and the old-time teachers thought children knew something if they could repeat it. Now we know better: we want from children achievements, not words from their mouth. The reason is that we want from them as adults, achievements, not speeches.

As we teach, we should set a good example by not making long speeches to children.

To reach practical understanding we do not need to use many words with young children. Let the wordless communication of things do their teaching at this stage.

Encourage the children to get the experiences. Help them - but not too much. Help them to get the materials they need and guide their work but do not tell them too much. Do not explain too much. Later in school, the children will have the theory and the explanations.

Let the children also experience failure sometimes. Then encourage them to work with patience until they turn it into some kind of success.

When children achieve something successfully, they are glad and it gives them confidence to attempt further activities.

Confidence encourages further learning.

Children are clever. When young they learn a lot for themselves. But they need time to understand, so if children are puzzled by something they are doing, let them puzzle and think for a long time if they wish. Do not tell them an answer if they can find it themselves from what they are doing. Help them to try fresh experiments to discover the answer. Do not spoil their chance of real understanding by too quickly giving them an answer in words.

The activities in this book are designed to avoid the use of too many words.

The introduction to each activity is brief and is addressed to the children for the adult who is teaching, to speak just as it is written, or to modify to suit the children, the materials available and the local situation.

Young children learn best from simple things. And naturally it is most helpful for them to understand first those things that are around them in their daily lives.

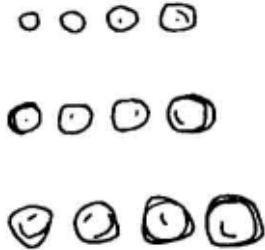
It is best for two or three children to work together at these activities so that they can share materials and help each other. Thus they begin to learn cooperation.

This book is particularly a preparation for understanding Science. Science is built from curiosity, experience, analysis and finally the expression of a discovery. The main part of this process is arranging objects, activities and ideas so as to create a new order or pattern. Science is the discovery of new patterns. This book is to help children discover the patterns and arrangements of the world around them by using their hands, senses and minds.

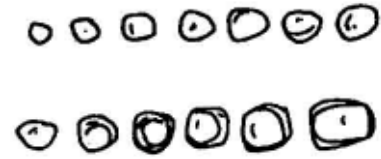
Understanding is the discovery of order.

SIZE

Get a handful of small stones. Divide them into three groups and put each group into order according to size.



Then mix them together again and divide them into two groups and put these in order.



Then mix them again and put the whole the whole lot in order.

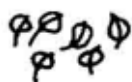


Do the same thing with a small handful of wheat, dal, beans or any other small articles you have. This is more difficult because there is not much difference in size.

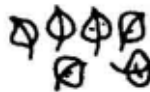
Do the same thing with a small amount of earth or sand or gravel. You will need to shake this gently on a leaf until the bigger pieces separate from the smaller ones. Or you could toss it up and down carefully like people do to winnow grain.

Use only a small amount or it will take too long.

Get a small plant with all its leaves on. Take all the leaves off and arrange them into



Small leaves



Middle-sized leaves



Big leaves

Tell me about the thing that people in your village or towns separate into sizes.

Explain why they do it and how they do it.

Think of cooking, farming, making clothes, shoe making, and so on.

SIZE

Discuss the insects that you know. Tell me their names in the order of their sizes, starting with the smallest and I will write them down.

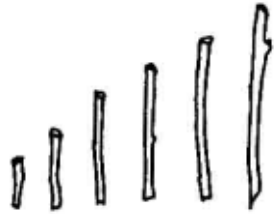
Next, tell me their names again but starting with the biggest this time.

Afterwards, you write some of their names down for yourself.

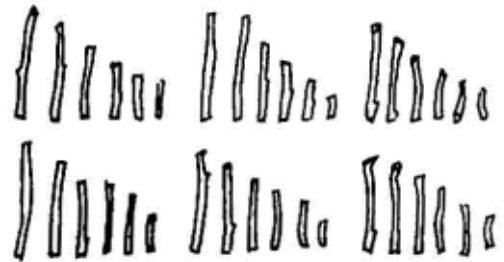
Then do the same thing with the birds that you know. And then with animals. Draw some of them it does not matter if you cannot draw them properly. Try your best.

Write some of their names.

Break some sticks into different lengths. Then arrange them in order from smallest to biggest. Do this all by yourself.



Afterwards, if there are several of you doing the same thing, bring all your sets of sticks together to make a sort of pattern on the floor.



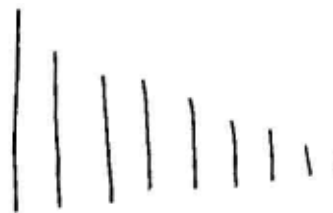
At the end, all of you can mix all your sticks together and then make a big arrangement of all the sticks from biggest to smallest.



Draw some lines that gradually get longer as you go from left to right.



Draw some lines that gradually get shorter as you go from left to right.



This needs a lot of children. Line up along the side of a room or outside, in the order of your heights with the smallest of you at the left and the tallest at the right.

Try to do it by yourselves without any adult helping you. This makes it difficult. Try to find your right place without arguing. That shows you that you can do things quicker if you cooperate with each other.

Then mix yourself up again. Then arrange yourselves again. Next, arrange yourselves in order the opposite way, with the smallest at the right and the tallest at the left.

SIZE

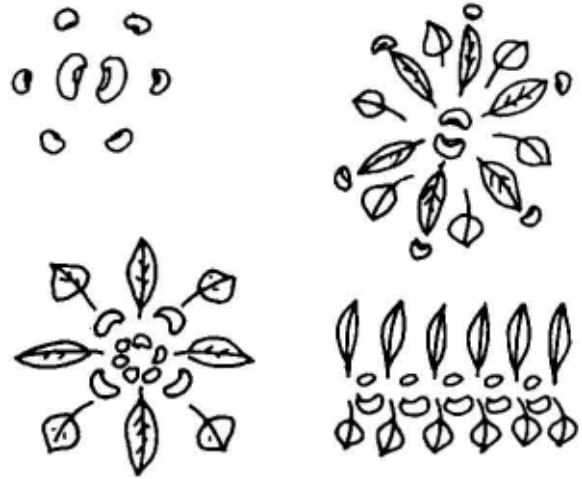
Get some nuts, seeds and leaves so that you have four types of things of different sizes. Get about six of each type, such as 6 small seeds, 6 larger seeds, 6 nuts bigger still and 6 large leaves.



Take plenty of time and make as many patterns as you can think of.

Arrange them, in a pattern so that it looks attractive.

Use some of them or all of them.

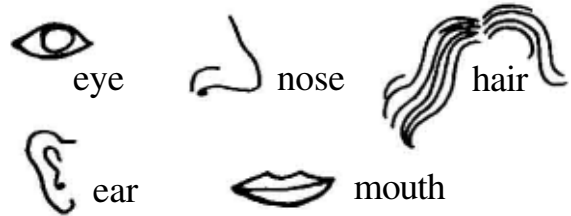


Draw your face.



It does not matter if you cannot draw it well. Do it on a slate or on the ground, in the dust or on paper.

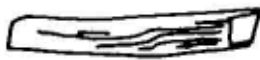
Then draw separately the small parts of your face and write the names of them if you can.



door



roof tile



wood



window



brick

Look at a building such as the house you are in.

Draw it.

Tell me all the parts of it, the big ones and the small ones.

Draw the parts as well as you can and write their names beside them.

Discuss the kinds of work that are done at home that need small things put together to make large things: such work as sewing, cooking etc.

Then discuss other work done in your village or town, like making pots or carts. Draw the small things and the big things that are made from them.

SHAPE

Here is a plantain leaf (or tray or thali) full of stones Separate them into different kinds of shape: round ones, flat ones, sharp-edged ones, and so on. Of course you cannot do this perfectly, but do the best you can. Tell me the kinds of shape you have chosen.



Here are lots of leaves. Separate them into wide, fat ones



and thin, pointed ones



Separate these twigs into straight twigs ...



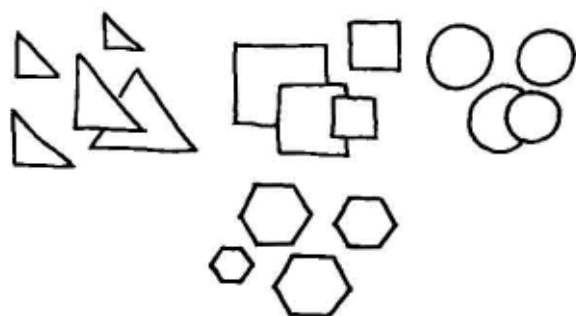
curved twigs....



and twigs that have sharp bends ...



Do the same with these pieces of wire I have made for you. I give them to you all mixed up.



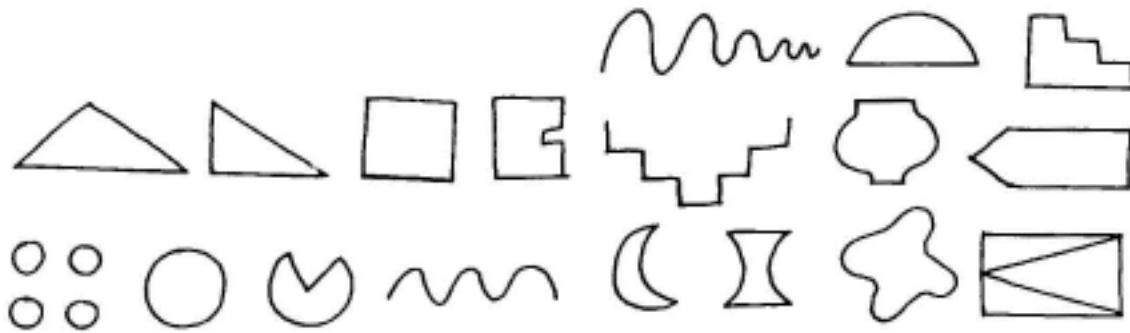
And here is a mixture of shapes cut out hexagons.

Instead of my giving you many of there, make some for yourself by cutting up (or tearing) leaves or paper.

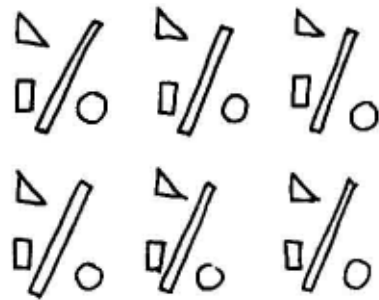
Try to make them neatly if you get big leaves and crease them first before you tear them, it is easier to make them tear neatly.

SHAPE

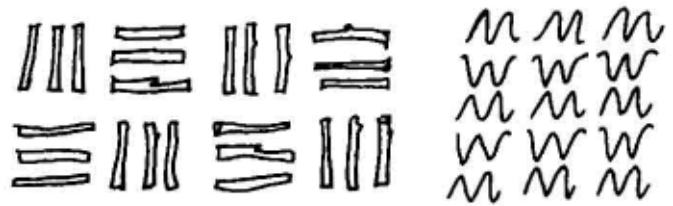
Look at these shapes I have drawn for you.
Copy them carefully on a slate or on paper or
in the c



Draw 3 or 4 very simple shapes. Then
make a pattern by repeating the drawings
of the shapes many times.

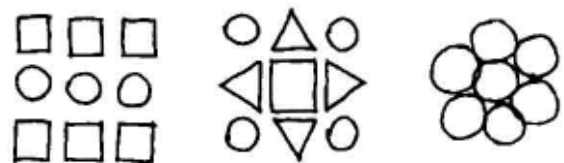


Make patterns with twigs or shapes of
wire laid on the floor



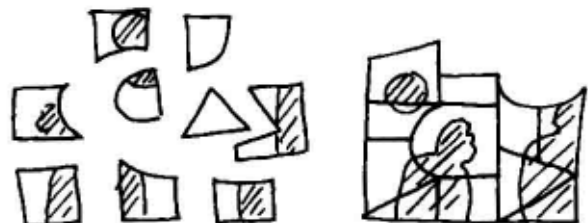
You must break the twigs for yourself to the
length you want I will give you lots of short
lengths of wire but you must bend them for
yourself to the shape you want.

Cut leaves into triangles, squares, circles and
other shapes.



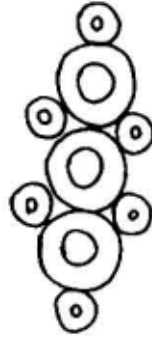
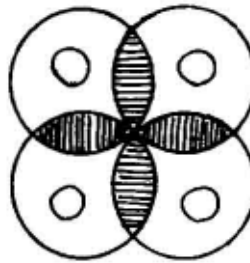
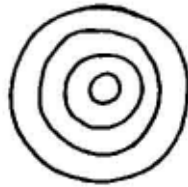
Arrange them on the floor in patterns you
invent for yourself.

Here is a large picture out of a newspaper,
but I have cut it into pieces.
Fit the pieces together again in the right
way.



SHAPE

Tie a pencil to a piece of string and tie the other end loosely





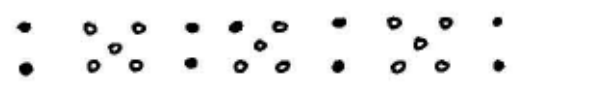
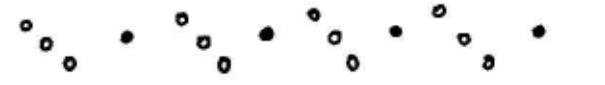
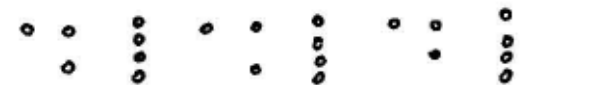
Draw circles on paper or on the ground with your pencil string and stick. Make patterns with circles. If you do it on paper, colour parts of your patterns by painting them. If you do it on the ground, fill in the patterns with rangoli.

Here is a broken pot (or cup or plate). Most of the pieces are here. Try to put it together again. You will need a friend to help you hold it. Perhaps you can almost stick it together again with some soft clay.

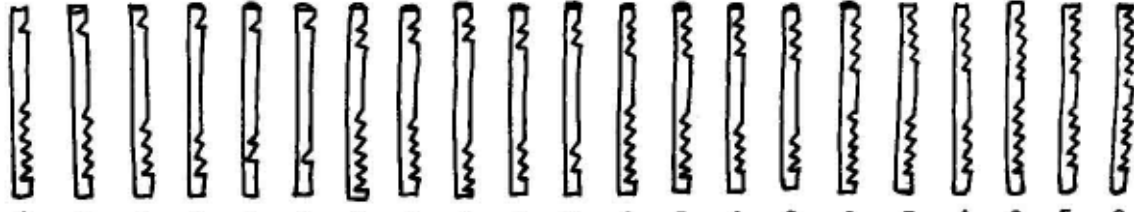


NUMBER ORDER

I have drawn some dots (on the ground or a blackboard or paper). You must write down the set of numbers of the dots. I will give you some examples first.

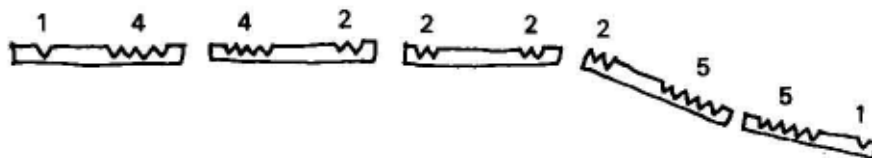
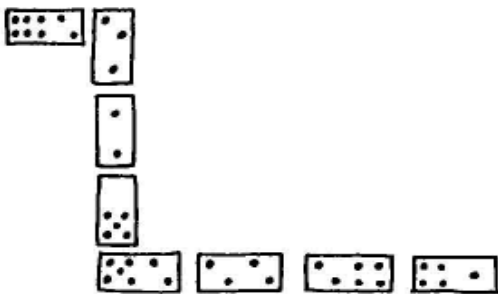
	3	3	3	3				
	4	4	4	4				
	2	5	2	5	2	5	2	
	3	1	3	1	3	1	3	1
	3	4	3	4	3	4		

Make some “dominoes” by cutting notches in sticks all 10 cm long. Make 21 sticks. Then you can play a game for 2, 3 or 4 people.

1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	4	4	4	5	5	6
																				
6	5	4	3	2	1	6	5	4	3	2	6	5	4	3	6	5	4	6	5	6

Give each person the same number of sticks. Take turns to put down sticks end-to-end so that the numbers match. If you have not got a stick with the right number of notches, you cannot put any stick down.

Whoever uses up all his sticks first is the winner of the game.

Instead of cutting sticks, make some flat blocks of clay and make dots in them at each end instead of notches.

SHADE, COLOUR

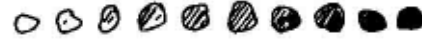
Here is a tray (or plantain leaf) or mixed stones, some dark and some light. Separate them into two groups, one of light stones and the other of dark stones.

Then make 3 groups: light, medium and dark.



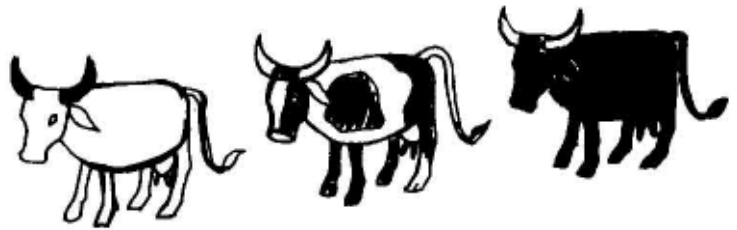
Do the same thing with leaves, plant stems, flowers, tree bark, paper and cloth.

Then arrange all the stones in one series from light to dark.

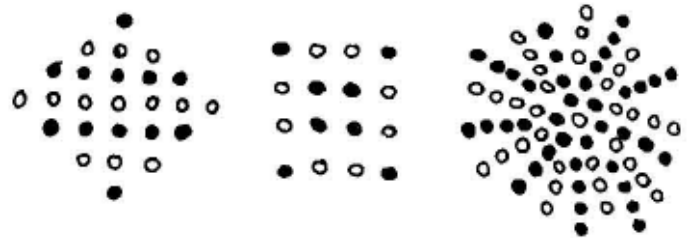


When you walk through the village later today look at all the cows. Tomorrow, tell me how many black cows there are in the village, and how many white and how many of a mixed colour.

If you are a group of children, arrange yourselves in a line according to the lightness and darkness of the cloth of your pajamas, sadaries, caps, etc.



Here is a trayful of black and white seeds (or beads or buttons). Invent your own patterns.



You know that if you rub a pencil hard on paper it makes a dark mark but if you press lightly it makes a fainter mark. Use a pencil to shade a strip of paper so that it starts dark at one end and gradually gets lighter until it is white at the other end.

Tell me the names of birds that have two or more colours on them. Tell me the names of the colours and we will write them down.



Do the same with flowers, animals and insects.

COLOUR

Today or tomorrow, find some soft earth and clay of different shades of brown, black, grey and white.

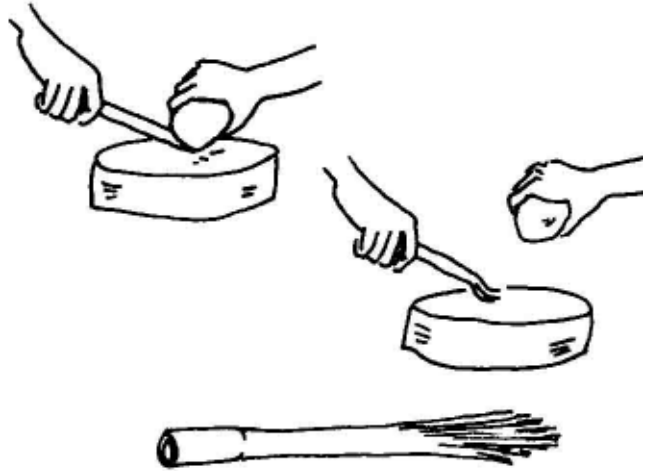
Put a little water on it to make each colour into a thick paste. Put the paste on a large, flat stone and grind it with a smaller stone until it is like paint.

Then paint patterns with it on paper or on a smooth wall. You can use paper that has been written on, or you can use newspaper because the paint will cover the writing.

Of course you probably have several local colours, paints and ink that you can also use.

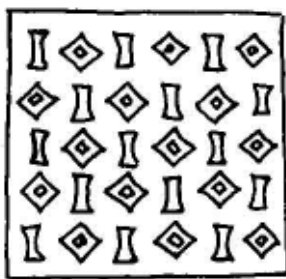
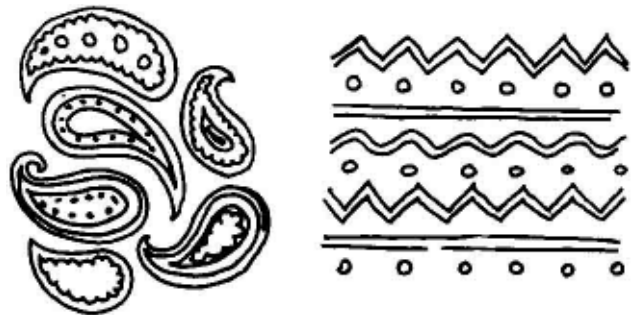


Make a brush by hammering the end of a piece of bamboo or reed between two stones until just the fibers are left. You have to do it carefully to make a good brush. Trim it with scissors.



Take some crayons (or paints) of only three very different colours and make a pattern that repeats itself, all over a sheet of paper, or on the ground.

Then do another, different pattern with three different colours.



If you have no crayons or paints, use grains of coloured earth or sand, or use coloured rice or other forms of rangoli such as people sometimes use to make patterns on the ground at festivals.

Write down the names of all the different colours you know.

Bring tomorrow some flowers, which have two or more shades or tints of the same colour in the flower.

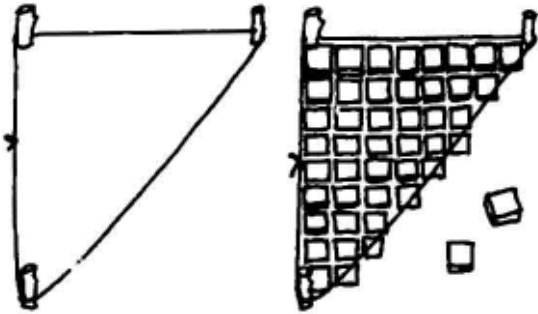
And bring in leaves from trees and plants that have various shades of green. Arrange these from darkest to lightest in a long line.

Make patterns with these leaves according to the shade of green.



AREA

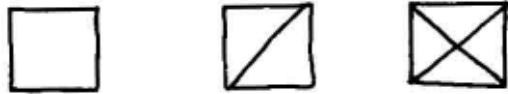
Make about 100 flat blocks of clay of the same size as this... When the clay dries they will be about one square centimeter in size. We make them a bit bigger because they shrink as they dry.



Knock 3 short sticks into the ground and stretch a string around them to make a triangle. Now you are going to find out how big the triangle is.

Arrange the clay blocks in the triangle and count how many you need to fill it.

Make other shapes with the sticks and string and find how many square centimetres you need to fill them.



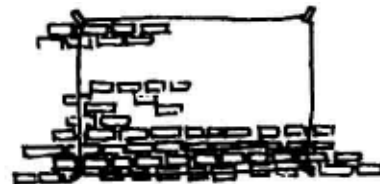
Make a big square with sticks and string on the ground. Use string to divide it into 2 triangles, then into 4 triangles.

Divide it also in other ways.

Do the same thing with chalk lines on a slate or writing board.

Find out how many square centimeters will cover one of your books or your slate.

With nails or sticks and string, mark out a square on the wall of your room or a wall outside. Count how many stones or bricks or bamboos there are in the square.



In the dust of the ground, draw a shape with seven sides of different lengths. Then draw lines to divide it into triangles. Then draw a similar shape and divide it into different triangles... Then do the same thing with shapes of 5 sides, then 6 sides.

Next fold a sheet of paper into 2 triangles, then into 4 triangles.

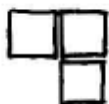
Then cut a sheet of paper into a shape with 5 sides and fold it into triangles in different ways.



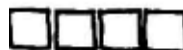
Cut the paper shapes you have just made along the folds so that they are a lot of triangles.

AREA SOLID SHAPES

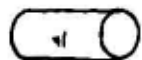
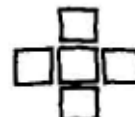
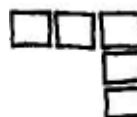
Use the clay square centimeters (that you made before) to make as many different arrangements as you can, first with 3 blocks...



then with 4...



then with 5...



cylinder



wedge



cone

Here are some wooden shapes that the carpenter has made for us (or clay shapes made by the potter).



cube



box-shape



ball



pyramid

I will write the names for you to learn.



Here is a short piece of bamboo, a carrot, etc. What are the names of their shapes?

Here is a lot of clay that we must keep damp in a wet gunnysack or well wrapped with large leaves, or it goes hard.

Use it to make some small balls, rolling the clay in your hands. Then put the balls to dry in a cool place. (Do not put wet clay where it will dry too quickly or it might crack).

Then make a cylinder by rolling clay on the floor with a flat board. Cut its ends off with a thin knife.

Start to make another cylinder but press more on one side of the flat board so that you make a cone...



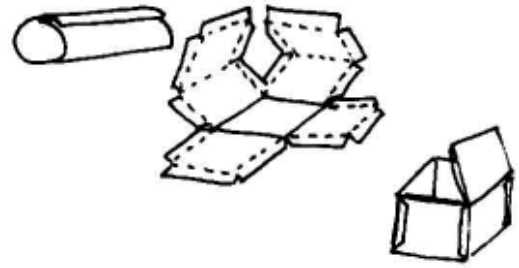
Beat some clay flat on the floor. Put cloth or paper on the floor first or the clay sticks. I will tell you when the clay is 1 centimeter thick (I push a little stick into it to see how deep it is). When it is flat enough, I will mark a set of square centimeters on the top. Then you can cut along the liner and make a lot of small cubes. Put them to dry but do not squash them.

Use your cubes to build larger cubes by piling them together...



SOLID SHAPES. ANGLES

Make a wedge with clay. Use a knife to cut it.
Then make a pyramid. It is difficult to make these things, so take plenty of time and be careful.
Perhaps you can make the shapes (of the things you know the names of) by using paper.
This is even more difficult: deciding what shape to cut out of paper and how to fold it and glue it.



Bend a wire into a semi-circle with the ends sticking out.

Hold the ends and twirl the wire quickly so that it turns and looks like a ball.

Do the same kind of thing with other shapes of wire so as to make:



a cone,



cylinder,

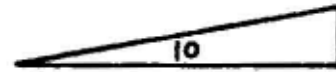


a double cone,

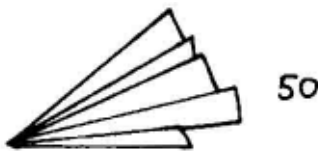


and any shape you like.

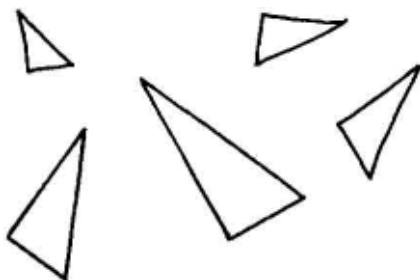
Here is a piece of card that I have cut to a point. The part at the end is called an “angle”. The size of the angle I have cut is ten degrees.



Here are some more angles, cut in card or paper that are 10 degrees, or 20 or 30 or more. Use the 10-degree card to measure the others. It will be easier if you make some more 10-degree angles for yourself.



Now make some angles for yourself, of 20 degrees. 30 degrees etc. cutting them out of paper or drawing them in the dust. Write the size of the angle at the side of them.



Here are some cut-out triangles that are the same shape but different sizes.

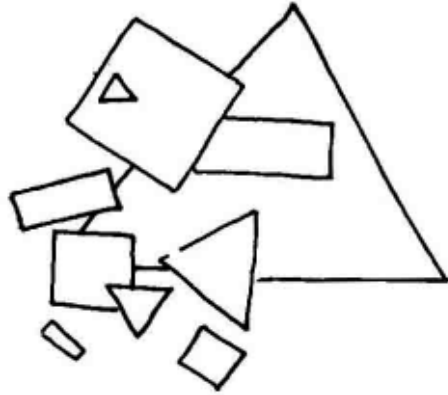
Put them into order according to size.

ANGLES

Here is a mixture of shapes and sizes cut out of paper, card or leaves. Make groups of similar shapes from out of the mixture.

Draw a set of squares gradually getting bigger.

Do the same with triangles, but keep them all the same shape.

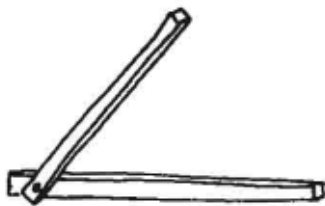


As before, draw on the ground if you have no paper.

If you have no paper, perhaps you could make part of a wall smooth with mud or cloth and let it dry. Then fill any cracks with clay.

Afterwards, make it white by rubbing it with the block of white clay or orange colour that is used for colouring the walls of houses. Then do your drawing on this. At the end of the day, colour it again with the block of clay to give a good surface on which to draw tomorrow.

Draw with a piece of reed cut across to make a point. Use ink, colour, or paint available locally.



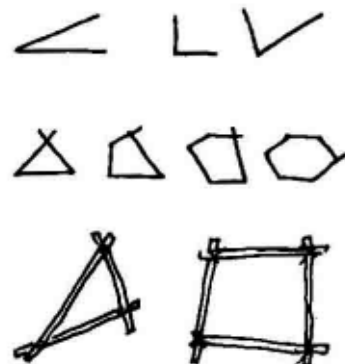
Hinge two sticks together with a nail. Move the sticks so that they make different sizes of angle.

Use the 10-degree piece of card to make angles of 10 degrees, 20 degrees etc.

Make some angles with some short pieces of wire.

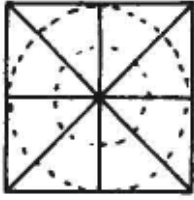
Make some triangles, squares and shaper with four, five and six sides with wire.

If you have no wire, use rice straw or wheat straw fastened together with thread.



ANGLES

Fold a square of paper to make 4 folds as in the diagram. Then mark a circle (the wide dotted line circle) and cut it out.



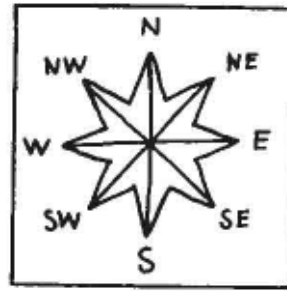
Then make a half-sized circle.

Then make a star and cut it out.



Next, stick your star on a square card. Mark the “points of the compass” on the card beside the points of the star.

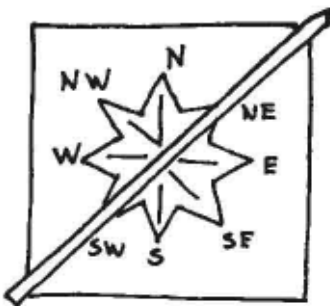
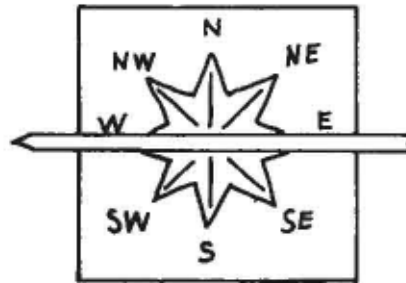
You will use this “compass card” later, so keep it safe.



Put the compass card on the ground outside. Get a straight long stick with one sharp end and rest it on the card over the center.

Move the stick so that it points to where the sun sets. Then keep the stick pointing to where the sun sets and move the card underneath the stick so that the West end of the star is in the direction that the stick is pointing.

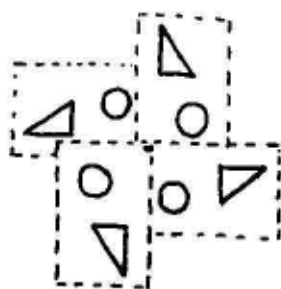
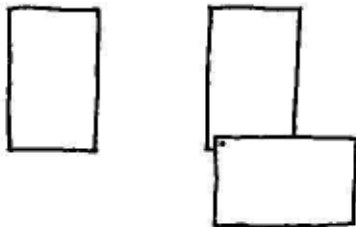
Now do not move the card again, because its directions are correct you can take the stick off.



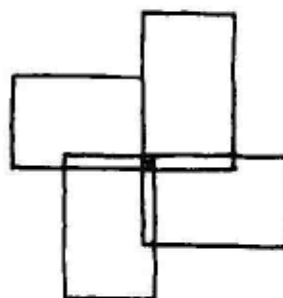
Now put the stick on the card so that it points to something that you can see in the distance, such as a house or a tree. Tell me the direction of the house by looking at the compass card. In the diagram, the house is North-East.

SYMMETRY

Cut a rectangle of paper, about 10 x 5 cm. Put it on a large piece of paper and push a pin or a thorn through one corner. Put it straight on the paper and draw around it. Then turn it a quarter of a turn and draw around it again.



Then turn it another quarter turn and another drawing around it each time...



Next, cut a triangle in the rectangle of paper and do the same kind of thing again, but this time draw inside the triangular hole instead of around the whole paper.

Then cut other shapes and rotate the paper and draw to make other patterns.

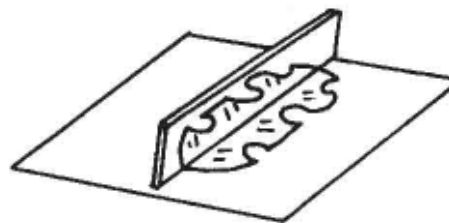
Use the small clay balls you made, and leaves to make "patterns of rotation" like these.

Fold a small piece of paper in half. Cut shapes in its edges. Then open it out to see the pattern you have made...



If you have a mirror, even just a small one, draw a shape then put the mirror beside it so that the shape doubles itself in the mirror.

Do the same with a pattern you have painted in colour so that the pattern becomes double in size.



Or use a leaf. Invent lots of other shapes.



Look at some leaves that look as if they have been doubled in a mirror - especially complicated leaves.



WEIGHT

Here are some stones, all of different weights. Separate them into two piles - heavier ones and lighter ones. Try to tell whether each stone is heavy or not by tossing it, lightly in your hand.



Chose a stone from among your stones that is about half way between light and heavy. Put it on one pan of the balance. Now put stones one by one on the other pan to see if they are lighter or heavier and whether they should go to the “light” pile or the “heavy” pile.



Make a simple balance with a length of thin wood such as bamboo and some pieces of string. You can use leaves or dishes as the pans of the balance.

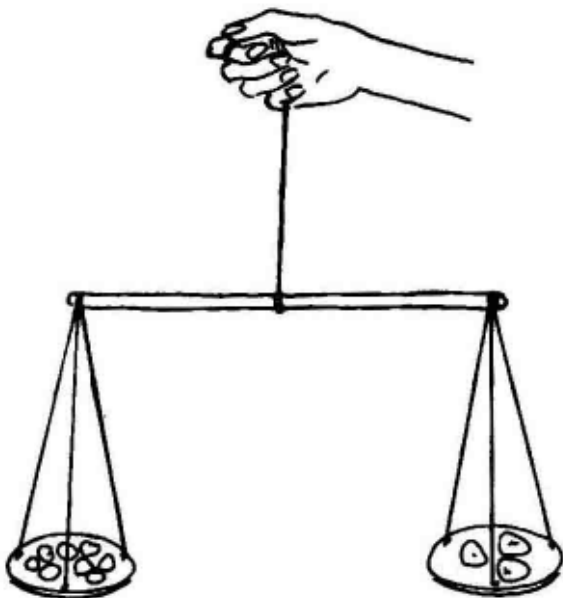
It is very important to get the length on each side exactly the same: that is, the distance from the middle string to where you hang the pan strings. When you make it, it will not be level. But do not change the distances. Tie a small stone on one side and move it along until the wood becomes level. (Or you could put sand in one pan. But keep the distances equal or it will not “weigh correctly”).

Weigh out 4 piles of sand: 1 tola, 2 tola and 4 tolas, if you have a “tola” weight.

Tell me the name of a wood that is heavy and another wood that is light.

Here are eight different stones, but they differ only a little in weight. Use your balance to help you put them in a line in order – with the heaviest at one end and the lightest at the other.

You can do this without using any special weights on the balance because you can always tell which of two stones is heavier by putting one on each pan of the balance.



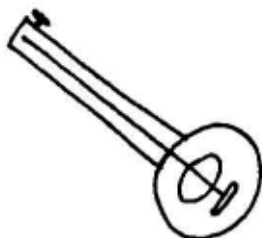
SOUND. TOUCH

Tell me the names of birds, which make loud calls or cries, and those which make soft sounds.

Do the same for animal.

Tell me the names of birds that have high or shrill cries and those that make low-pitched sounds. Do the same for animals.

Here is a simple musical instrument. Play some notes of different loudness. Then play notes of different pitch, high and low.



Do the same with other musical instruments and a drum or tabla.



Sing, hum or whistle notes of different loudness, then of different pitch.

Try to describe all the different kind of noises that you hear during the day.

Play various arrangements of 2, 3, or 4 notes on an instrument. Then ring or whistle or hum different arrangements.

I am going to fasten a cloth over your eyes so that you cannot see. Then I shall give you some things that have various types of surface: smooth, rougher and very rough.

I want you to feel them with your fingers and put them in a line, with the roughest at one end and the smoothest at the other.

They will be things like: stones, pieces of pot, bits of bark from trees and shrubs, pieces of wood of different roughness etc.

After this experience, do the same with your eyes uncovered so that you can see.



Find some things that give opposite sensations to your fingers. For example, you could bring a pencil that is sharp, and another that is blunt.

Bring as many other examples as you can find that give you opposite sensations, such as rough—smooth, hard-soft, sharp edge—dull edge, stiff-bendable, wet—dry, sticky-smooth, solid—liquid.

Think for yourself of many other possibilities.

Some of the things you could use are: ashes, clay, silk, cotton, wood, brass, lead, jaggery, feathers, leaves, metal wire, sandpaper, thorns, burrs, reeds, pottery, paper etc.

You can learn a great deal from these experiments, so take time over doing them and thinking out new ideas and contrasts and opposites.

HOT AND COLD. ODOURS

Make some clay balls about the size of eggs and let them dry. Put one out in the sun and put another in the shade. After some minutes pick one up, and then the other and see which is hotter.

For the next experiment, instead of feeling the clay balls with your hand, it is better to close one eye and gently press the clay ball into eye socket. This judges hot and cold quite well. Keep one clay ball in the shade. Put another in the sun for half a minute, another for one minute, another one for 2 minutes and the last one for 3 minutes. Then test them gently against your eye socket to see which is warmest.



Get a pot of water that is hot but not too hot to put your hand in. Get another pot of cold water and some empty pots or basins.



Put equal amounts of hot and cold water into an empty basin. Then put your hand into the hot, the cold and the mixed water to see how hot each one is. Try mixing different amounts and testing how hot the mixture is each time.

You soon discover that your hand is not a good tester of hot and cold because it gets accustomed to one temperature and it tests the next one wrongly.

Try this with a friend, but do not let your friend see what you are doing:

Collect some things, which have an odour or smell. Then cover your friend's eyes with a cloth so that he cannot see: then give him each thing to smell and ask him to tell you what it is. If the things you use are liquids, you could smear them on a piece of paper or on a leaf that has no smell of its own. Wash your hands so that he cannot smell anything from them.

Some of the things you could use are: kerosene, mustard oil, linseed oil, ghee, gud, sugar, milk, buttermilk, vinegar, mango pickle, chilli, onion, fresh pakodas, a slice of radish, a slice of carrot, citron, cinnamon, clover, ground-nuts, dried dates, tea leaves, orange, lemon or any crushed leaves, flowers, bark or root of any common plants, bushes or trees which have an odour.

Make a list of pleasant smells and a list of bad smells.



MEASURING CHANGES

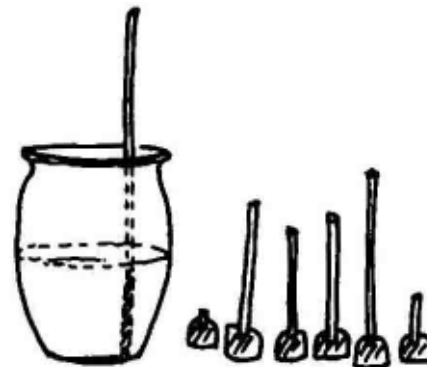
Plant a seed (wheat, barley, corn, gram or bean etc) in some damp earth in a drinking glass or in a plastic bag hanging on a wall. Put the seed next to the glass side so that you can see it grow. Each day, notice how much the root and shoot have grown and break a piece of thin stick to the same length. Then fix the stick upright with a bit of clay upright on the ground beside the glass.



Next day do the same thing, putting the next stick beside the first. After a week or two, your set of sticks will show you a set of measurements of how the plant is growing.

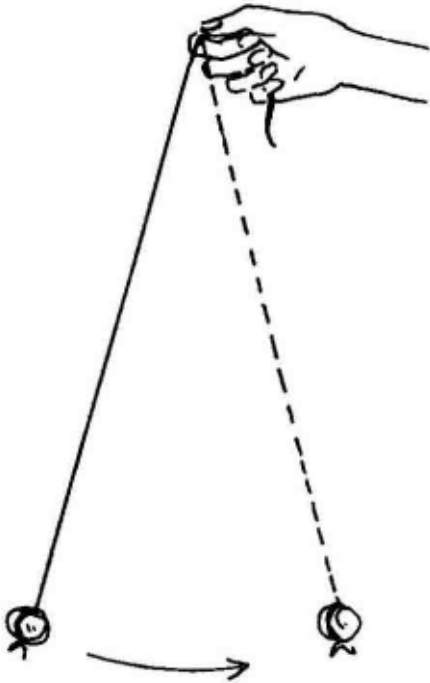
In the rainy season, put a deep container outside to hold the rain. At the same time each day, bring it inside, stand it on a level surface and measure how deep the water is in it.

Do this by putting a thin stick in, down to the bottom. Then take it out to see what length of the stick is wet. Break off the wet part exactly and fix it upright on the ground with a bit of clay. Do this each day so that your lengths of stick give you a picture of the rainfall measurements each day for a week or more.



Empty the container before you put it outside again

MEASURING TIME



Hang up a string with a stone tied to the end so that it can swing without touching anything. Set it swinging gently if you hold the string rest your hand against something to stop your hand moving at all.

Make the string shorter and longer and notice whether the string swings quickly or slowly.

Make the string one-meter long (one meter is about as long as 14 or 15 cigarettes). Start it swinging gently, hanging from a tree branch or a long nail in a wall.

The time the stone takes to go from one side to the other is one second when the string is one meter.

Count sixty swings to understand how long one minute is.

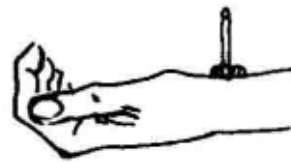
Practice counting swings with your eyes shut while a friend watches the swinging stone. In this way you can learn to count seconds even without a swinging stone.

Start the stone swinging and find far how many seconds you can hold your breath.

With a bit of soft clay fix a matchstick on the pulse of your wrist so that you can see the end of the match move slightly each time your heart pumps blood.

Does your pulse move every second, or faster or slower?

How many times do you breathe in one minute?



Tell me what things you know that happen very quickly such as a blink of your eye or a flash of lightning.

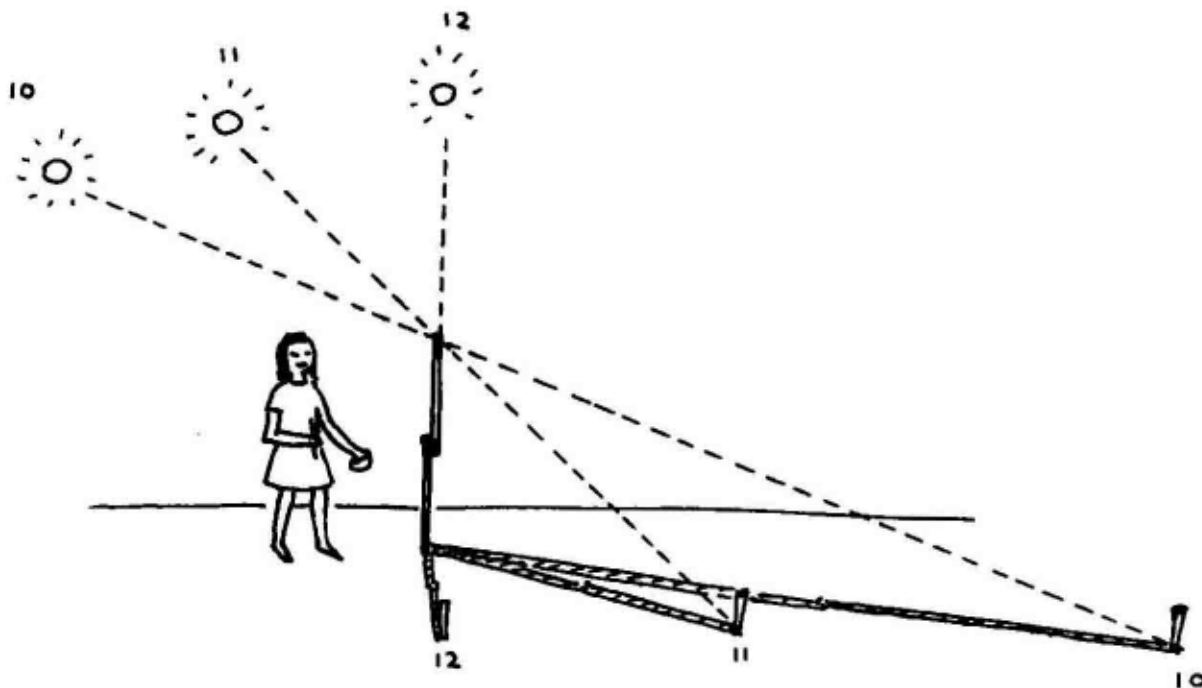
What things happen very slowly such as plant growing or a snail moving?

With a stick beating on the floor or with a drum, beat out a fast rhythm, then a slow rhythm, then rhythms of mixed fast and slow.

MEASURING TIME

Fix a stick, about as tall as yourself, upright, firmly in the ground. To make it firm it is perhaps best to hammer a short, thick stick deep in the ground and then lash the other stick to it strongly with string.

Do this in an open space where there are no shadows.



When you know by looking at a clock that it is ten o'clock in the morning, draw a line on the ground along the shadow of the stick or push a short stick into the ground at the end of the shadow. Do the same thing for all the other hours of the day.

What are you going to do today?
What time are you going to begin to do each thing?
How long will it take you to do each thing?
Keep checking up with your sun-clock to see whether you are right.

Now you have a sun clock you can use instead of an ordinary clock, because it will show you the time every day.

After about a month your clock will not be quite correct because the position of the sun changes with the seasons.

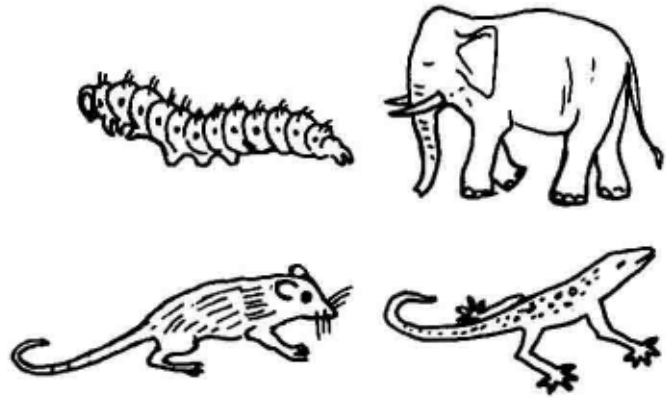


Draw a clock-face on the ground use a short stick and a longer stick as the clock fingers. I will tell you a rime of the day and you must set the fingers.

Then I will set the fingers and you must tell me the time.

SPEED. MOTION

Tell me the names of some animals,
which move slowly.
And some which move fast.
Draw some of them.
Write some of their names.
Make models of some of them with clay.



Which craftsmen in your town or village
work slowly, and which work fast?
Make a list of your friends in the order of
the speed at which they can run.

Think of the different kinds of work which
people do. Which is slow work and which
is fast work? Think of farm work such as
ploughing, milking, harvesting, etc. and
work at home such as sewing, boiling rice,
making tea, etc.

Look at the branch of a tree moving in the
wind. Try to do a drawing, or several
drawings to show how its position changes.
Do it in any way that you wish.
Tell me how the positions of a man's feet
move as he walks.
Tell me how you think the wings of a
butterfly move when it flies.



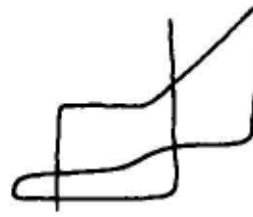
Use your legs to show me how a
man's legs move when he pedals a
bicycle.

Stand in one place and whirl a piece of
rope around your head. Tell me the
shape the end of the rope makes as it
goes through all its positions.

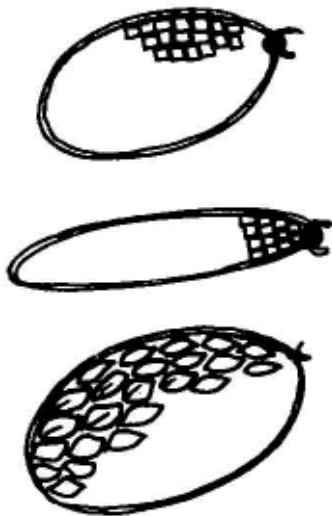


HOW TWO THINGS CHANGE TOGETHER

Walk about on an empty piece of ground.
Change your direction after every few steps.
Ask a friend to follow you and scratch a line
on the ground with a stick where you walk.
Then look at the map he has made which
shows where you walked. It shows how your
direction and your walking distance changed.



Early in the morning, use a stick to scratch
on the ground the shadow of a bush or small
tree. Scratch around the shadow again about
every 2 hours during the day to see how the
shadow moves its position and its size.



Make a loop of about a meter of rope or
string with the ends knotted together and
lay it on the ground.

Make it into an oval shape.

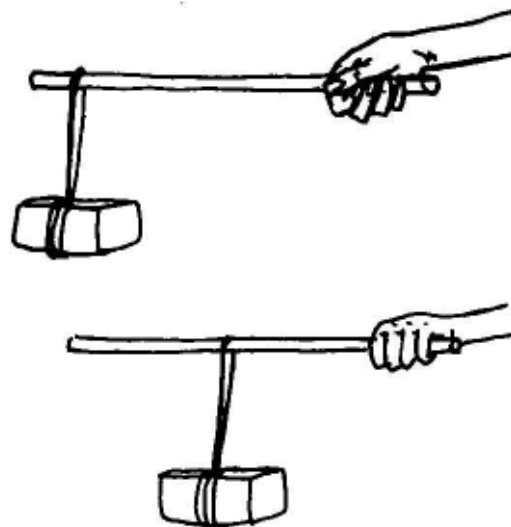
Use leaves all the same size or use the clay
square centimeters you made earlier to fill up
the oval shape.

How many can you place there, all touching
each other neatly but not overlapping?

Then make a narrow oval shape and see how
many leaves you can get in.

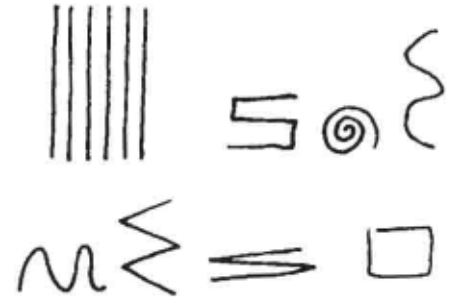
Change the shape of the loop until you find
what shape allows the most leaves to be put
inside is it an oval, a square, a triangle ...?

Hold a stick in your hand, level with the
ground. Ask a friend to hang something
by a loop of string from the stick.
Feel how it is more difficult to hold the
stick level as he hangs the thing further
along the stick.
Do it again with lighter and heavier things
hanging from the stick.



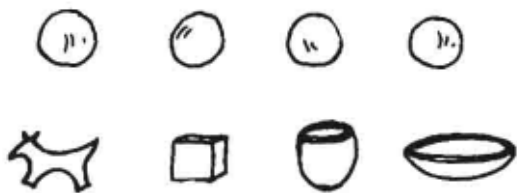
NOTICING SIMILARITIES

Cut some pieces of wire all to the same length. Then band them into different shapes—curves, triangles etc. Tell a friend who has not seen you cut them to the same length that all the things are alike in some way. Ask him to discover what is the same about them all. Tell him he can bend them if he likes. If he cannot find out, help him a little by straightening two of them. (Of course he is correct if he says they are all made of wire. But tell him there is some other way they are alike also).



Make some pieces of soft clay all the same weight.

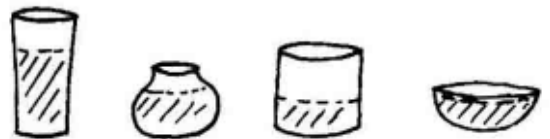
To do this you need a simple balance like the one you used once before. You do not need any special weights because you can put one piece of clay in one pan and keep it there to weigh all the others so that they all weigh the same.



When you have done this, make the clay into various shapes so that they all look very different. Ask a friend who has not seen you do this how all the clay objects are similar in some way, apart from the fact that they are all made of clay. He will need to use the balance.

Put an exact cupful of water into each of several pots, jugs, jars or other vessels. Now it will be difficult to tell that there is the same amount of water in each because the sizes and shapes of the vessels are so different.

Ask your friend to tell you the ways in which the vessels with water are alike. This time there are several ways in which they similar:



1. They are all containers.
2. They all contain water.
3. They are all waterproof.
4. They all contain the same amount of water.
5. etc.

Invent some games like this for yourself. For example, flowers with the same number of petals. Several types of flowers have many other similarities, which you and your friend can discover together.

You can also use small Plants and find out many ways in which they are the same or nearly the same.

Tell me the names of all the birds that have nearly the same colour. Write some of their names down. Do the same with animals, insects, flowers, etc.

Make some collections of things, which are different in some ways but alike in others; for example things, which look very different, but are all soft or all hard or all small. With each collection, write on a slate or a piece of paper how they are alike.