

# TEN LITTLE FINGERS

## Ideas and Activities in Science

Arvind Gupta

Illustrations: Avinash Deshpande

**Ten Little Fingers** is a collation of innovative toys and science activities which the author has tried and tested in more than one thousand schools over the past twenty years. With detailed illustrations, each activity is clearly depicted. Children do not need fancy laboratories and expensive equipment for doing science activities. There is much, which can be done using throwaway things found at home. Only when children use ordinary things do they realise the relevance of science in everyday life.

**Arvind Gupta** graduated from Indian Institute of Technology, Kanpur with a degree in Electrical Engineering in 1975, has written ten books on science activities, translated more than fifty books and presented seventy films on science activities. He has received several honours, including the first National Award for Science Popularisation amongst Children and the Distinguished Alumnus Award from IIT, Kanpur for making science interesting for children.

**Avinash Deshpande** graduated from the JJ School of Art, Mumbai, has been deeply involved with grassroots level movement.

NATIONAL BOOK TRUST, INDIA  
A - 5, Green Park, New Delhi 110016, India  
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## SCIENCE ACTIVITIES & IDEAS



If children don't do science experiments they will never get a feel for science.

Science without experiments is like learning to swim without getting into water.



There are a lot of expensive test tubes and other fancy science equipment. But the children are afraid to use them in case they break.



Can't we use simple things found at home for doing science experiments.

There is no scientific apparatus available in my town.



Children learn by doing. In their free moments they are always tinkering, pottering, playing and messing around with whatever they can lay their hands on. It is during play that children learn a lot of important things about science. When they handle different materials they get a feel for them. While making a toy they cut, paste, bend, join and assemble things. In this process, not only do they imbibe new skills but also familiarize themselves with properties of common things and everyday science.

Children learn a lot of things without being taught. They learn to make things, do things on their own. It is in their nature to explore. Little things hold great meaning for them. Simple things fascinate them - be it the climbing of an ant on the wall, or the vein patterns on the underside of a leaf. To a child even the humblest object is a source of endless joy. They are forever collecting old boxes, throwaway pens, lids, bottles etc. and fashioning them into imaginative playthings. Cardboard boxes are ideal for making houses and castles, and several of them can be put together to make a toy train. Old toothpaste tubes are cut and made into dynamic human figurines - which can be made to sit, jump or simply lie down.

In this book I have tried to put together some of the most interesting toys and science experiments which I have ever come across. It shows ways of making the most fascinating toys with the simplest of materials. It shows how low-cost things and a lot of modern 'junk' can be reused for doing a variety of science experiments.

But this book is more than just toys and science experiments. This book is about doing more with less. It is about cleaning up the earth of all the modern junk and recycling it into joyous toys for children. It is about making toys so that even the poorest children can afford them. For only when the children are happy will there be peace on earth.

## BIRDS OF PEACE



Illustration: Suddhasattwa Basu

When America dropped the atom bomb on Hiroshima during the Second World War, Sadako was only two years old and too young to remember the bomb. She lived a mile away from Hiroshima, so nothing much happened to her, although more than two hundred thousand people died in the holocaust. After the reconstruction of Hiroshima, Sadako began to attend school. Sadako was now eleven years old.

One day while she was practicing for the relay race she fell down unconscious. She was immediately rushed to the hospital. The doctors found out that she had leukaemia - a sort of blood cancer. Lots of people had earlier died of this disease by radiation.

Sadako was admitted to the hospital. She felt afraid because she knew that everyone who had got this disease had died. Sadako wanted to live. She did not want to die.

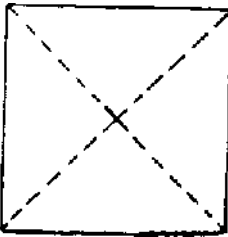
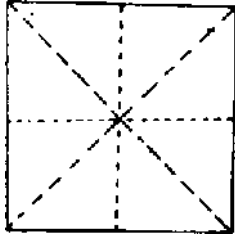
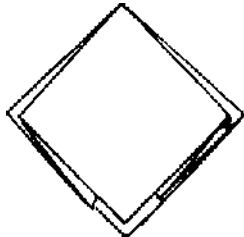
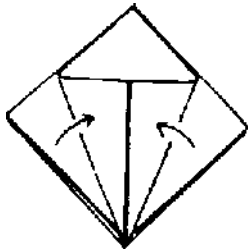
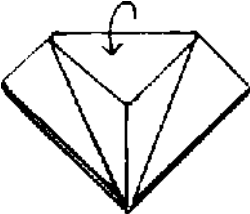
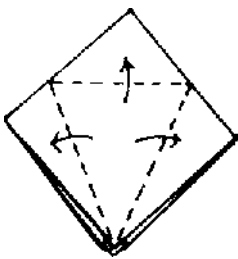
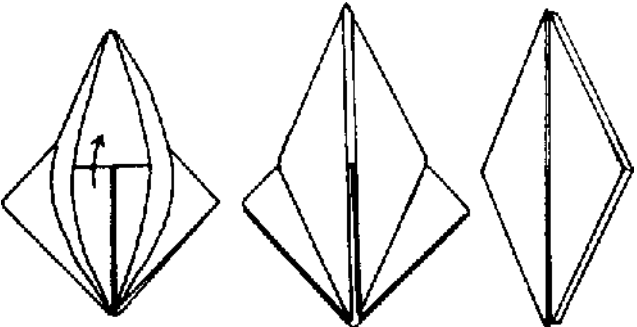
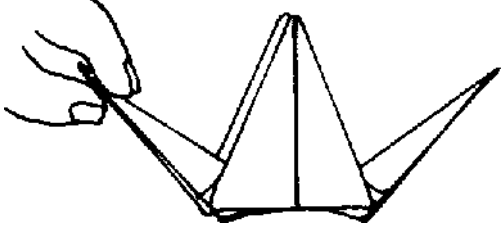
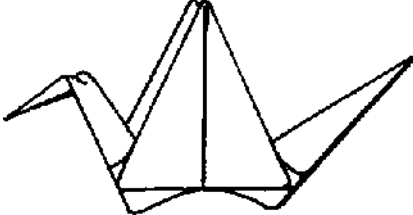
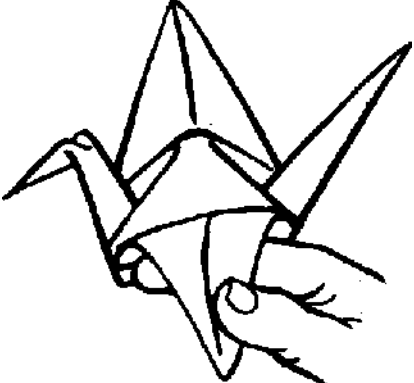

One day her best friend Chizuko came to see her. She had brought with her some squares of white paper. Chizuko took a paper square and folded it into a bird - a beautiful crane. She told Sadako that the crane was sacred to the Japanese and that it lived for over a thousand years. She told her that if a sick person folded a thousand cranes she would surely get well. Every day Sadako tried to fold the cranes. But the disease left her very weak. On some days she would fold twenty cranes while on some other days she could fold only three. Sadako knew that she would not become all right but still she was determined to fold the cranes.

On one particular day she could manage only one. But she kept on making cranes until she could not make them anymore. She folded 644 cranes. Sadako Sasaki died on October 25, 1955. Her friends folded the remaining 356 cranes. Her friends admired her brave and hopeful spirit. Sadako's death made them feel very sad. Her friends collected money to build a monument of **PEACE AND LOVE** in the memory of Sadako. This monument is called the Children's Peace Monument, and is in the Peace Park, right in the middle of Hiroshima, where the bomb was dropped. The statue depicts Sadako standing on the Mountain of Paradise, holding a golden crane in her outstretched hands. Every year, on Peace Day, children hang garlands of paper cranes under the statue. Their wish is engraved at its base.

**THIS IS OUR CRY  
THIS IS OUR PRAYER  
PEACE IN THE WORLD**

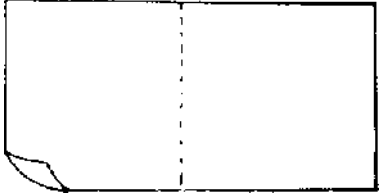
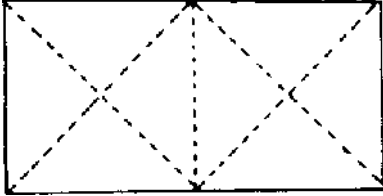
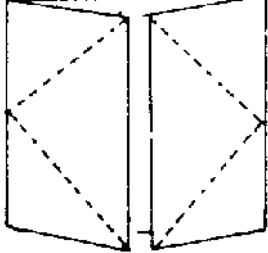
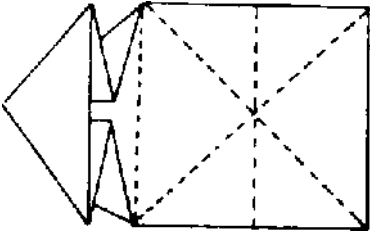
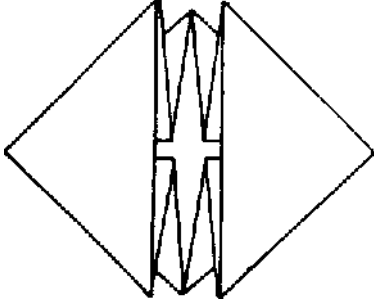
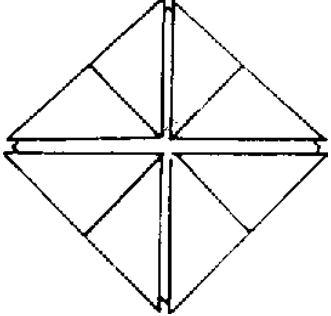
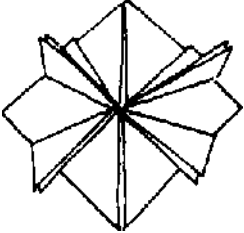
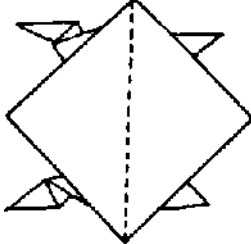

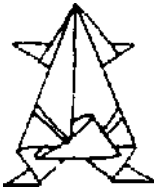
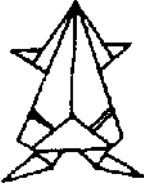


## FLAPPING BIRD

This is the bird, which Sadako made. Children in Japan have been making this flapping bird for the last 300 years. You do not require a scissors or glue to make it. You just need a paper square and your fingers.

 <p>1. Start with a square. Fold a criss-cross. Then turn over. You will find a hillock.</p>	 <p>2. Fold a plus sign in the opposite direction.</p>	 <p>3. Fold to make a bud - a quarter square.</p>	 <p>4. Fold left and right flaps to the vertical centre line.</p>
 <p>5. Fold the top triangle to make a cobra head.</p>	 <p>6. Lift one layer to the base of the top triangle to fold a diamond.</p>	 <p>7. Similarly make another diamond on the reverse. This is the bird-base.</p>	
 <p>8. Lift the cut portions between the two wings.</p>	 <p>9. Fold a beak on the neck.</p>		
 <p>10. Gently curve the wings downwards.</p>	 <p>11. Hold the bottom of the bird's neck with one hand and pull its tail repeatedly with the other. Its wings will flap.</p>		

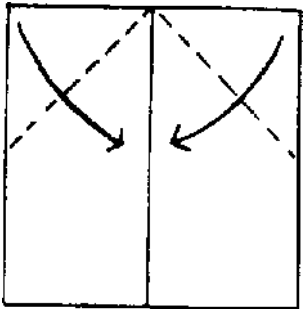
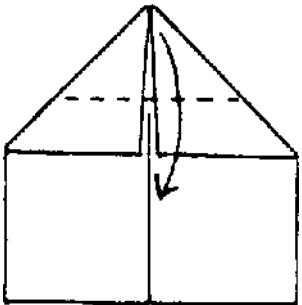
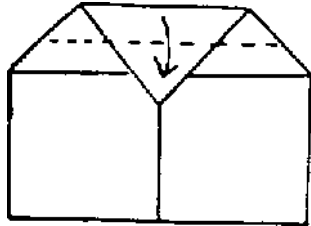
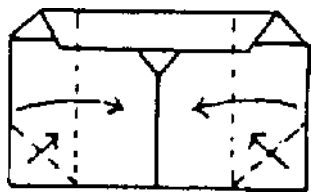
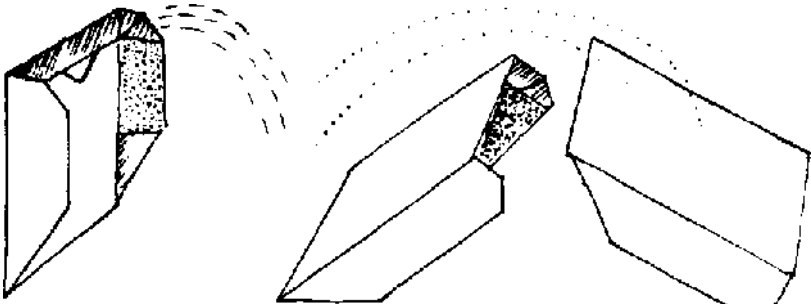
## JUMPING FROG

This is an amazing paper toy. It needs a special size of rectangular paper where the length is double the width. The frog has a special spring folded from the paper itself. When you press the spring it makes the frog leap and jump.

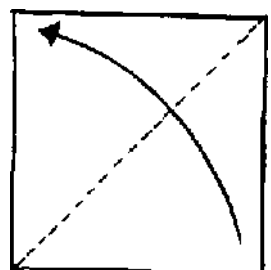
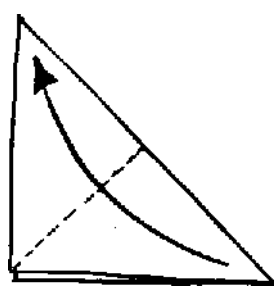
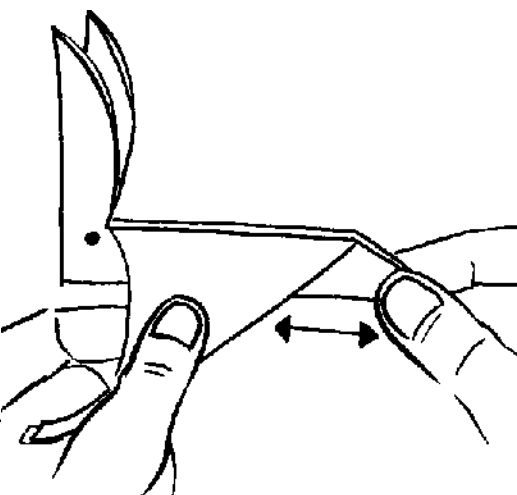
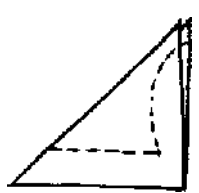
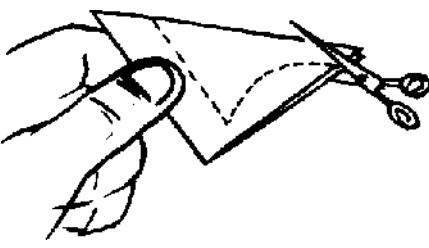
 <p>1. Take a 10 cm x 20 cm rectangular sheet of paper. Fold two squares in it</p>	 <p>2. Fold criss-cross diagonals in both the squares. All the four creases should be in the same direction.</p>	 <p>3. Reverse the paper. It will look like two hillocks. Fold the edges of the hills to the midline.</p>	
 <p>4. Reverse the paper. Tap the centres of both squares to get two cups. Push to make a triangle.</p>	 <p>5. Repeat the same for the right side.</p>	 <p>6. Bring all the four standing triangular ears to the left and right hand side corners and crease.</p>	
 <p>7. Bisect the internal angles to make the legs jut out.</p>	 <p>8. The model when reversed looks like a tortoise. Crease its backbone.</p>	 <p>9. Crease the left and right hand edges of the diamond shape to the backbone.</p>	 <p>10. Fold the base triangle upwards, and insert the left flap in the pocket of the triangle to make a lock.</p>
 <p>11. Similarly, lock the right flap.</p>	 <p>12. Make a Z shaped spring by first folding the frog backwards and then forwards.</p>	 <p>13. Press the spring to make the frog jump and leap.</p>	

## ROLLING TOY

You will thoroughly enjoy making this two minute tumbling toy.

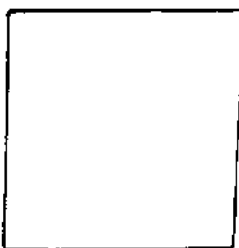
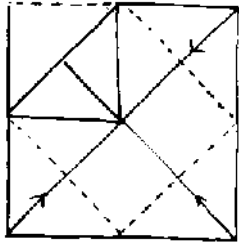
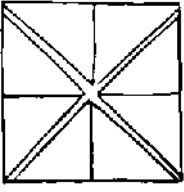
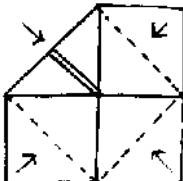
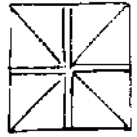
		
<p>1. Take a slightly stiff square paper with an edge length of 10 cm. Fold its two adjacent corners to the centre.</p>	<p>2. Fold the top point to bring it down slightly below the centre line.</p>	<p>3. Crease the folded part along its centre line.</p>
		
<p>4. First fold the sides to the vertical middle line - unfold, and then fold the corners to the crease.</p>	<p>5. Leave the toy straight with the ramp end down and see it tumble. Why does it roll over? The 8 layers of paper on the top make it heavy. So, when it falls there is enough momentum to roll over once</p>	

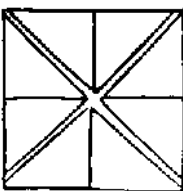
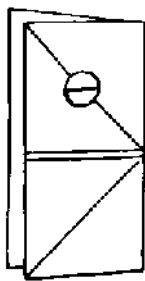
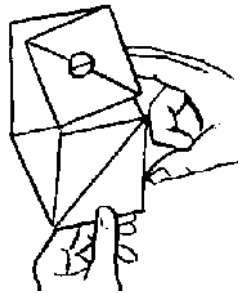

## RABBIT

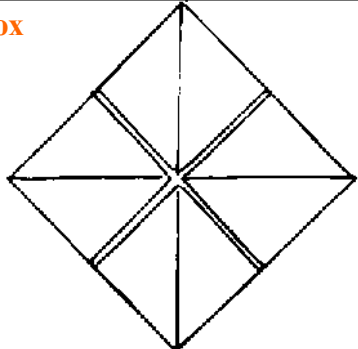
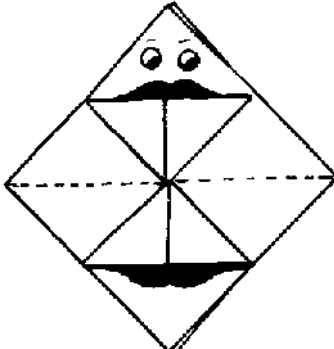
		
<p>1. Fold a 10 cm edge length square along the diagonal to make a triangle.</p>	<p>2. Fold this big triangle into half to make a small triangle.</p>	
		<p>5. Fold along the straight dotted line to make the front legs of the rabbit. Hold the rabbit with the left hand as shown and move the tail back and forth with the right hand. The rabbit will flap its ears.</p>
<p>3. This small triangle will have a 'V shape. Draw the ears of the rabbit with a curved dotted line.</p>	<p>4. Cut only along the dotted curved line to make the ears of the rabbit.</p>	

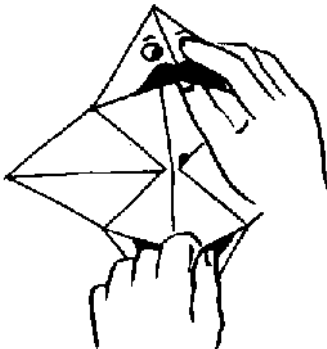
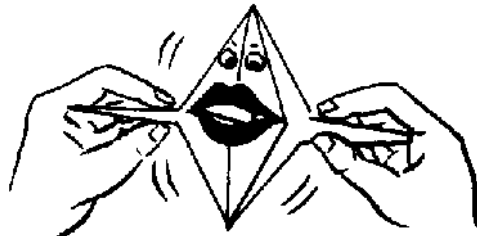
## PAPER PUPPETS

Most children make the Tippy - Tippy - Tappy (also called the salt and pepperbox or *DIN- RAAT*).  
With a few more folds they can make two delightful paper puppets.

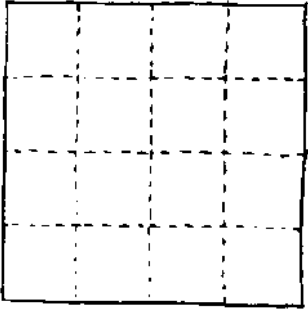
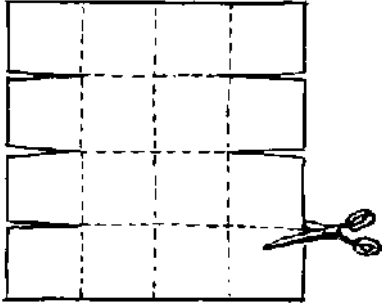
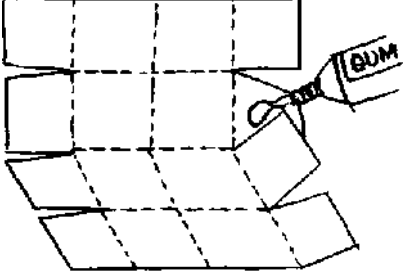
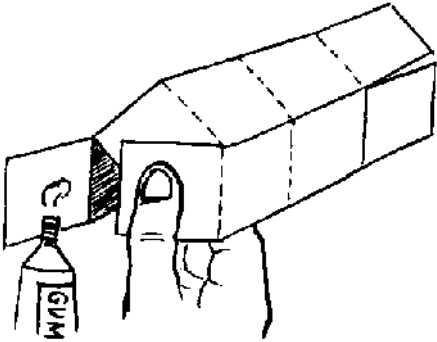
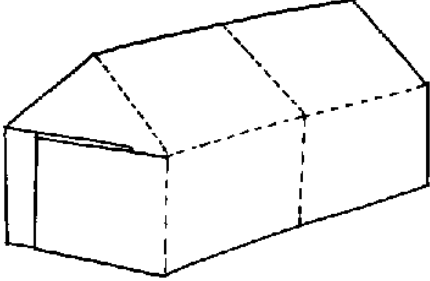
				
<p>1. Fold the diagonals of a 20 cm square piece of paper to locate its centre.</p>	<p>2. Fold all the four corners to meet at the centre.</p>	<p>3. It will look like an envelope.</p>	<p>4. Turn over the envelope and fold the 4 corners once again to the centre to make a smaller envelope.</p>	<p>5. Turn over the small envelope.</p>

<p><b>Cat-Chat</b></p> 			
<p>1. Bring the top edge to meet the bottom edge. Crease sharply and open. Now, fold the right edge to meet the left edge. This time do not open.</p>	<p>2. You will find four flaps along the right edge. Draw the eyes of the cat.</p>	<p>3. Slip your right index and middle fingers into the two upper pockets. Grasp the lower right hand corner between your right thumb and ring finger.</p>	<p>4. By raising and lowering your right hand fingers you can make the cat chat.</p>

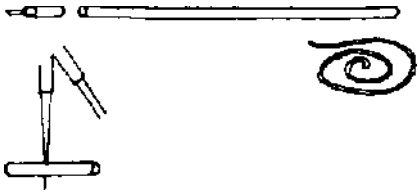
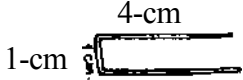
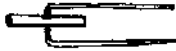
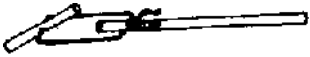
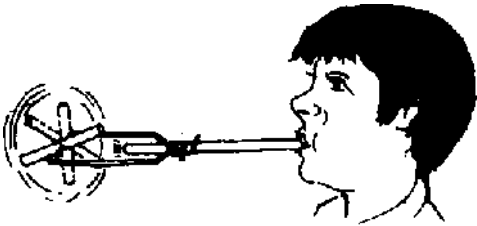
<p><b>Chatterbox</b></p> 	
<p>1. Take the double envelope base and fold its two opposite flaps in the middle. These two triangles will make the upper and lower halves of the chatterbox's face.</p>	<p>2. Crease along the middle line and draw the face.</p>

	<p>3. Slip your thumb under the upper half of the face and pinch the centre crease, so that the nose stands out. Pinch the bottom centre crease too.</p>
	<p>4. Hold the side corners with the thumb and index fingers of both your hands so that the two halves of the face are brought together. By moving your hands you will be able to make the chatterbox chatter.</p>

## PAPER HOUSE

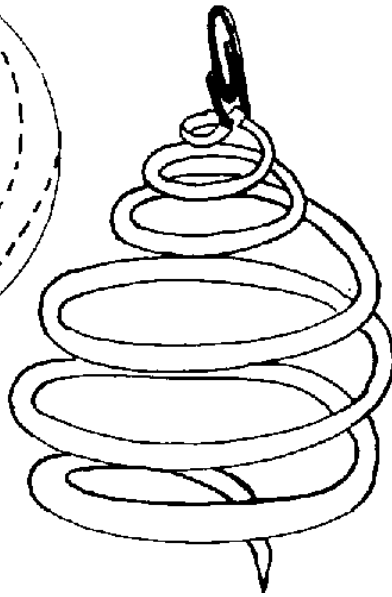
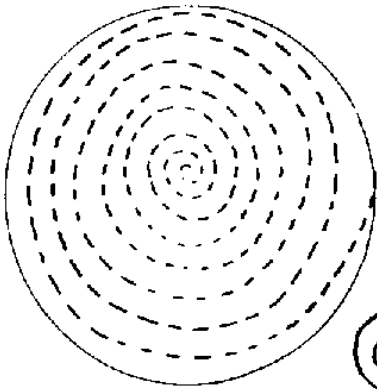
		
<p>1. Take a stiff square paper with an edge length of about 20 cm. Fold 16 small squares in it.</p>	<p>2. Cut along six quarter lines as shown.</p>	<p>3. Put one middle square exactly on top of the other and stick them with glue. They will make the triangular roof of the house.</p>
		
<p>4. Stick the two end squares to make the side wall of the house. Do the same on the other side to complete the house.</p>	<p>5. Using different sizes of squares you can make houses of different sizes. You can cut doors and windows in them. The outline of the house can be drawn on a big cardboard. Children can make the rooms, furniture, kitchen etc on the cardboard and then cover it with the paper house.</p>	

## SPINNER

		
<p>1. Cut a 2 cm long piece from an old ball-pen refill and make a hole in its centre with a divider point.</p>	<p>2. Take a 9 cm long thin wire and bend it into a 'U' shape.</p>	<p>3. Weave the refill spinner in the 'U' shaped wire.</p>
		
<p>4. Wrap the two ends of the wire on the plastic refill, leaving enough clearance for the spinner to rotate.</p>	<p>5. On blowing through the refill the spinner will rotate. For obtaining the maximum speed adjust the wires so that the air is directed towards the end of the spinners.</p>	

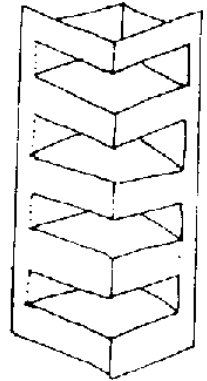
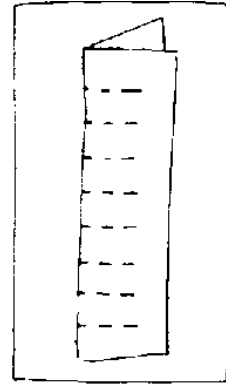


## FUN WITH PAPER



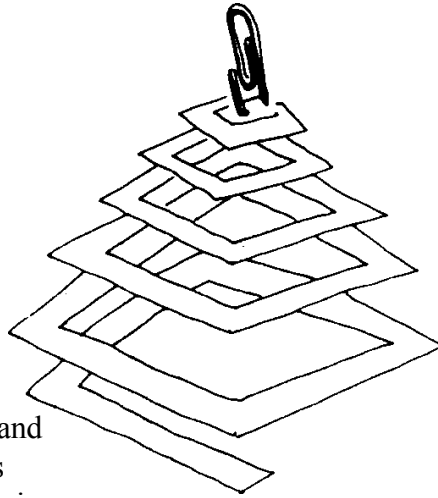
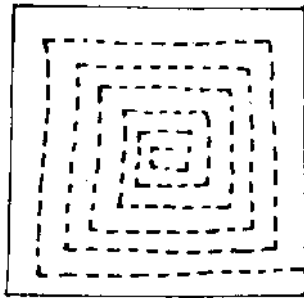
### Circular Spring

Take a circle of any size and cut it round and round into a spiral. Hang the centre by a paper clip to make a helical spring.



### Self-standing shelf

Fold a rectangular sheet of paper in half. Make cuts in the margin and fold the cut strips back to make a pretty pattern. You can make this shelf stand.

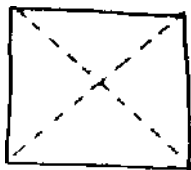


### Square Hanger

Take a square paper of any size and cut a square spiral in it. Hang this square spiral and enjoy it swaying in the breeze.

*MAKING THINGS*  
by Ann SayreWiseman

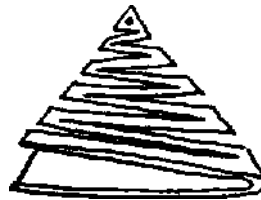
### Lace Hanger



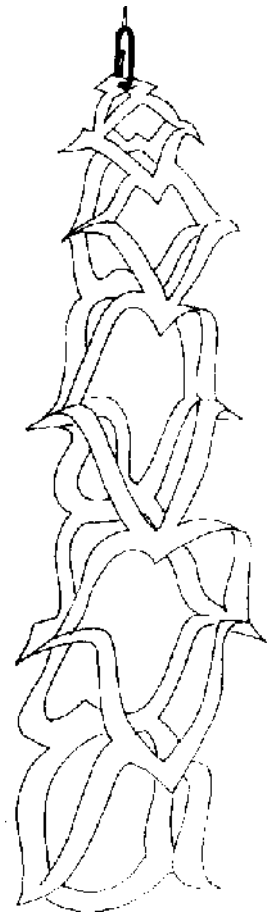
1. Fold a criss-cross in a paper square.



2. With open ends down, draw a half centimetre margin and cutting lines.



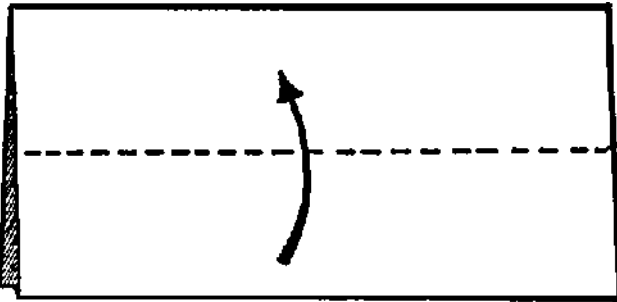
3. Cut from the left side to the margin on the right. Then cut from right side to margin on the left.



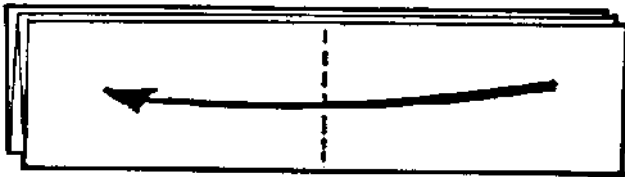
4. Open folds carefully to get a beautiful paper lace hanger.

## PAPER PATTERNS

To make these cut-out repeat patterns all you will need are some paper squares (newspapers will do) and a pair of scissors. First fold the square of paper in half.



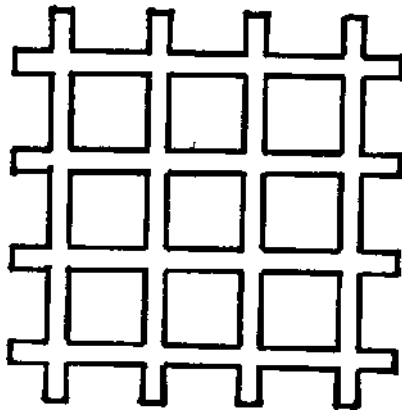
1. Fold the top layer of the bottom edge up to the folded edge. Turn over and do the same behind.



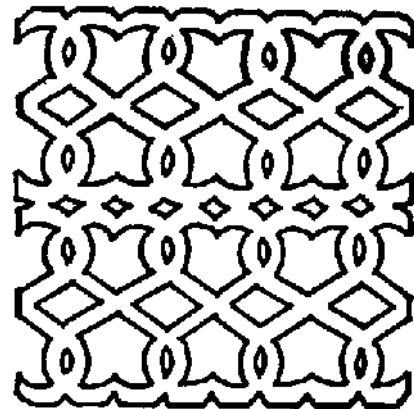
2. Fold the right edge to the left edge.



3. Fold the top layer of the left edge to the folded edge. Turn over and do the same behind. This gives you a little square of paper sixteen layers. By cutting into this shape and unfolding, you can discover many interesting patterns.



4. Simply cutting away each corner of the little square, for example will create a grill (*jaali*) like pattern.



5. By cutting these two curves you will achieve a more complex pattern.

6. Experiment in this way and when you find a pattern which you like make several similar ones. You can stick these together to decorate the cover of a book or perhaps to decorate a wall. You can make lovely greeting cards by sticking the cut-out of one colour on a background card sheet of a different colour.

## EVERYTHING HAS A HISTORY

Science is also the history of science. Every generation adds its own quanta of knowledge. We know so much because we stand on the towering shoulders of so many past generations. A High School student of today, knows more maths than Newton did, four hundred years ago.

S. E. Stokes was an American who came to India in 1910. He pioneered the plantation and propagation of apples in Himachal Pradesh. Being a philanthropist, he also set up a school in Kotgarh for the local children. In 1920, the American economist Richard Greggs—deeply inspired by Gandhiji came to work in India. For two years, Greggs taught activity based science to children in Stoke's school at Kotgarh. Based on his real life experiences with Indian children he wrote a book titled *Preparation for Science* in 1928. This book was first printed by *Navjivan Prakashan* from Ahmedabad. This remains the most pioneering treatise on how science should be taught to children in Indian schools. Greggs wrote:

“The apparatus required is exceedingly simple and inexpensive, and almost all of it is familiar to village children. Most of it can be made by village carpenters, potters or blacksmiths. The children must not get an idea that science is machinery or strange technology. The great pioneers of science did their work with very simple apparatus. It is possible, therefore, to follow their footsteps and learn to do scientific thinking without much expensive or elaborate apparatus. After all, the student's mind is the most expensive piece of apparatus involved.”

Greggs further commented, “I do not want Indian children in villages to get the idea that science is only a school affair or only relates to shiny brass and glass devices and paraphernalia. I believe they can learn to think more clearly and to acquire a scientific attitude without all the expensive and complicated apparatus used in western laboratories, or at least with extremely little of it.”

As has often happened in the history of science, the prophetic book remained buried until Keith Warren - a UNICEF consultant rediscovered it in 1975, illustrated parts of it, and brought it out as *Preparation for Understanding*.

The activities in the next few pages have been collated from the above books. 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.

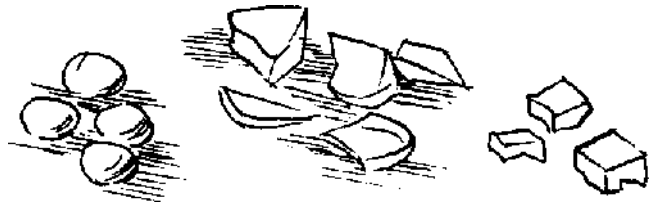
It is best for two or three children to work together at these activities so that they can share materials and help each other. Thus they begin to learn cooperation.

Science is built from curiosity, experience, analysis, and finally the expression of 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. These exercises will 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.

## SHAPE

Take a plate full of stones and separate them into different kinds of shapes - round ones, flat ones, sharp - cornered ones. Of course, you cannot do it perfectly, but do the best you can.



Take a lot of leaves. Separate them into



broad, thick ones.....

and thin, pointed ones .

Separate these twigs into



straight twigs....



curved twigs....

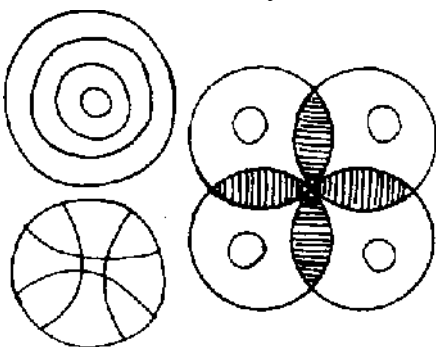


and twigs that have sharp bends..

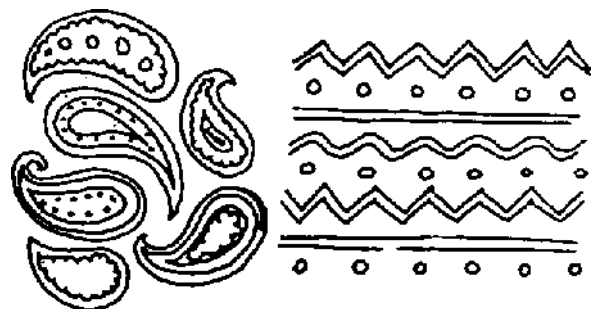
Do the same with these pieces of wire. They are all mixed up and you have to separate them into straight wires, curved wires and wires which have sharp bends.



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



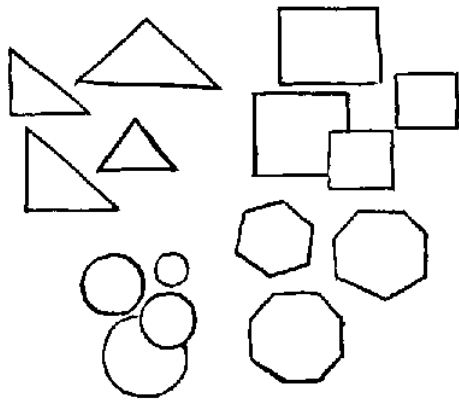
Draw circles on paper or on the ground with your pencil, string and stick. Make patterns with circles



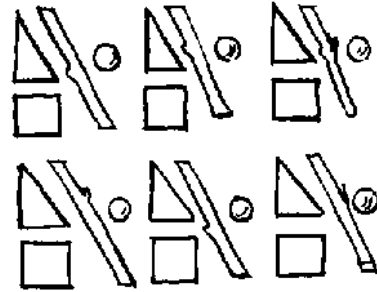
Make traditional *Rangoli* patterns on the ground and observe the symmetry in them.

## SHAPE

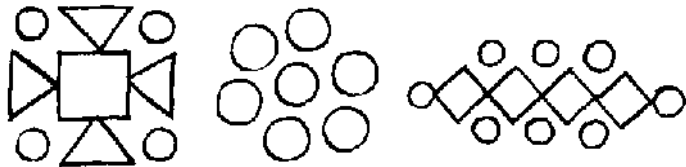
Cut a lot of small and big geometrical shapes out of cardboard or newspaper and then separate them into triangles, squares, circles and hexagons.



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



Cut leaves into triangles, squares, circles and other shapes. Arrange them on the floor in different patterns.



Take any picture and stick it on an old postcard to make it stiff. Cut the picture into many parts to make a jig-saw puzzle.



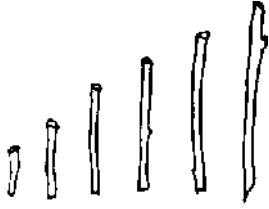
Take a broken clay pot and try to put all the broken pieces together to make the pot again.



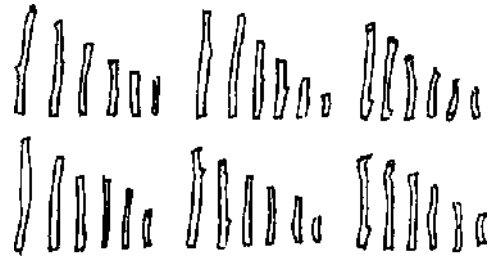
Take a coconut. Break its hard shell into pieces without cutting into its soft flesh. Collect all the hard pieces of the coconut shell. Put them together to make the whole coconut. This will make a three-dimensional jig-saw puzzle.

## SIZE

Break some broomsticks into different lengths. Then arrange them in order from the smallest to the biggest



Some of you can bring 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 the biggest to the smallest.

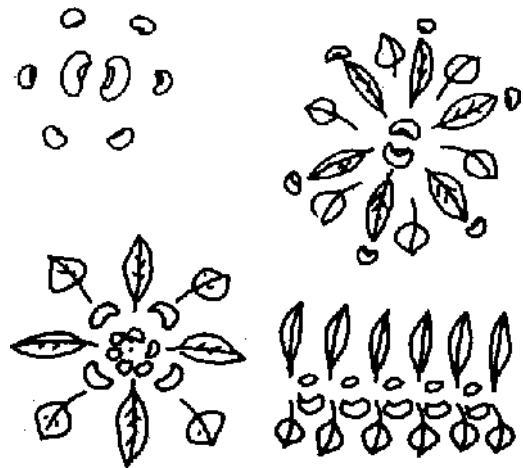


Draw some lines on the ground that grow longer as you go from right to left. Then draw some lines that gradually get shorter as you go from right to left.

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 large seeds, 6 nuts still bigger in size and 6 large leaves.



Arrange them in a pattern so that it looks attractive.



Any design which is repeated again and again soon becomes a pattern. Take plenty of time and make as many patterns as you can think of.

## SIZING UP

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



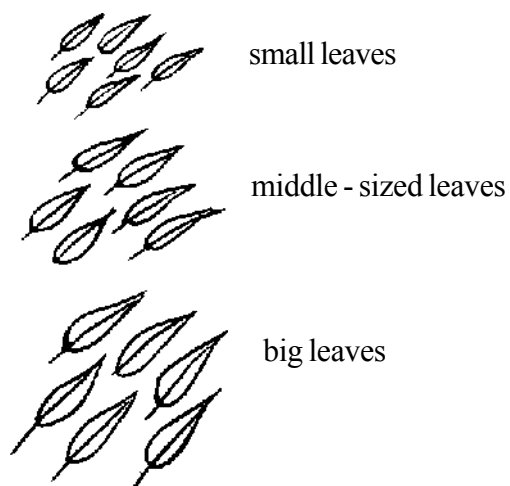
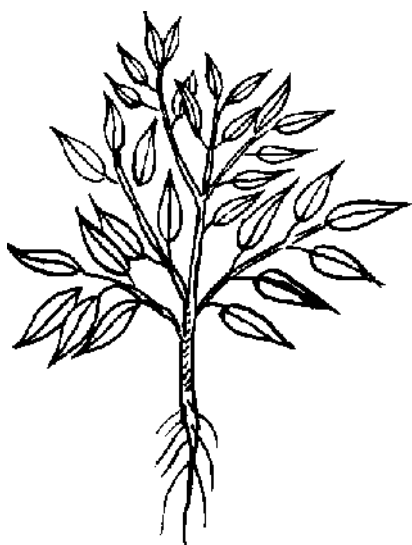
Then mix them together and divide them into two groups and put these in order.



Then mix them all together and put the whole lot in order.



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



Discuss the insects that you know. Tell their names in the order of their sizes, starting with the smallest.

Repeat their names again, but start with the biggest insect this time

Later on, write down some of the names in your copy.



Do the same things with the birds that you know. And then with animals. Draw some of them. It does not matter if you cannot draw them well at first. Try your best.

Write down some of their names.



This activity would need a lot of children - in fact, the whole class. Line up along the side of a room, with the smallest of you in the front and the tallest of you at the back.

Then mix yourself again. Then arrange yourself again. This time arrange yourself in the opposite order, with the tallest in the front and the smallest at the back.

Try to do this all by yourself without the help of an adult. This makes it difficult. Try to find your right place without arguing.

## Picture Bingo

Draw about 20 pictures like this on the board. Talk about the pictures as you draw them.

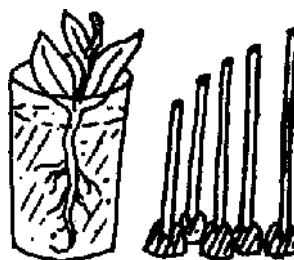


- 1 Tell the children to choose any six of the pictures they like and copy them on a paper.
2. Give each child six seeds .
3. Tell them to cover a picture if you call its name. For example if you call out ‘ snake’ then the child who has drawn a snake should cover it with a seed. Keep a record of the words you have called.
4. The first child to cover all six pictures should shout ‘ Bingo !’
- 5 Check out if you have called all the six. If the child has covered a picture you have not called, that child is out. If you have called all six pictures, that child has won.

### Measuring growth

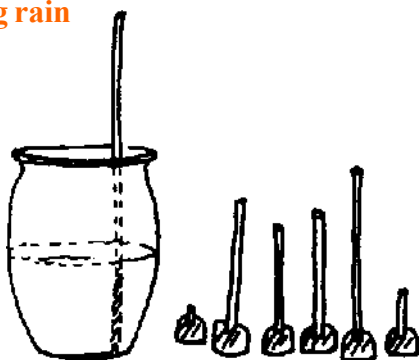


Plant a seed in some damp earth in a transparent glass so that you can see it grow. Each day, measure how much the root and shoot have grown and break a thin stick to the same length. Then fix the stick upright with a bit of clay on the ground beside the glass.



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

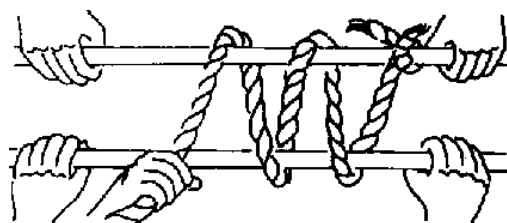
### Measuring rain



In the rainy season, put a deep container outside to hold the rain. Bring the container inside everyday, stand it on a level surface and measure how deep is the water 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 the wet part of the stick and stand it upright on the ground with a bit of clay. Do this everyday so that the length of the sticks give you an idea of the rainfall each day for a week or more.

### Block and Tackle



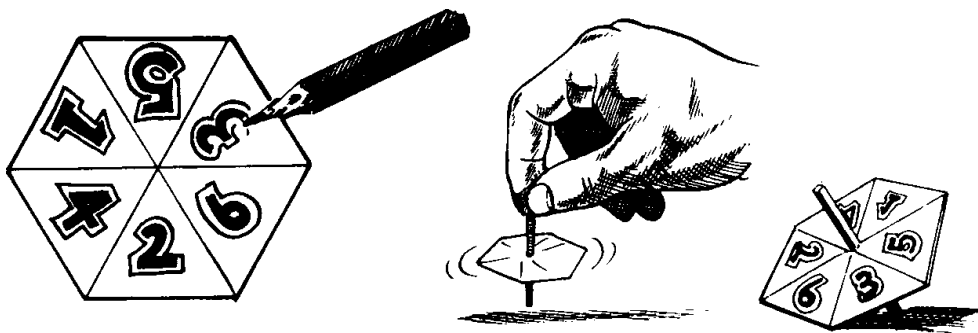
Let two strong adults hold two bamboo sticks. Then tie a rope and weave it around the sticks as shown. You pull on the free end of the rope. You will be able to pull the two sticks together even though they are kept apart. You have formed a combination of pulleys. In this experiment, you increase your force each time you wrap around the broomstick. A small force moving a long distance results in a greater force moving a shorter distance.



## SPINNING DICE

If you find that you cannot play your favourite board game like *Ludo*, Snakes and Ladders etc. because you have lost your dice, then try making a substitute dice in the following way:

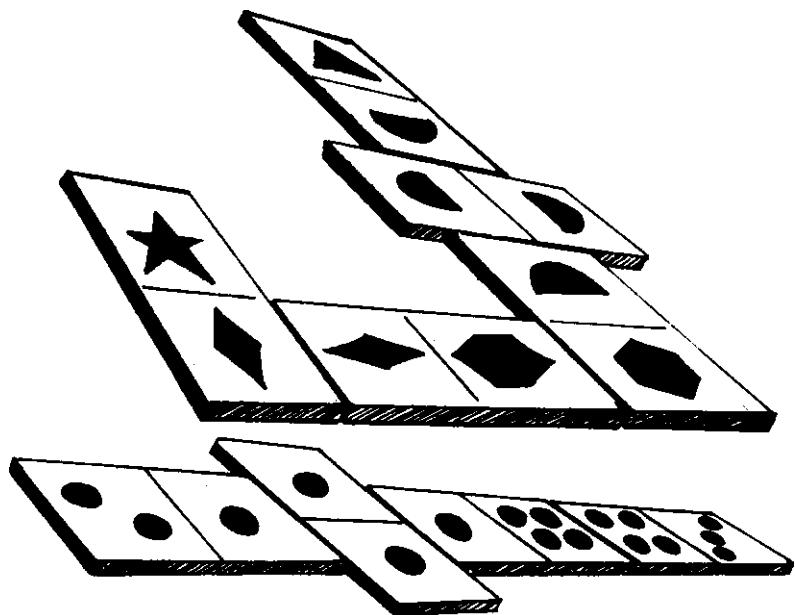
1. You will require a thick card sheet, a matchstick, a pencil and some glue.
2. Make a six sided regular hexagon about 8 cms across. Divide the surface into six equal triangles by drawing lines across from corner to corner. Write numbers from 1 to 6, one in each triangle.
3. Push the matchstick halfway through the centre point and apply a bit of glue to secure it firmly in place. Once the glue dries the dice is completed. Spin it on a flat surface.
4. When the dice stops spinning one of its edges end up lying on the surface. This indicates the face number, or the number of moves you can make.



## DOMINOES

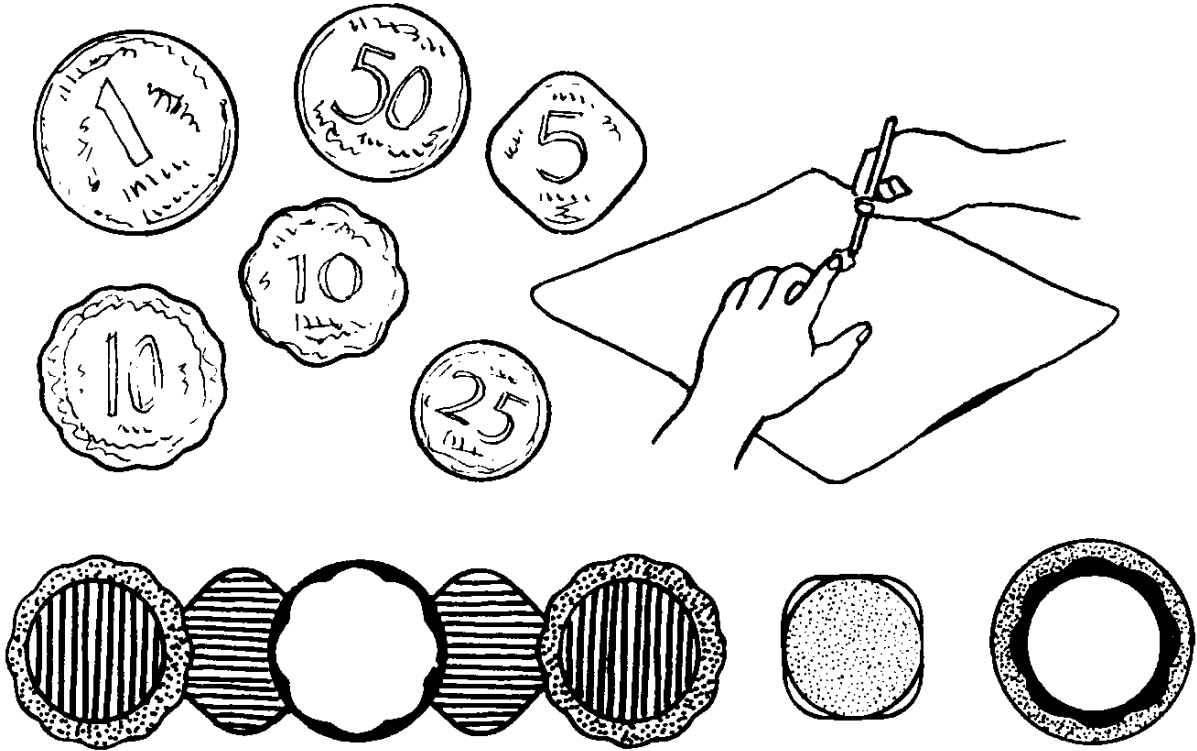
Dominoes are made from 2 x 1 rectangles of card, with different coloured shapes glued to each end. You will require 28 pieces to make a set, decorated with combinations of six different shapes, plus the blanks.

Here are some traditional dominoes in which pieces are marked with a number of spots at either end. Some ends are left blank.



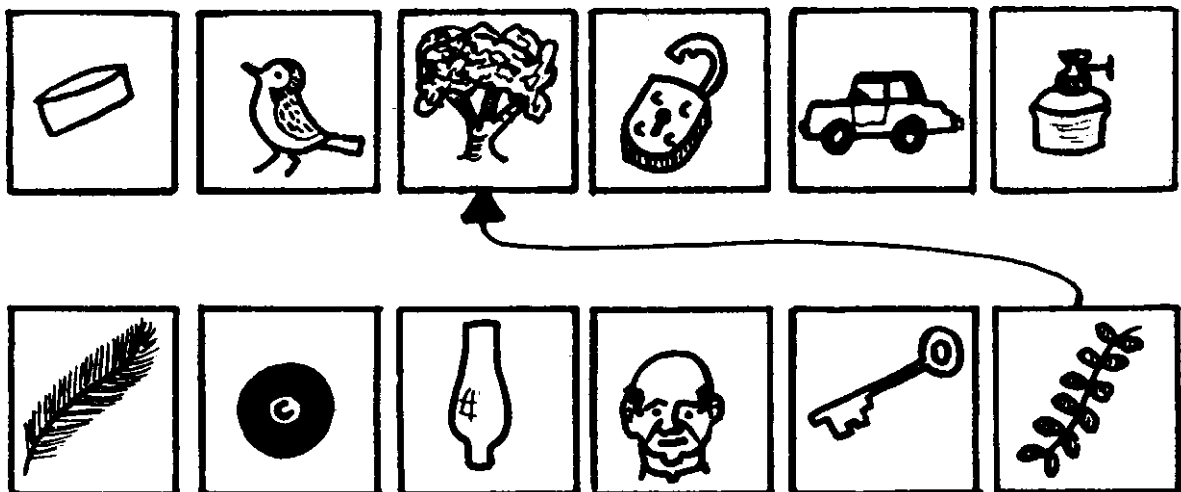
## PATTERNS WITH COINS

Ask the children to collect different coins. Children can keep these coins on a paper and draw their outlines with a pencil. Using a combination of coins of different shapes and sizes children can make different patterns. Children can later colour or shade these patterns.

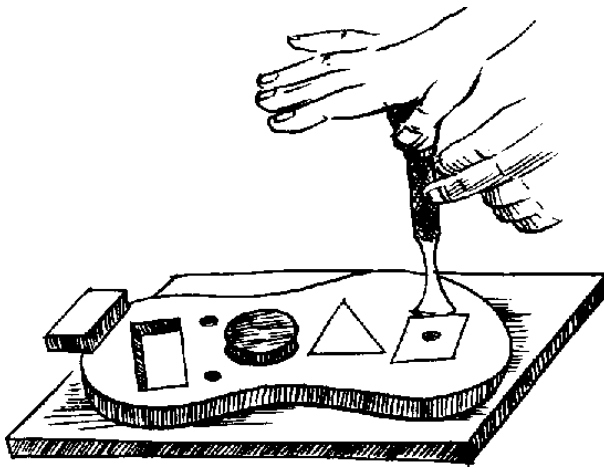


## MATCH THE PICTURES

Draw two sets of pictures.  
Children have to join the matching pictures of the two sets by a line.



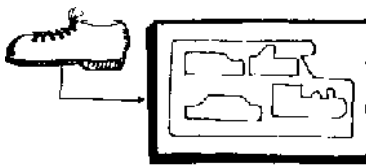
## ZERO-COST INSET PUZZLES



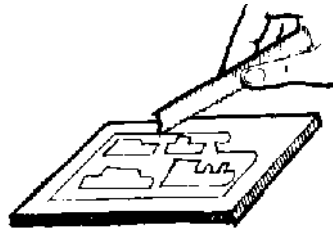
Old rubber slippers are great for making Montessori Inset Puzzles. Take an old rubber “Hawai slipper and scrub it clean with soap. Mark out some geometric shapes on the slipper with a pen. Keep the slipper on a wooden board and cut the shapes using a shoe maker’s knife (*rampi*). Round circles are best cut by hammering a sharpened pipe on the rubber.

Rubber slippers have no sharp points so they cannot hurt children and are safe. The rubber blocks fit snugly into their slots. The inset blocks are white above and blue below. If you upturn them then the blue block stand out clearly on the white background. So, there is no need to paint them.

## MOTHER TRUCK



1 Take a 20 cm x 30 cm piece of shoe sole rubber (about 8 mm thick). Mark out different vehicles - engine, car, jeep and van on it.



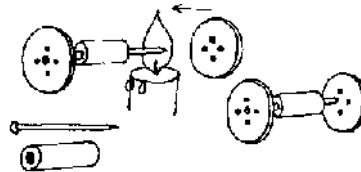
2. Cut these shapes with a sharp knife



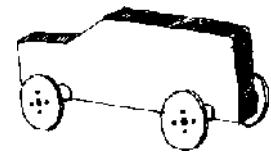
3. Using a shoe maker’s punch make two holes of 8 mm diameter near the base of each vehicle.



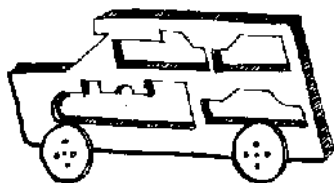
4. The finished rubber cars will look like this.



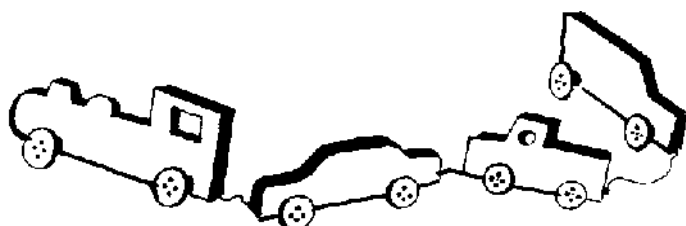
5. Make several button wheel pairs. Use 1.5 cm long pieces of a ball-pen body as bearings.



6. These pieces will snap into the holes of the rubber vehicles. You can fix or remove the wheels at will.



7. You can also fix wheels on the **Mother Truck**.



8. Fix the wheels on the vehicles to make them run. Join all the vehicles into a train.

## A THORNY ISSUE

This happened in the early years of the Hoshangabad Science Teaching Programme (HSTP). This programme emphasized on activity based science learning. It was thought that the best way to learn science was by doing scientific experiments. There was a lot of emphasis on learning from the environment.



It was thought that the best way to learn about various types of plant roots was not by drawing pictures of taproots and fibrous- roots on the blackboard but by actually stepping out of the classroom and studying these real plants in the field. For botanical observations the children were provided with hand lenses and dissecting needles.

One day the children went on a field trip. They were to collect different wild flowers and dissect them. Soon the children were cutting the flowers and examining the stamens, pistils and ovaries. They were all using their dissecting needles to pry open the flower parts.

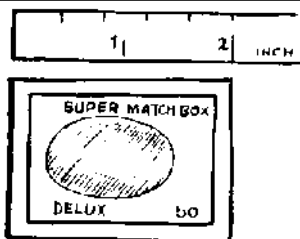
But, for one girl. She had forgotten to bring her dissecting needle. What could she do? She was searching for something pointed and sharp to open up the flowers. And soon she found a lot of Babool (*Acacia arabica*) thorns. These thorns were strewn all around and worked as beautiful dissecting needles.

This little girl had taught the Science Programme a great lesson. Why use the standard dissecting needle - a long steel needle embedded in a plastic handle, when you can use a thorn for the job. The needle had to be bought from the nearby town, as it was not available in the village. The thorn on the other hand was free. Millions of those thorns were crying to be picked up right there in the village.

This was a great lesson learnt. It was easy to make the thorn walk on two legs. The result was a simple, no-cost divider, made out of thorns. The humble Babool thorn had become an important tool for scientific inquiry!

## LENGTH

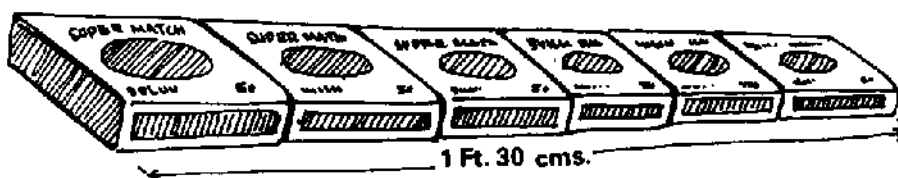
If you know the lengths of some common things around you, then you can use them for estimating the length of other objects. Things like matchboxes, postcards, coins - which are mass produced conform to certain standard dimensions. The lengths of these and many more objects can be used for estimation of length. You must verify the lengths of these objects by actually measuring them with a scale. Later on, even if you do not have a scale at hand, you can always use these objects to make a good estimate of length.



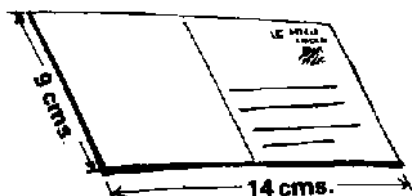
1. The length of the common matchbox is a good estimate of 2 inches or 5 centimetres. It can be used for estimating length. Half the matchbox would measure 1 inch, or 2.5 centimetres.



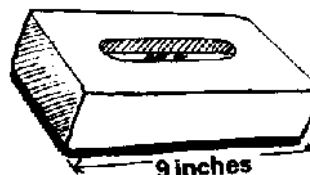
2. Every matchstick has a square cross-section. Each side of the square measures 2 mm.



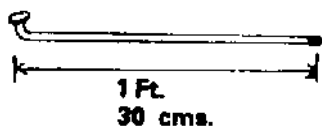
3. The length of six matchboxes kept end-to-end would almost be 1 foot, or 30 centimetres.



4. The postcard is always 14 cm long and 9 cm broad.



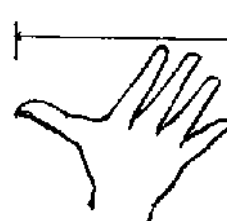
5. Bricks are normally 9 inches long, 4.5 inches wide and 3 inches thick.



6. The length of a normal bicycle spoke is approximately 1 foot or 30 centimetres.

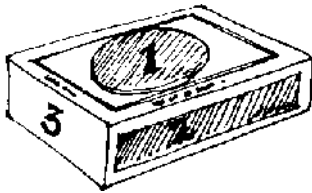


7. Coins have standard dimensions. They can be used as pretty good estimates for measurement of length. Stack 20 similar coins one on top of the other and measure their height. Divide it by 20 to get the thickness of one coin.



8. Measure the length of your hand span and remember it. This is one ruler which you will always be carrying around. Also measure the distance between two steps as you walk. This will be a good estimate to measure long distance.

## AREA



The matchbox has three distinct surfaces: The labelled surface (1); the strike surface (2); and the drawer surface (3).

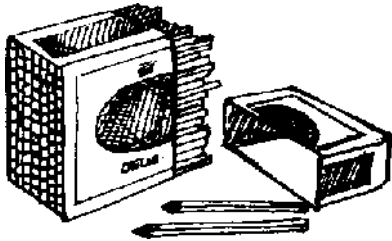
Which surface is bigger, the labelled or the strike surface (1 or 2)?

Why is (1) bigger than (2) when both of them share a common length?

Which is bigger the strike surface or the drawer surface (2 or 3)?

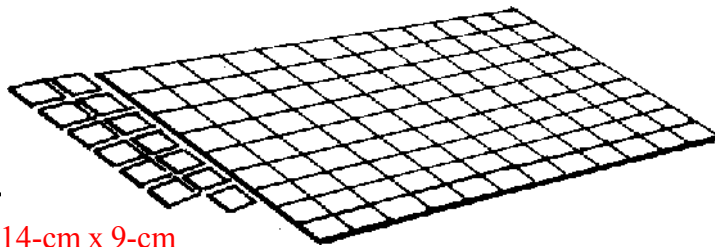
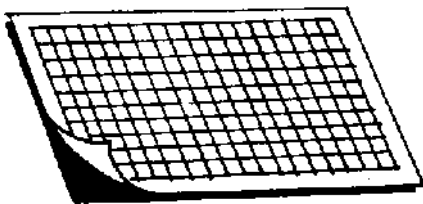
Why is (2) bigger than (3) when both share a common breadth?

### How to find the area of the outer shell of a matchbox ?



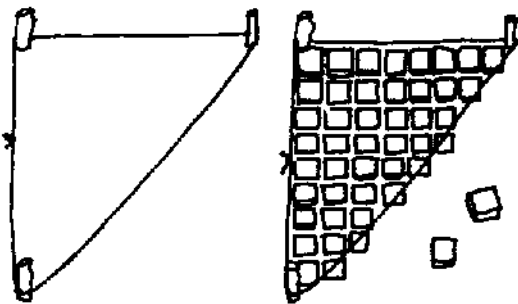
One way, of course, is to measure the length and the breadth and multiply it. There is however, another interesting way of finding out the area. Matchsticks have a square cross-section measuring 2 mm x 2 mm. So, burnt matchsticks can be used as standard bricks for measurement of area. Pack burnt matchstick ‘bricks’ in the outer shell of a matchbox to construct a wall. The area of each standard ‘brick’ is already known.

By counting the total number of matchstick ‘bricks’ used, you can estimate the area of the matchbox shell.



POST CARD 14-cm x 9-cm

Cut a postcard - 14-cm x 9-cm into one centimetre squares. Use these squares to estimate the area of various shapes.



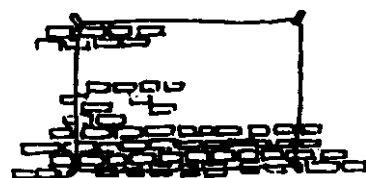
Knock three short sticks into the ground and stretch a string around them to make a triangle. Now you are going to find out how big the triangle is.

Arrange the post card unit squares in the triangle and count how many you need to fit in.

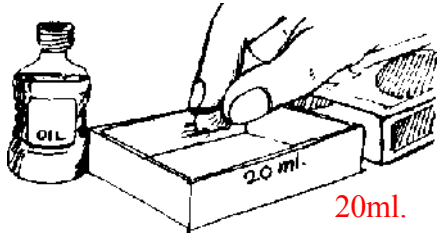
Make other shapes with the sticks and string to find out how many square centimetres you need to fill them.



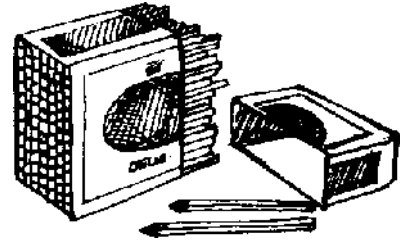
With nails or sticks and strings, mark out a rectangle on the wall of your room or a wall outside. Count how many bricks are there in the rectangle.



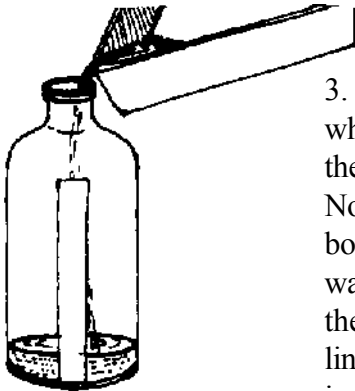
## VOLUME



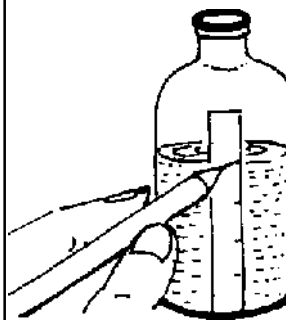
1. Dip a little cotton ball in oil and rub it on an ordinary matchbox drawer. Soon the wood / card of the matchbox will absorb the oil. Oiling makes the drawer water proof.



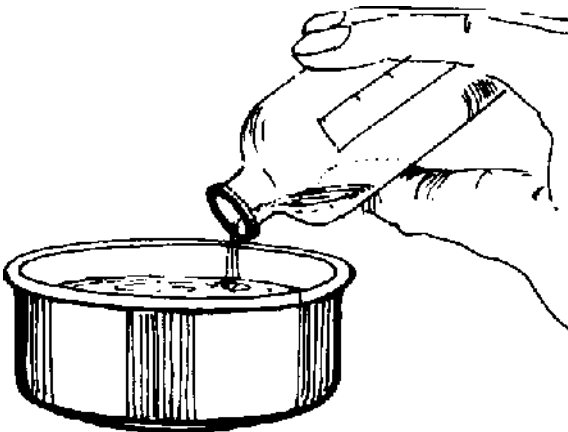
2. This drawer when filled with water holds approximately 20 ml of water. The drawer can be used as a rough standard for measurement of volume.



3. Stick a strip of white paper along the length of a bottle. Now, fill the matchbox drawer with water and pour it in the bottle. Mark a line on the strip indicating 20 ml.



4. Add more drawers full of water and similarly mark the levels of 40 ml, 60 ml, 80 ml and 100 ml. You can draw a line midway between 40 and 60 to indicate 50-ml.



5. This bottle now becomes a graduated cylinder for measurement of volume. Fill the bottle upto the 100 ml mark and then pour it out in a big pan. Repeat this ten times. Now the water in the bucket will be 1,000 millilitres or 1 litre. You can also use old mineral water plastic bottles for measurement of volume.

### Conservation of Volume



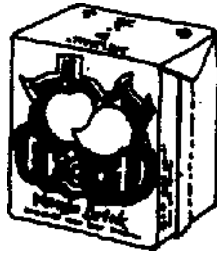
6. Put an exact cupful of water into each of the various pots, jugs, jars, bottles and other utensils. Now it will be difficult to tell that there is the same amount of water in each because the sizes and shapes of the vessels are so different.

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 are similar:

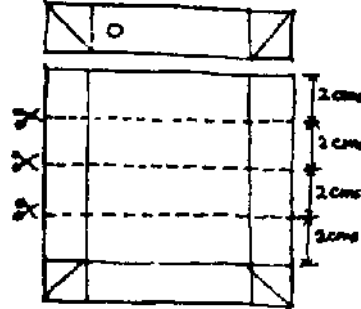
1. They are all containers.
2. They all contain water.
3. They are all waterproof.
4. They all contain the same amount of water.

## FROOTI FACTS

The Frooti carton is called a tetrapack. Tetrapacks are made by fusing together layers of different materials like plastic, aluminium, paper etc. into a single composite sheet. This wonder packaging material apart from being very expensive is also very energy-intensive. Being non-biodegradable, tetrapacks are very difficult to recycle. Nothing illustrates it better than the Frooti packet. The Frooti packet costs Rs. 8.00. The empty Frooti carton itself costs Rs. 1.50 - perhaps more than the drink itself!



1. The dimensions of a Frooti packet are length 6.2 cm, breadth 4.0 cm, and height 8.0 cm. The area of cross-section of a Frooti packet is 6.2 cm x 4.0 cm., which approximates to 25 sq. cm. Its height is 8 cms.



2. Flatten out the Frooti pack and cut off its top lid. Reshape it again into a container.



3. The container with a height of 8 cm will have a 200 ml. capacity.



4. The container with a height of 6 cm will have a 150 ml. capacity.



5. The container with a height of 4 cm will have a 100 ml. capacity.

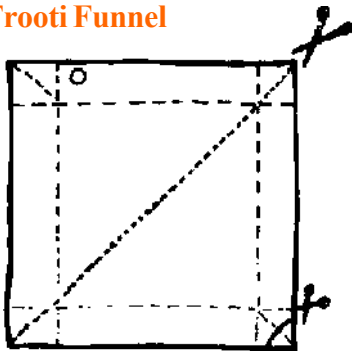


6. The container with a height of 2 cm will have a 50 ml. capacity.

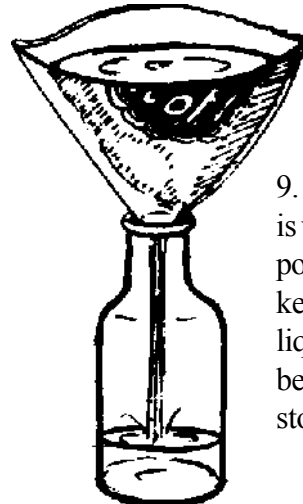
7. As Frooti packets are water proof, unbreakable and collapsible they are ideal containers for measuring volume. They can be used to approximate volumes of 200-ml, 150-ml, 100-ml and 50-ml. Dhara packets can be used to measure 1000 ml or 1 litre. The Frooti container can also be used as a collapsible tumbler for drinking water during a journey. Afterwards you can flatten and tuck away the tumbler in your pocket.



### Frooti Funnel



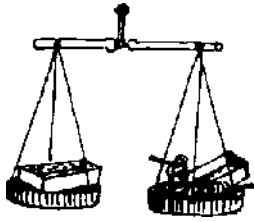
8. A useful funnel can be instantly made out of a Frooti packet. Flatten a Frooti packet and cut it along the diagonal and also make a small cut at the bottom right hand corner.



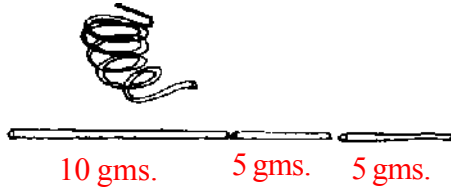
9. The Frooti funnel is very handy for pouring out oil, kerosene and other liquids. It can also be flattened and stored away easily.



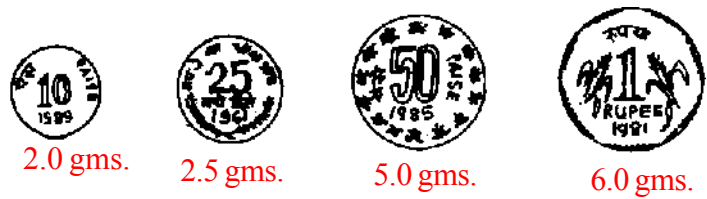
## WEIGHT



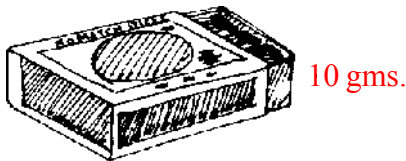
1. Make a weighing balance using two tin lids for the pans. Ensure that the balance point is equidistant from the two pans. Only then will the balance weigh truly. Now keep one oiled matchbox drawer on each of the pans. As the drawers have the same weight the beam will remain horizontal. Fill the left hand drawer completely with water. The drawer will hold 20 ml of water which will weigh 20 gms (density of water 1-gm/ml). It will amount to putting a 20 gm weight in the left pan. Put some junk wire on the right pan so as to balance the beam. The wire shall now weigh 20 gms.



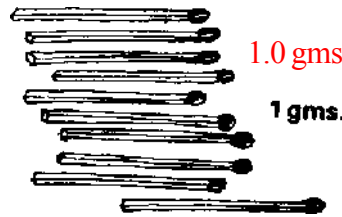
2. Straighten out the wire and cut it out into half and quarter lengths to make 10 gms and 5 gms weights. You can similarly make 50 gms and other weights.



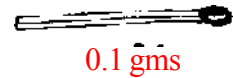
3. Coins are made in a mint and have standard weights. The new circular 10 paise coin is exactly 2 gms. The old 25 paise coin is 2.5 gms. The old 50 paise coin is 5.0 gms. The old one rupee coin is 6.0 gms. These coins are still in circulation and can be used for measurement of weight. The weights of new coins are in odd fractions and are not easy to remember.



4 An ordinary brand new sealed matchbox is a good estimate for 10 gms. The new matchbox has approximately 50 matchsticks which weigh about 5.0 gms



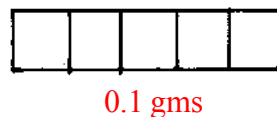
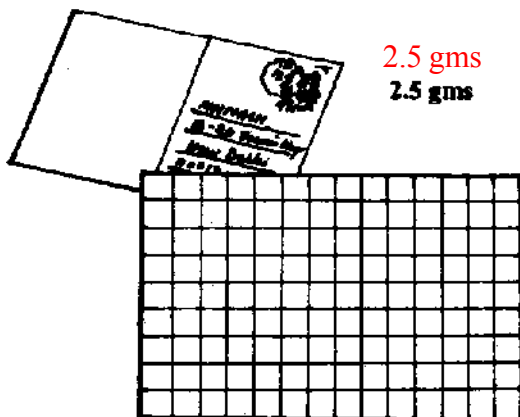
5. Ten unburnt matchsticks approximately weigh 1.0 gm.



6. One unburnt matchstick is a very good estimate for 0.1 gms.



7. A single, double spread sheet of ordinary newspaper, weighs approximately 25 gms. Four such double spread sheets will weigh close to 100 gms.



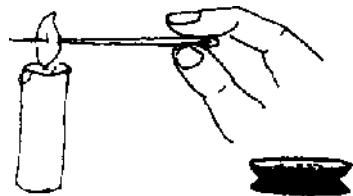
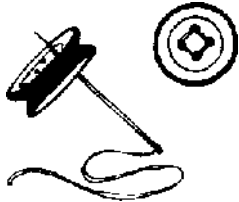
8. The weight of an ordinary postcard is around 2.5 gms. Its area is  $9 \times 14 = 126$  cm sq. Five, 1 cm squares of the postcard will weigh 0.1 gm and a lone 1 cm sq will weigh 20 milligrams. So you can easily make fractional weights too.

## BUTTON PULLEYS

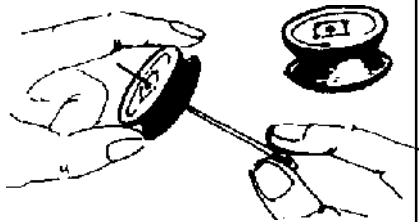
1. You will need needles, thread, paper clips, pins, old ball-pen refills and cheap quality pant/coat buttons. The plastic of these buttons should melt with a hot needle.



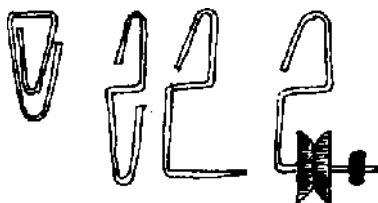
2. Put two similar buttons back-to-back and sew them with a needle/thread in the form of a square. Do not make a cross-stitch as this will cover the centre.



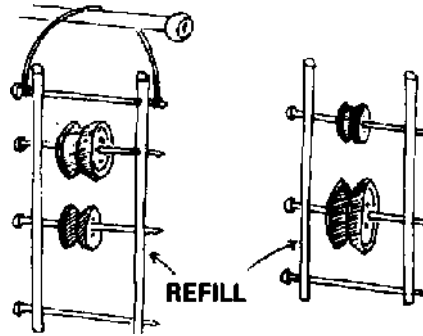
3. Now make a hole through the centre of the two buttons using the tip of a hot needle.



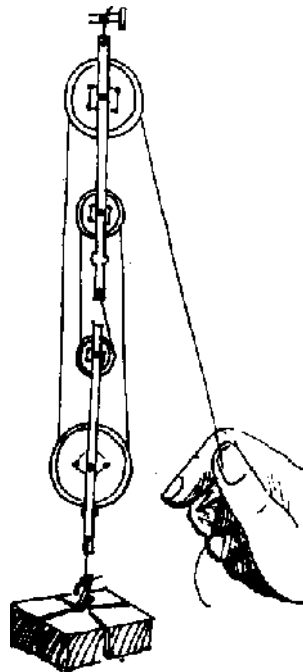
4. Make the bore smooth until the pulley rotates smoothly on the needle.



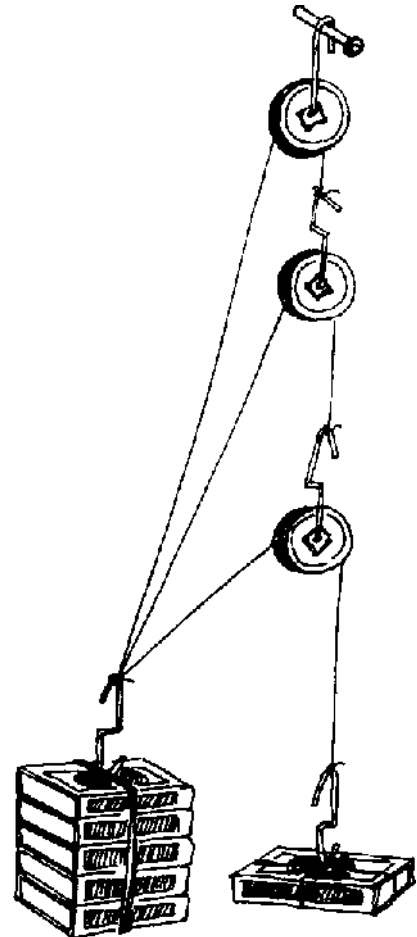
5. Make the hanger of the pulley by opening up a paper clip. Bend one of its legs at right-angles and slip in the button pulley. Put a cycle valve tube as a stopper to prevent the pulley from slipping out.



6. Different sizes of cheap quality buttons can be used to make different sizes of pulleys. Several big and small pulleys can be assembled into pulley blocks.



7. Make a ladder shaped hanger for hanging the pulleys. Use empty ball pen refills for the long members and paper pins for the short members of the ladder. With the help of these pulley blocks you can lift heavy loads by applying less force.



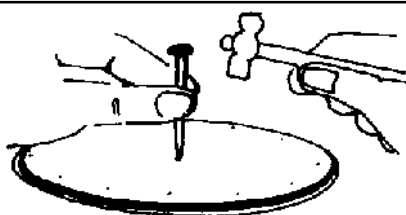
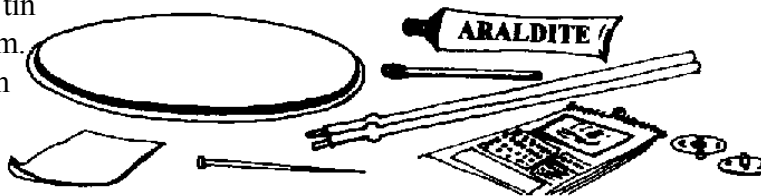
8. Assemble three pulleys and three separate strings in the above configuration. Put 5 new matchboxes (approximately 50 gms) on the load end. Now, put one new matchbox (10 gms) at the effort end. You will be surprised to find that one matchbox is able to lift up a load of 5 matchboxes.

## TIN CLOCK

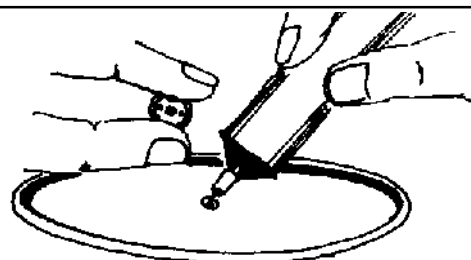
Today Montessori teaching aids have become so expensive that even the very rich schools cannot afford them. The Montessori Clock for teaching how to read time costs over Rs.200. Apart from its expense it also occupies a lot of space. You could build your own tin clock for less than One Rupee!

But then you will have to collect a lot of throw away junk.

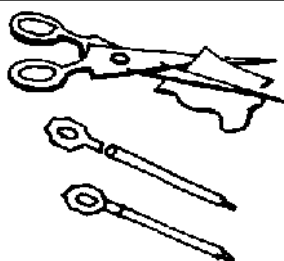
1. You will need a circular lid of an old tin box, an old ball pen plastic refill, a 1 cm. diameter press-button, some aluminium foil, a pin, a matchstick and some ordinary hand tools. You will need a small tube of Araldite to stick the button to the lid.



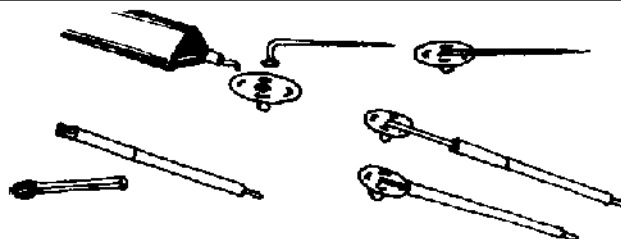
2. Make a hole in the centre of the lid with a nail.



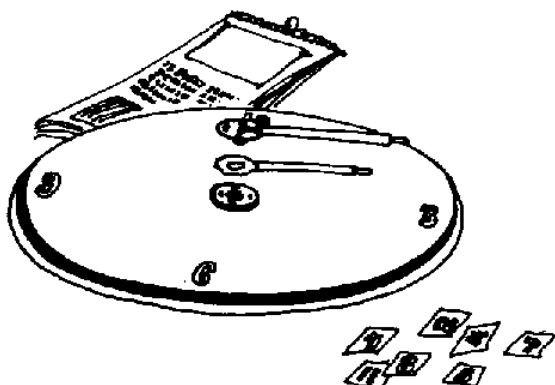
3. Stick one half of a big press-button in this hole using a drop of Araldite. Keep the assembly to dry overnight.



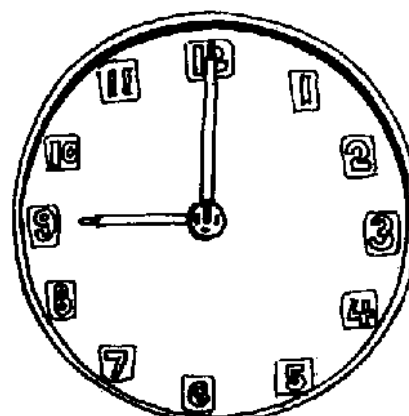
4. Cut an 8 mm. diameter circle out of an aluminium foil. Punch a hole in its centre, and cut a little tongue in its rim. Insert a small plastic refill in this tongue. This becomes the hour hand of the clock



5. Bend the head of a paper pin at right angles. Insert this head into the depression in the other half of the press-button and apply a drop of Araldite. Leave it overnight to dry. Now the pin will become attached to the press-button. Insert the pin point in a refill using a piece of matchstick as the wedge. This becomes the minutes hand of the clock.

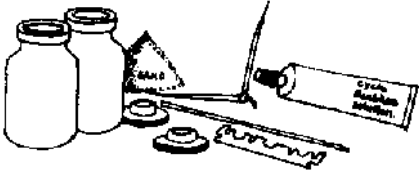
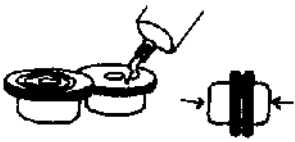



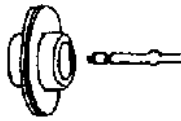

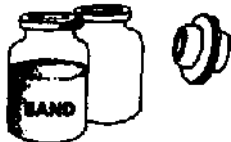



6. Cut numbers from 1 to 12 from an old calendar and stick them on the face of the tin lid to make the dial of the clock. Assemble the needles to complete the clock.



7. Instead of the tin lid you can also use a circular cardboard for the dial. In this case you can sew one half of the press button in the centre of the cardboard.

## SAND HOUR GLASS

 <p>1. You will need two clean injection bottles, an old refill, thorn or divider, sand, blade and some rubber adhesive.</p>	 <p>2. Apply cycle puncture solution on the flat sides of the two rubber caps and stick them back to back.</p>	 <p>3. Make a see through hole (2mm) through the centre of the caps by repeatedly poking them with a thorn or a divider.</p>
 <p>4 You should be able to see a clear hole in the caps</p>	 <p>5. Cut a 5 mm long piece from an old plastic ball pen refill.</p>	 <p>6. Insert this refill piece in the hole between the two rubber caps.</p>
 <p>7. The ball pen refill bore provides a smooth and uniform orifice for the flow of sand.</p>	 <p>8. Fill fine and dry sand in one of the injection bottles. Assemble the two rubber caps and the other empty bottle on top of it.</p>	 <p>9. On inverting, sand from the top bottle will trickle down into the lower bottle. By filling in the right quantity of sand and calibrating it against a standard watch you can make a one minute sand hour glass.</p>

### Pulse Beat

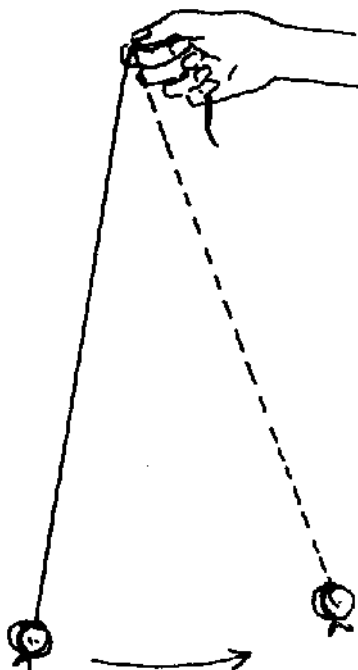


With a bit of soft clay or plasticine, fix a matchstick on the pulse of your wrist so that you can see the end of the match move slightly each time your heart pumps blood.

Does your pulse move every second, or faster or slower? How many times do you breathe in one minute?

How many steps do you walk in one minute?

### Simple Pendulum

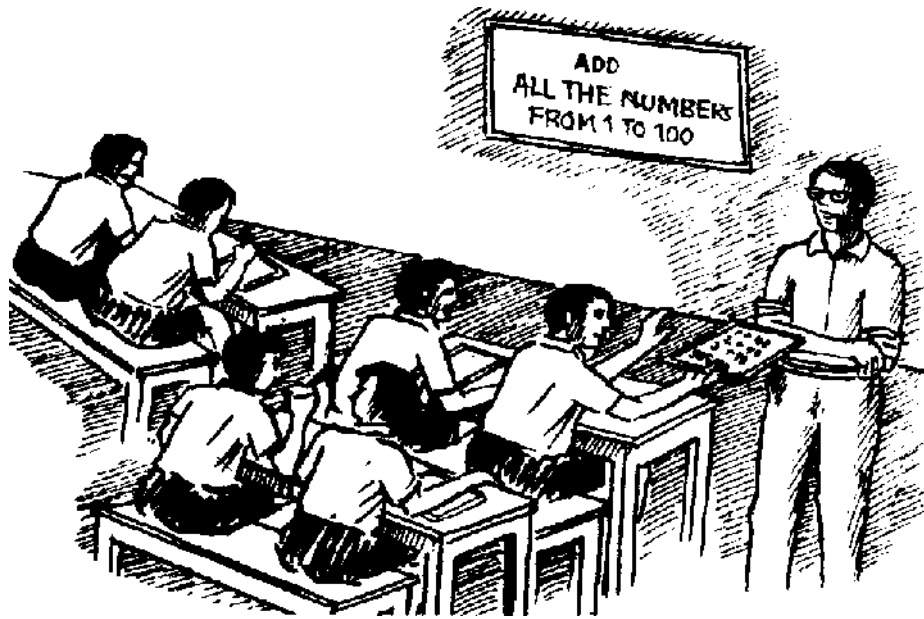


Hold a string with a stone tied to the end so that it can swing without touching anything. Give it a slight push so that it swings gently. Make the string longer and shorter and notice whether the stone swings quickly or slowly.

Take a 1 metre long string and hang it by a nail so that it swings freely. Give it a light push so that it starts swinging gently. You will find that the time the stone takes to go from one side to the other is one second when the string is one metre. Count sixty swings to understand how long one minute is.

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

## NUMBER PATTERNS



It is sad to see children learn tables by rote. It would have been so much better if children looked at number patterns instead. Most children grow up to hate mathematics. This is because of the horrendous way that maths is taught in schools. If there was less emphasis on rote learning and more in discovering the hidden number patterns, then maths would be such great fun.

This happened a long time ago - some two hundred years ago. Fredrick Gauss - the famous mathematician was then studying in class three. One day, his teacher wanted to take a small snooze in the class. So he asked all the children to take out their slates and write numbers from 1 to 100. This was not too much of a challenge for class three kids. As an after thought, the teacher asked them not only to write numbers from 1 to 100 but also to add them up. This, the teacher thought, will enable him to have a longer sleep.

The children quickly wrote down the numbers and then started to add them up. It was easy to add the first few numbers, as they were small. But as they went to two digits and higher numbers the going became slow. All the while, that the other children were frantically adding up, Fredrick looked intently at the numbers. As he peered at the numbers with rapt attention he discovered an amazing pattern. In a flash, he wrote 5050 as the answer on his slate.

The teacher looked at him in utter disbelief. On being asked how he found the answer, Gauss explained:

$$1 + 2 + 3 + 4 + \dots \dots \dots 97 + 98 + 99 + 100$$

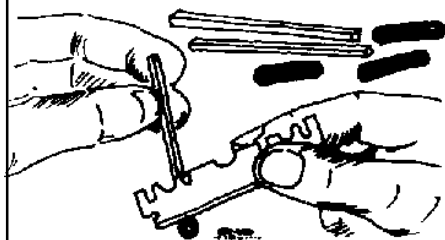
“I looked at the first and the last number. Their sum was  $1 + 100 = 101$ . Then I looked at the second and the second last number. Their sum was also 101 ( $2 + 99 = 101$ ). The sum of the third and the third last number was also 101. This pattern extended to the whole series. I reckoned that as there were only hundred numbers, there would be 50 such pairs - each adding to 101. So I simply multiplied 101 by 50 and got 5050.”

## MATCHSTICK MODELS

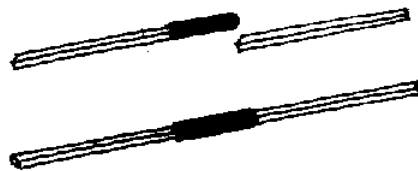
1. These matchstick models use matchsticks as the basic structural members and cycle valve tubes as the basic joints. Cycle valve tube is cheap. A packet of 100 gms. costs Rs.15/- and contains 12 metres (50 feet) of valve tube.



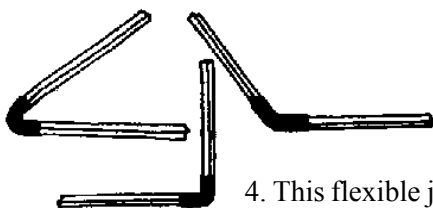
cycle valve tube



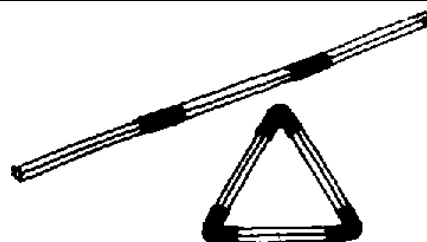
2. Cut 1.5 cms. long pieces of the valve tube. Scrape the sulphur from the matchstick heads with a blade.



3. Push two matchsticks through the two ends of the valve tube. This is a **joint-of-two**.



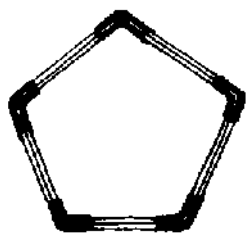
4. This flexible joint can be used for depicting angles - **acute**, **right**, **obtuse angles** etc.



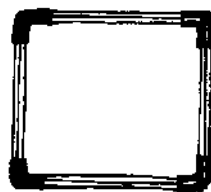
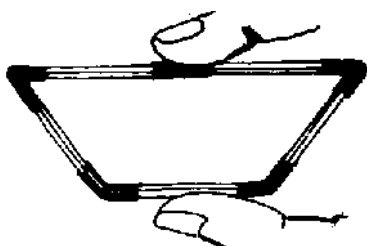
5. Three matchsticks and three valve tubes can be looped to make an **equilateral triangle**.



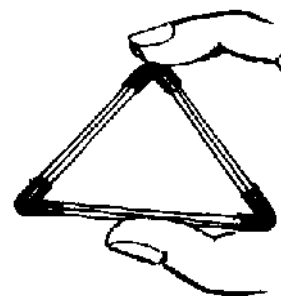
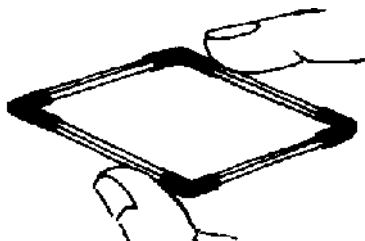
6. Other shapes like squares, rectangles, pentagons, hexagons can be made by joining more matchsticks and valve tube pieces.



7. If you press the pentagon it changes shape and becomes boat shaped.

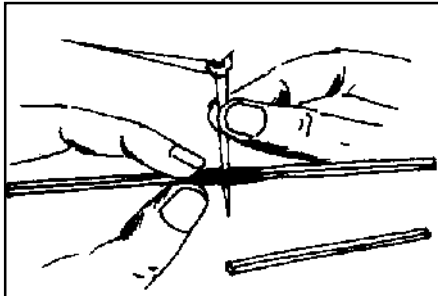


8. The square when pressed becomes a rhombus.

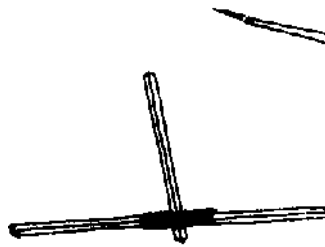


9. But no matter how hard you press, a triangle remains a triangle. The triangle is the only rigid polygon. That is why roof trusses, bridges, electricity towers are made of triangles. The triangles make them rigid and strong.

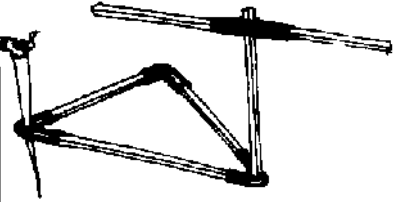
## THREE DIMENSIONAL MODELS



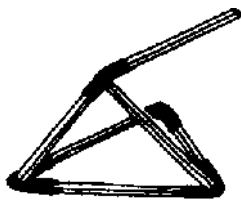
1. Pierce a hole in the valve tube **joint-of-two**, by poking it at right angles either with a long needle or else a thorn.



2. Insert a third matchstick (slightly sharpened at the end) in this hole. This is a **joint-of-three**, or simply a **T-joint**.

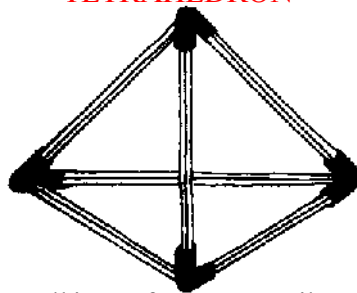


3. Take the equilateral triangle and poke holes in its valve tube joints with a thorn. Now insert the three matchstick ends of the **T-joint** in the holes of the triangle.

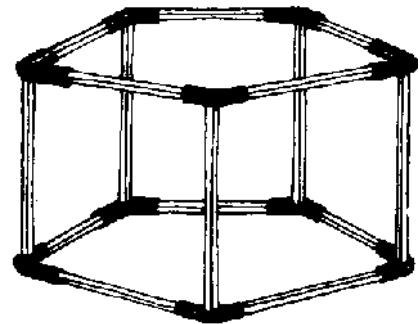


4. This structure is called a **TETRAHEDRON**. It has 4 corners, 6 edges and 4 distinct surfaces.

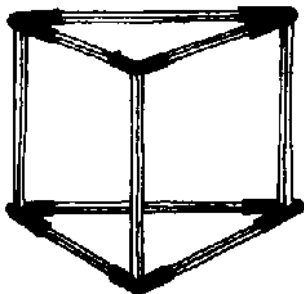
### TETRAHEDRON



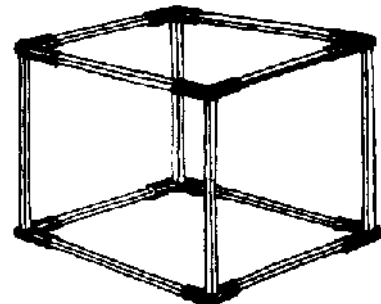
5. All its surfaces are equilateral triangles. Triangles are rigid. So this triangular house is very strong.



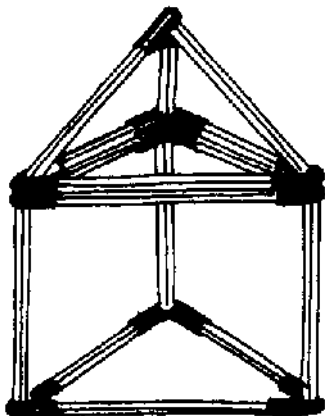
### 6. PENTAGONAL BOX



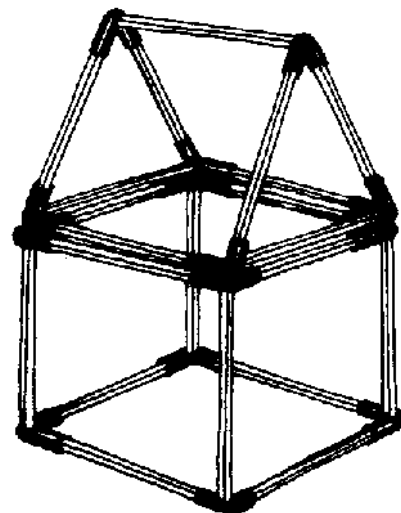
7. In a similar manner two separate triangles can be joined together using three matchsticks to make a **PRISM**.



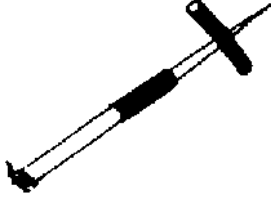
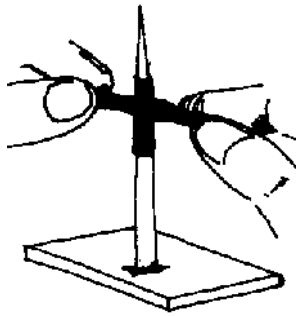
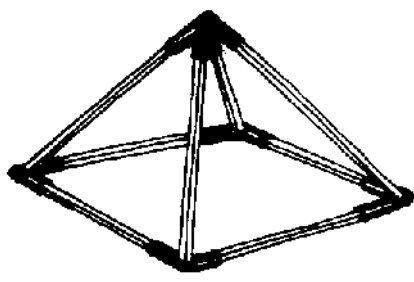

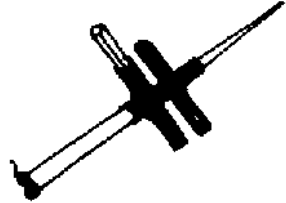

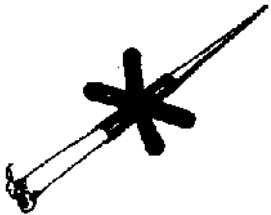
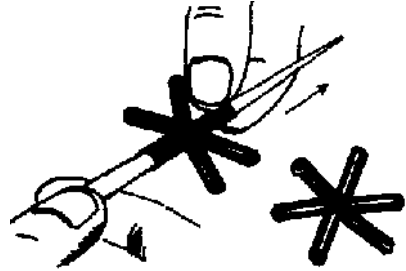
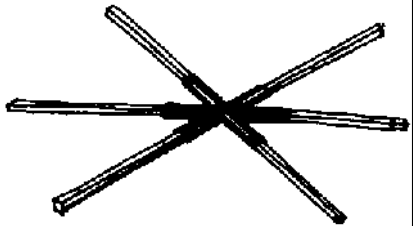
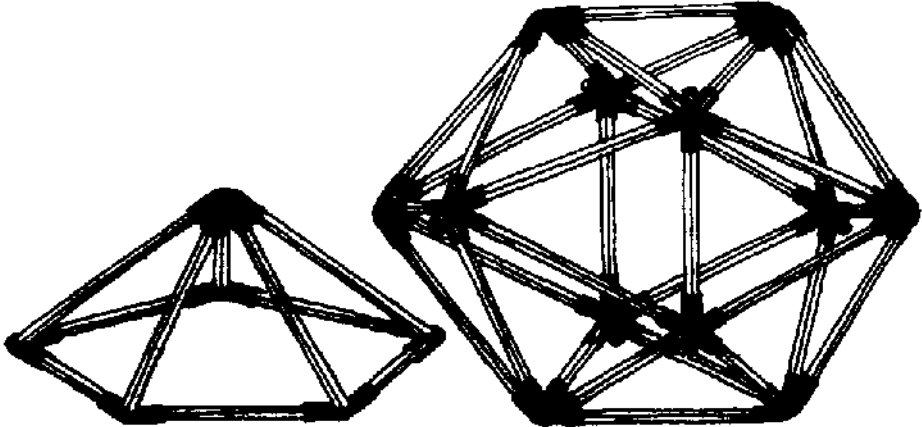
8. Two separate squares can be joined with four matchsticks to make a **CUBE**.



9. Several of these three-dimensional structures can be put together to make different kinds of houses and other configurations. You can play with this simple meccano to create your own models.



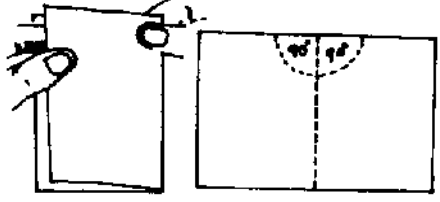

## JOINTS OF FOUR, FIVE AND SIX

 <p>1. Take two pieces of valve tube about 2 cms. long. Weave a thorn through the hole of one. Then pierce the thorn through the centre of the other valve tube.</p>	 <p>2. Pull both the ends of the second valve tube and slide it over the first one. Gently remove the cross, <b>joint-of-four</b> from the thorn.</p>	 <p>3. Use these joints to make a <b>PYRAMID</b></p>
 <p>4. Make a joint-of-four but do not remove it from the thorn. Just like the second, insert a third valve tube.</p>	 <p>5. The second and the third tubes are at right angles to the first tube. Insert a small piece of a matchstick in any of the four free legs of the 'H'.</p>	 <p>6. Weave this matchstick needle through the centre of the other leg of the 'H'.</p>
 <p>7. Now remove the thorn and phase out the six valve tube legs to form a star.</p>	 <p>8. This is a <b>joint-of-six</b>. For a <b>joint-of-five</b>, simply cut one of the legs of the 'H'.</p>	 <p>9. You can attach six matchsticks to the <b>star joint</b>.</p>
		
<p>10. Assemble twelve <b>joints-of-five</b> and thirty matchsticks to make an <b>ICOSAHEDRON</b>. One pentagonal face of the icosahedron can be flexed in to make an <b>IGLOO</b>. With joints of 2, 3, 4, 5 and 6, and matchsticks as members there are many different kinds of models and structures which you can make. This is a very interesting way to learn solid geometry.</p>		

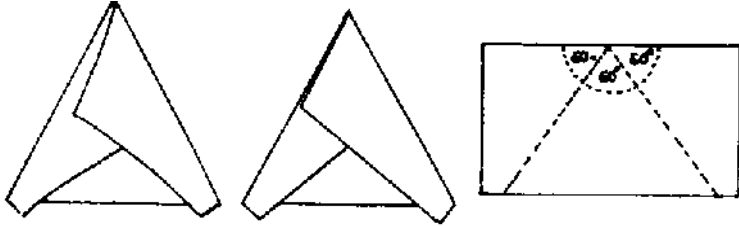


## GEOMETRY BY PAPER FOLDING

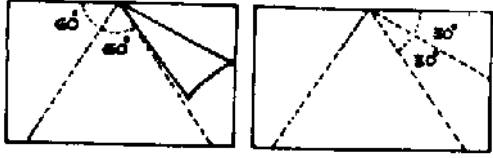
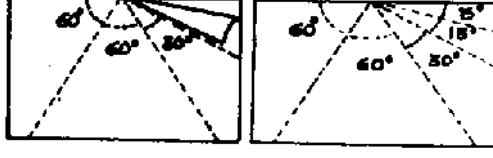
Most of these *Geometric Exercises in Paper Folding* have been inspired by a book of the same name, written by an Indian mathematician in 1893. His name was T. Sundara Row (anglicised from Rao).

<p style="text-align: center;"><b>Ninety Degree angle</b></p>  <p>1. We will start with simple angles. A straight edge is 180 degrees. If we double a straight edge upon itself we get two ninety degree angles.</p>	<p style="text-align: center;"><b>Forty Five Degree angle</b></p>  <p>2. A forty five degree angle is got by folding any right angle corner into half.</p>
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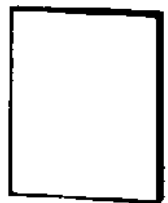


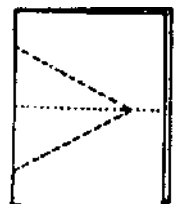
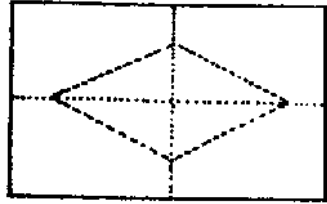
**Sixty Degree angle**


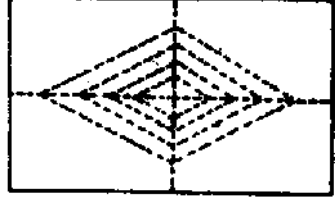


3. How to fold 60 degrees ? Divide a straight edge (180 degrees) into three equal angles. Take a point mid-way on the straight edge of paper lift both edges of the paper from this point and fold them to approximately 60 degrees. Before creasing ensure that the edges are flush with the folds to be creased.

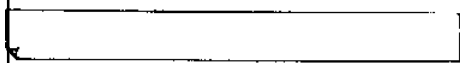
<p style="text-align: center;"><b>Thirty Degree angle</b></p>  <p>4. Fold the 60 degree angle such that its one edge doubles on the other. 60 will be divided into two 30 degree angles.</p>	<p style="text-align: center;"><b>Fifteen Degree angle</b></p>  <p>5. A fifteen degree angle can be got by halving the 30 degree angle. This can be done by doubling its one edge on the other.</p>
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**PAPER DIAMONDS**

 <p>1. First fold a sheet of rectangular paper into half.</p>	 <p>2. and then into quarter.</p>	 <p>3. Fold a triangle at the left-bottom, four fold corner (the centre of the paper).</p>	 <p>4. On opening one layer you will see half of the diamond.</p>
 <p>5. Open fully to see an elegant rhombus in the middle of the paper.</p>			

 <p>6. If you make several parallel creases at the four fold corner then ...</p>	 <p>7. On opening you will see a diamond in a diamond in a diamond - a series of nesting diamonds or rhombuses.</p>
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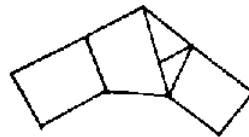
### Knotty Pentagon



1. Take a long rectangular strip of paper and tie the two loose ends into an ordinary knot.



2. Gently pull the ends to tighten the knot.

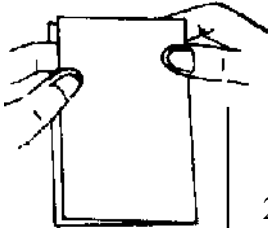


3. Tighten the knot and crease well and you will be surprised to see...

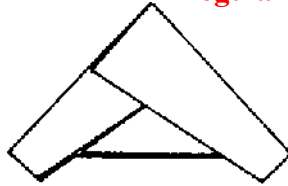


4. a regular **PENTAGON**.

### Regular Hexagon



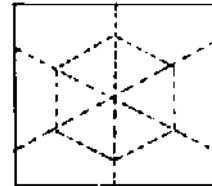
1. Fold a rectangular sheet of paper into half.



2. Fold the doubled up straight edge into three equal parts of 60 degrees each. Crease well

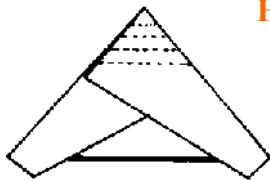


3. There will be 6 layers of paper on the top corner. Fold it into a triangle

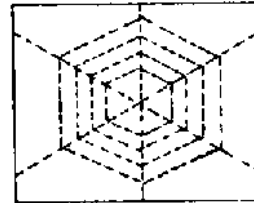


4. On opening you will see a regular **HEXAGON** in the middle.

### Hexagonal Cobweb

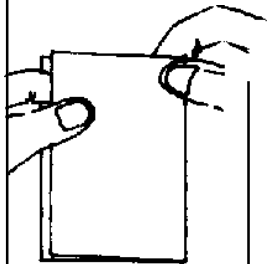


5. If you make several parallel creases at the top corner then....



6. On opening you will see a set of nesting hexagons resembling a cobweb.

### Octagon



1. Fold a sheet of paper into half and then...



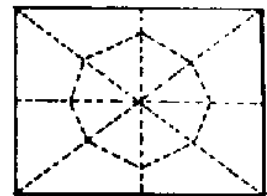
2. into a quarter.



3. Crease the 4 fold corner again into a triangle to make 8 folds.



4. Crease the 8 fold corner sharply.

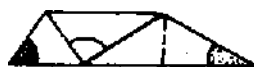


5. On opening you will find a regular **OCTAGON** in the centre.

### Sum of the angles of a triangle equal two right angles.



1. Cut a triangle from a piece of paper. Fold the top to meet at the base as shown.



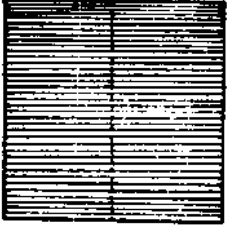
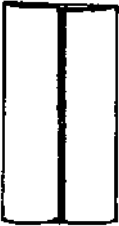


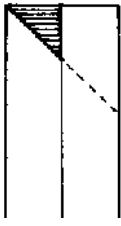
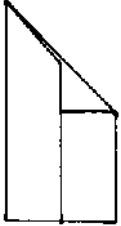
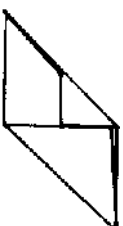



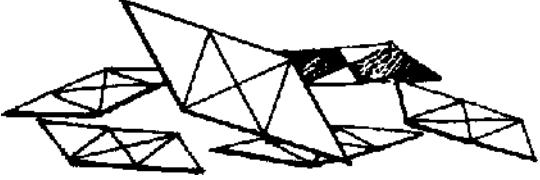
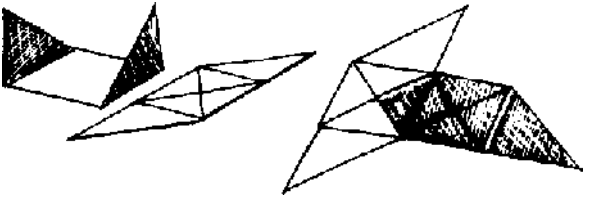
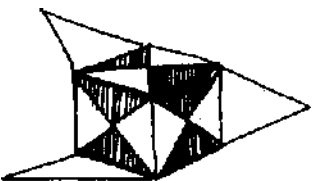
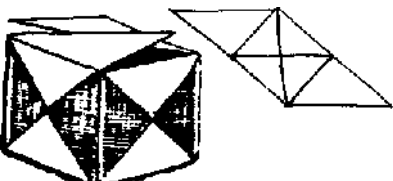

2. Fold the left and right angles too.



3. The three angles of the triangle can be folded to form a 180 degree angle. The three angles when placed like this make a straight line.

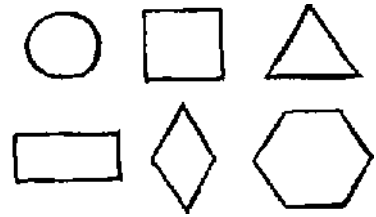
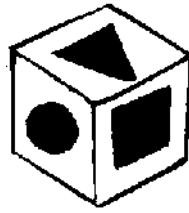
## PAPER CUBE

Using six similar squares of paper you can fold a very regular cube. You need no glue. Once you make the cube you can make various kinds of dices and a whole world of games based on the cube.

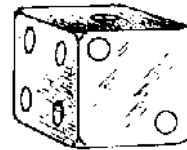
 <p>1. Take a 10 cms. square. Fold its middle line and open again.</p>	 <p>2. Fold the left and right edges to meet this middle line.</p>	 <p>3. Fold the top right angle corner into half.</p>	 <p>4. Crease and open up. You will find a small triangular flap.</p>	 <p>5. Fold it inwards.</p>
 <p>6. Now insert the right hand corner in between the folds of the left vertical rectangle.</p>	 <p>7. Repeat the same process for the lower left corner of the rectangle. First fold it into half.</p>	 <p>8. Then open the crease.</p>	 <p>9. And fold the triangular flap inwards.</p>	 <p>10. Insert the lower left corner between the folds of the right vertical rectangle. This is a self-locked parallelogram.</p>
 <p>11. One surface of this parallelogram is plain and smooth while the other surface has got four pockets. Fold the triangular flaps of all the six parallelograms towards the plain side. Now the pocket face will become an exact square.</p>		 <p>12. Start with two parallelograms. Insert the flap of the first into the pocket of the second.</p>		
 <p>13. Take the third parallelogram and insert both its flaps - one in each of the previous parallelogram pockets. Thus one corner of the cube will be made.</p>	 <p>14. Continue assembling, taking care that all the flaps will come over the square facets and get inserted in the pockets. No flap will be inside the cube.</p>		 <p>15. Finally you will get a regular <b>CUBE</b>, without using any glue. Small and stiff cubes make beautiful dices.</p>	

## FUN WITH DICES

Make a paper cube or dice. Mark six different shapes on it instead of numbers. Cut ten numbers of each of those shapes with cardboard and put them in a bag. Roll the dice. Feel in the bag for the shape that appears on the top face of the dice. If you pull out the right shape, then you keep it. Take turns. The first person to collect 5 shapes is the winner.



For this game you will need a few counters and a dice. Each person draws 4 boxes like this :



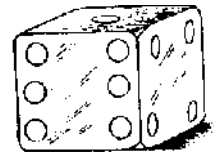
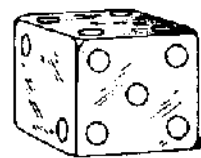
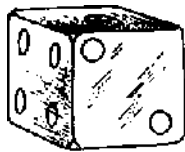
Roll the dice.

Write the number shown on the dice in one of the boxes. When you have put the number in the box it cannot be changed. Keep rolling the dice until all the boxes are full. Is the left hand number greater than the right hand number ? If it is then you collect a counter. The first person to collect 5 counters is the winner.

### Addition Game

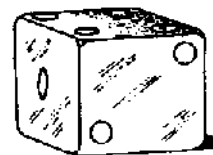
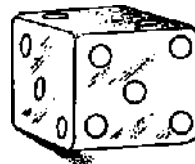
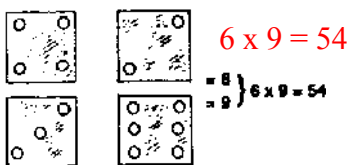
For this game you require three dices and a paper and pencil to record your score.

Throw all three dices together. Add the dots on the top surfaces of all the 3 dices. The winner is the player to score a grand total of 100.



### Multiplication Game

For this game you will require two dices and a paper and pencil to record your score. Both the dices are tossed by the player twice. The total number obtained by counting the dots on the top surface of each dice on every throw become the factors for multiplying and the player must give the final answer correctly.

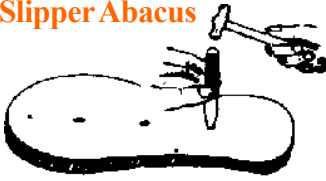
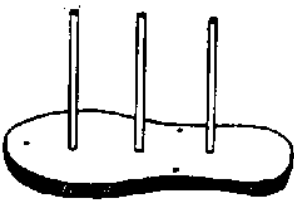
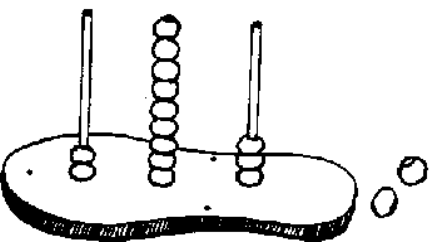
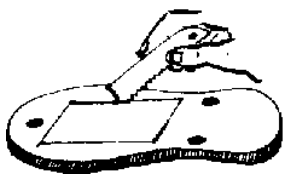
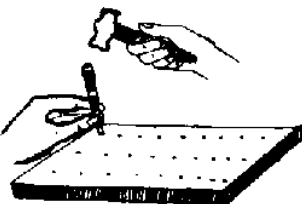
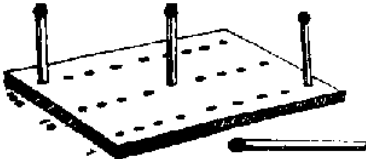
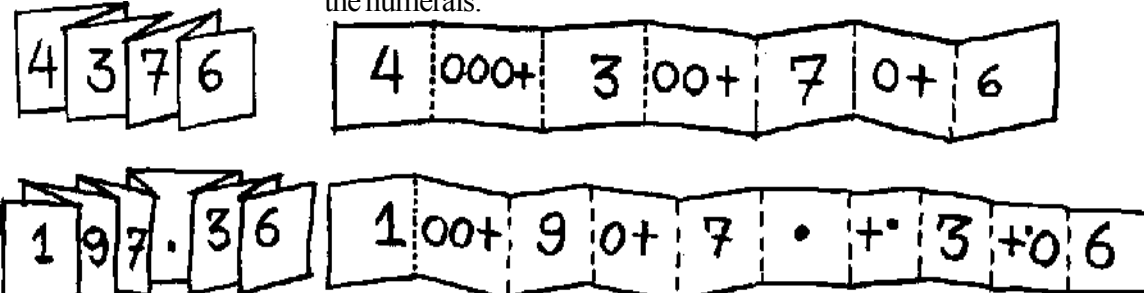


After each round, the player with the highest score gets 1 point. The winner is the player who scores 10 points first.

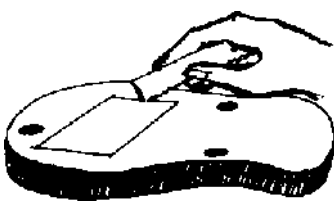
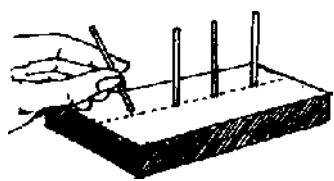
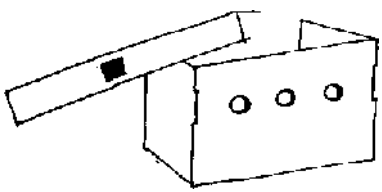
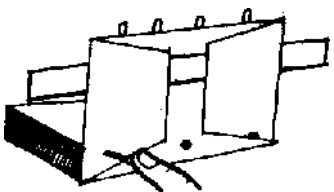
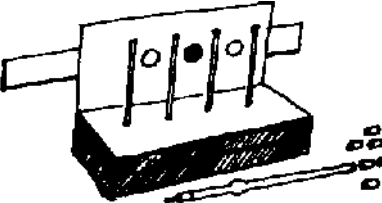
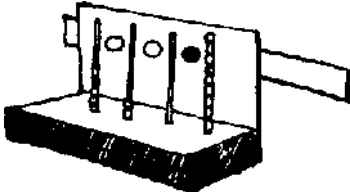
### Variations

Children can change the rules and make various games using three dices. They can throw all three dices together. Then add the two dices with the highest numbers and from this sum subtract the number on the third dice. This would be their score. They take turns and the player who scores 100 first is the winner. Alternately, they throw all three dices together. Multiply the two lowest numbers and add to it the third number. This becomes their score. The one who scores 200 first is declared the winner. The paper cube described on the previous page makes a very accurate dice. All that is required to make such a dice is six equal squares of paper. There is no gluing or pasting required. Having made a paper cube children could either make dots on them to make a number dice, or draw different shapes, or else make a dice with different colours on all its six facets. When children play with two or three dices they automatically learn to add, subtract and multiply in a very playful way. This kind of mental maths would stand them in good stead later on.

## PLACE VALUE / DECIMAL POINT

<p><b>Slipper Abacus</b></p>  <p>1. Take an old rubber slipper. Make three 7-8 mm diameter holes on its midline using a shoemaker's punch.</p>	 <p>2. Insert / press fit a pencil / reed in these holes. The height of the pencil should be only 9 beads high.</p>	 <p>3. This simple abacus can be used to show place value. The number 293 is denoted on it.</p>
<p><b>Rubber Abacus</b></p>  <p>1. Cut a 5 cm x 10 cm piece from an old hawai chappal.</p>	 <p>2. Mark out 3 columns and 9 rows of dots on it. Punch holes on the dots using a 2mm shoemaker's punch.</p>	 <p>3. Using matchsticks you can depict any score from 0 to 999 on this counter. The score right now is 159.</p>
<p><b>Place Value Snake</b> This splendid teaching aid is made from a strip of paper. When you open up the snake then you see the actual place values of all the numerals.</p> 		

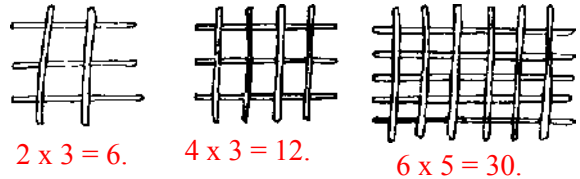
## DECIMAL ABACUS

 <p>1. Cut a 6 cm x 3cm piece from an old rubber slipper.</p>	 <p>2. Stick 4 needles in the rubber so that they are 4.5 cm above.</p>	 <p>3. Cut a 6 cm x 6 cm piece of old postcard. Make 3 holes and 2 slits on it. Mark a black spot on another postcard strip.</p>
 <p>4. Attach the postcard piece to the rubber with pins. Weave the strip through the slits.</p>	 <p>5. Cut 5 mm long beads from an old refill.</p>	 <p>6. The abacus indicates 520.9. It has got a sliding decimal point</p>

## BROOMSTICK TABLES

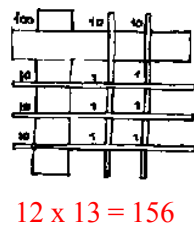
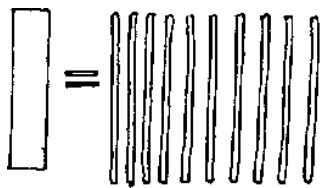
This article is inspired by the work of Sri P.K.Srinivasan of Chennai. Tables are often learnt by rote. This repetitious drill might help quick recall but it kills the whole joy of learning. With only 18 broomsticks children could discover the whole world of tables.

1. Lay one broomstick and place one across it. At how many points do they meet? Obviously one. So,  $1 \times 1 = 1$ .  
 If two vertical broomsticks are placed criss-cross over three horizontal broomsticks then they have six junctions. A criss-cross of 4 and 3 sticks will have 12 junctions. So,  $4 \times 3 = 12$ . Six vertical sticks over five horizontal sticks will have 30 intersections.



2. Children can make a 0 to 9 matrix on a square ruled copy and make their own table sheet by placing broomsticks criss-cross and counting the number of junctions. Children who know how to count should be encouraged to make their own multiplication table chart.

0	1	2	3	4	5	6	7	8	9
1									
2			6						
3									
4			12						
5									
6					30				
7									
8									
9									



$12 \times 13 = 156$

### Multiplication of two-digit numbers

Multiplication of two-digit numbers would mean counting too many junctions. So, ten broomsticks can be represented by one card strip. Criss-cross of two strips will be  $10 \times 10 = 100$ , while that of a strip and a broomstick will be  $10 \times 1 = 10$ . Add up the sums of all the junctions to get the multiplication value. For instance,  $12 \times 13 = 156$ .

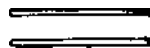
### Multiplication by Zero

The abstract concept of multiplication by a zero can be concretised by the use of broomsticks.



$2 \times 1 = 2$ .

1.  $2 \times 1 = 2$ . Now remove the vertical stick.



$2 \times 0 = 0$

2. As there are no junctions now so  $2 \times 0 = 0$ . Now remove one horizontal stick.



$1 \times 0 = 0$ .

3. What remains is  $1 \times 0 = 0$ . Now remove the last horizontal stick.

$0 \times 0 = 0$ .

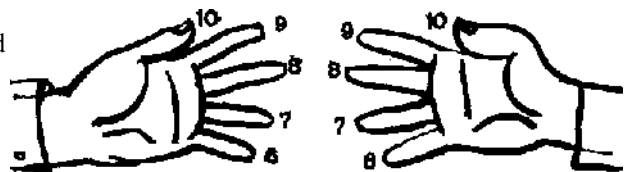
4. Now there are no junctions, so  $0 \times 0 = 0$ .

### Finger Multiplication

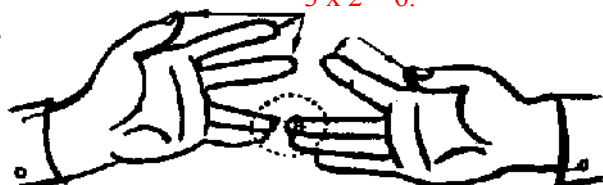
This is a simple way to multiply numbers from 6 to 10. This method was used in some parts of Russia before the Revolution because at that time poor people and their children could not go to school. For this method you must do the following:

1. You give numbers to your fingers from 6 to 10.  
 2. If you want to multiply 7 by 8, finger number 7 of one hand must touch finger number 8 on the other hand. Then the two fingers together with all the fingers under them are tens. You have five tens, that is 50.

Then you multiply the number of the other fingers on the left hand by the number of other fingers on the right hand. This gives you  $3 \times 2 = 6$ . So,  $50 + 6 = 56$ . This method always gives the right answer.



$3 \times 2 = 6$ .

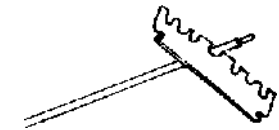
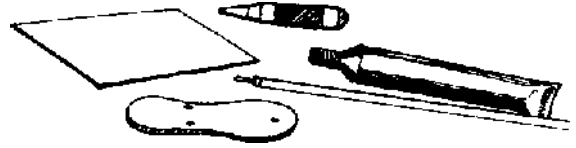


$5 \times 10 = 50$ .

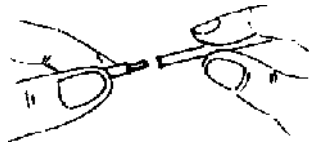
## ROULETTE

Empty ball pen refills are not for throwing for they make beautiful bearings. For this you need cheap refills which still cost 75 paise each and have a thin brass tip. The plastic end of these refills can easily slide into the brass tip (Reynold and Sharp refills will not be appropriate).

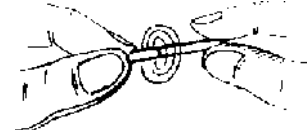
1. You will need an old refill (thin tip), an old rubber slipper, cardboard, a small 2 mm shoe maker's punch or a poker, Fevibond and scissors.



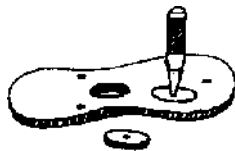
2. Cut a used refill about 1 cm from the top.



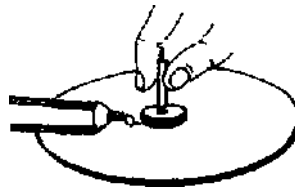
3. Insert the plastic refill in its brass tip.



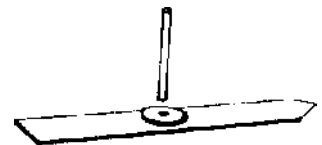
4. The refill goes in very smoothly. The refill on its own brass tip makes a very efficient bearing.



5. Punch a 2 mm hole in a 1 cm diameter rubber disc cut from an old slipper.



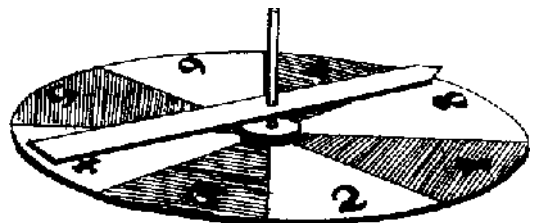
6. Stick this disc at the centre of a 15 cm diameter cardboard. Insert the 1 cm refill with the tip in this hole.



7. Cut a 15 cm long and 1 cm wide pointer out of cardboard. Stick another rubber disc at its centre. Insert an 8 cm long refill in this disc.

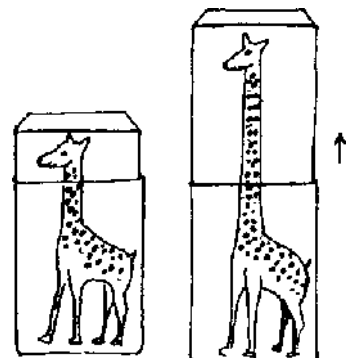
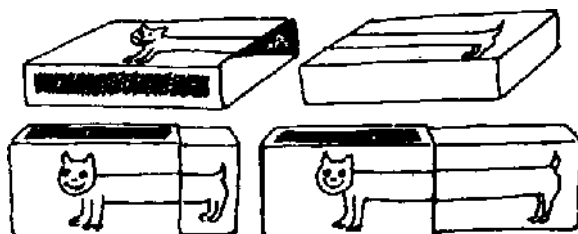
8. Place the refill in the pointer on the brass tip, in the middle of the cardboard disc. Try twirling the pointer. The pointer will rotate very smoothly. Place a circular card disc divided into 8 equal sectors on the cardboard disc. The roulette has now become an 8 digit dice. By dividing the card disc into different number of segments you can make a dice of any number. Children spin the pointer and later put seeds corresponding to the number indicated by the pointer.

Instead of numbers you can have shapes, colours, alphabets, different leaves on separate card sheets. You can make a number of very interesting matching games using this simple roulette.



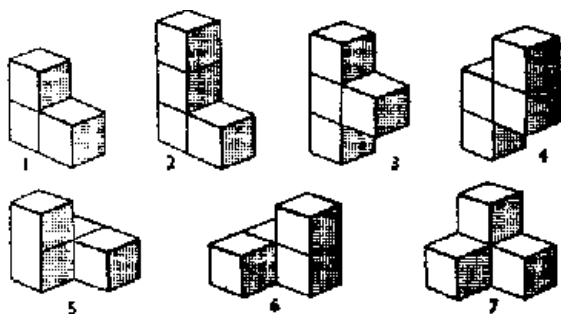
### Stretchable Stomach

This toy is a source of endless amusement for little children. Paste a white paper on the outer case of a cardboard matchbox and also on its drawer. Draw a cat as shown. When the drawer is slid inside, the cat appears in its normal size. On pulling the drawer out, it appears as if the cat has a stretchable stomach.

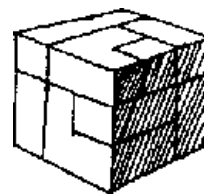


In another variation of this toy, the neck of a giraffe can be stretched, much to the amusement of children!

## THE SOMA CUBE

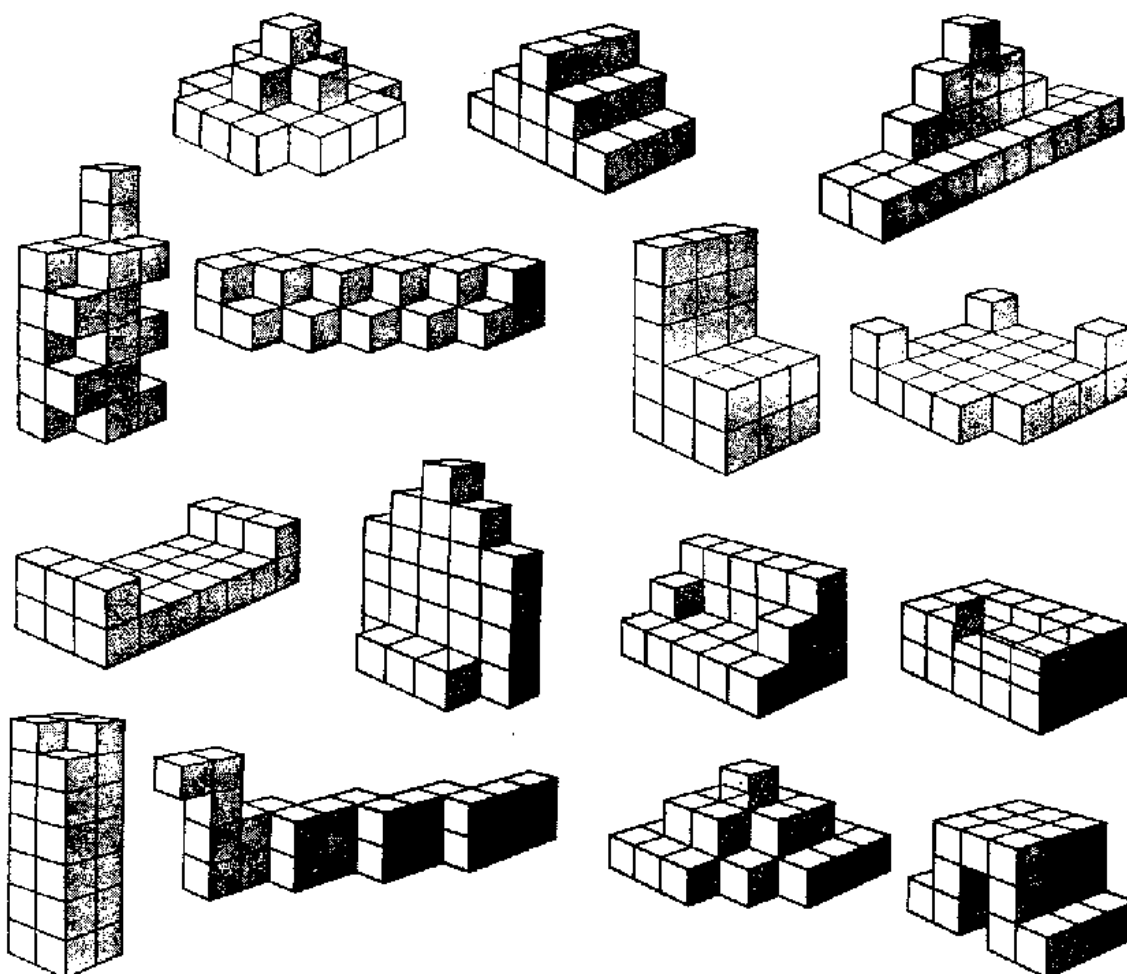


1. Take 27 wooden or plastic cubes and stick them into seven shapes as shown. You can also make use of the paper cubes shown on the previous page. These are the seven pieces of the **Soma Cube**.



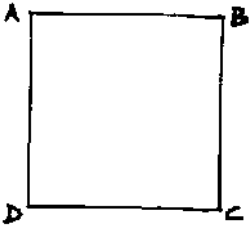
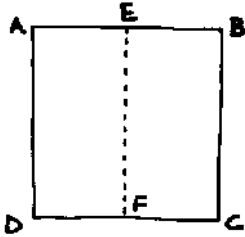
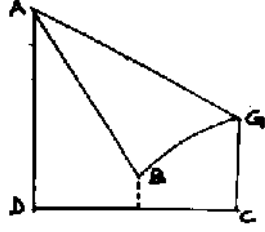
2. Assemble all these seven pieces to make a  $3 \times 3 \times 3$  solid cube. There are over 230 ways of making this cube. How many ways can you find?

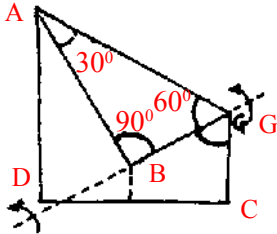
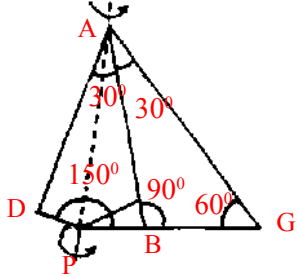
3. The number of pleasing structures which can be made with the seven pieces of the Soma Cube seem to be unlimited. You can make all these three - dimensional figures using all the seven pieces in each case.

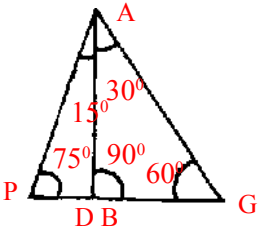
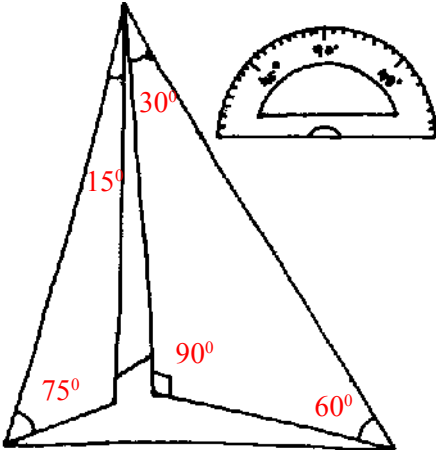





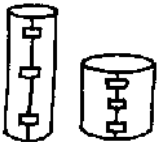
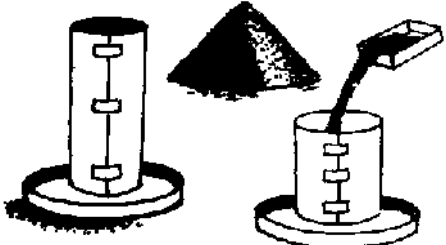
## PAPER PROTRACTOR

		
<p>1. Take a 10cm x 10cm piece of square paper (ABCD).</p>	<p>2. Fold along its middle line EF.</p>	<p>3. Fold corner B and move it up and down on mid-line EF until line BA passes through the left-hand corner A. Crease AG.</p>

	
<p>4. By doing this angle AGB will become 60 degrees. In triangle ABG, angle A is a corner of a square (90 degrees), angle AGB is 60 so the remaining angle BAG will be 30 degrees. Now fold the lower triangle along line BG and tuck it below triangle ABG.</p>	<p>5. Bring edges AD and AB together so as to bisect angle DAP (30 degrees) into half. Now angle PAB will be 15 degrees.</p>

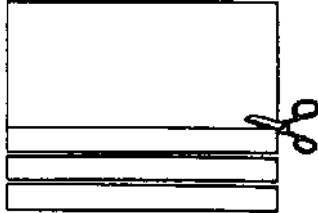
		<p>7. Now we have a beautiful paper protractor with angles of 15, 30, 45, 60, 75 and 90 degrees marked on it. Corners P (75 degrees) and G (60 degrees) can always be opened and doubled to make angles of 150 and 120 degrees. So, next time if you forget your geometry box, there isn't much to worry about. Just fold a paper protractor.</p>
<p>6. As angle ABP is a right angle being a corner of a square so the remaining angle APB will be 75 degrees.</p>		

### Which Holds More?

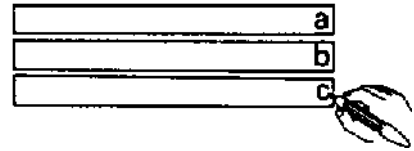
		
<p>1. Take two postcards and roll each one of them into a tube. One the long way and the other the short way. Do not overlap the ends. Tape the ends.</p>	<p>2. One cylinder will be tall and thin. The other will be fat and short Both will have the same surface area.</p>	<p>3. Will each cylinder hold the same amount? What do you think is the answer? The short and fat cylinder holds much more sand. Why?</p>

## THE MOEBIUS TWIST

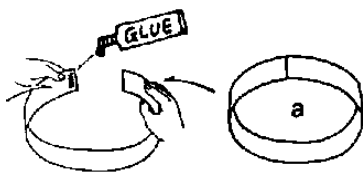
The Moebius strip is a geometric curiosity. An ordinary square piece of paper has four edges and two surfaces - the top and the bottom. But the Moebius strip has only one edge and one surface. It was discovered by a German mathematician and astronomer Augustus Moebius, during the last century.



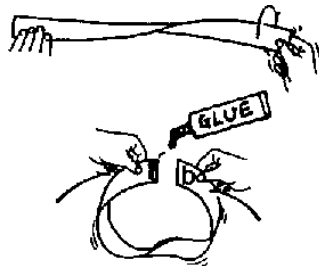
1. Take a full sheet of newspaper and cut three strips 5 cm. wide and about 80 cm. long.



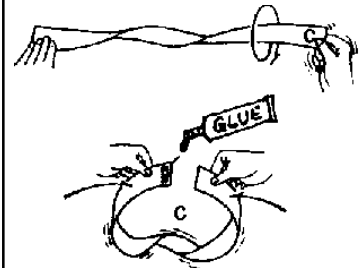
2 Label the strips a, b, and c.



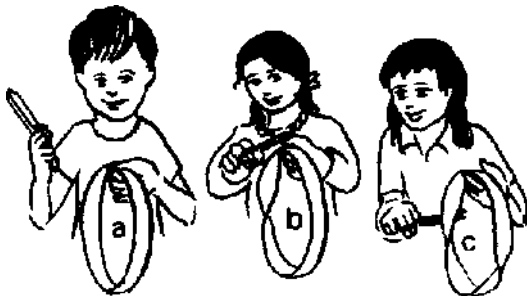
3. Take strip a and glue the ends together, so as to make a circular loop.



4. Give strip b half a turn (180 degree) before gluing the ends together to make a loop.



5. Give the last strip c a full turn (360 degrees) before gluing the ends together to make a loop.



6. Now, give the three loops to three different friends. The loops look almost the same. But when your friends..



7. cut them along the middle line of each loop they will be in for a great surprise.



8. The first loop **A** will get divided into two separate loops of paper.



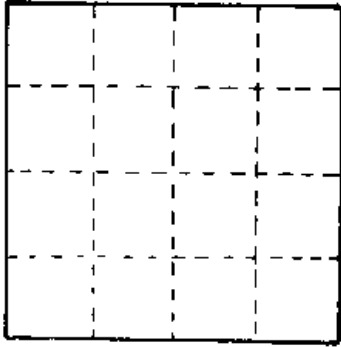
9. Loop **B** will become a single loop whose length will be double that of the original loop.



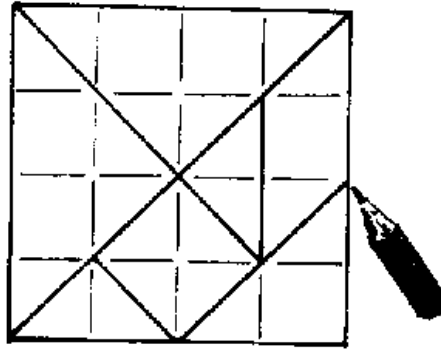
10. However, it is the third loop **C** which will surprise you the most. It will become two loops which are linked together.

## TANGRAM

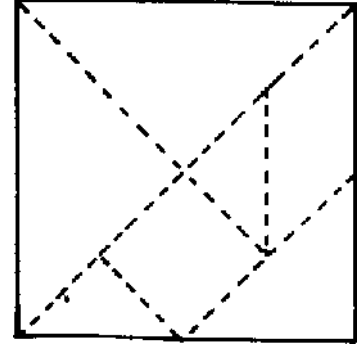
Tangram is a thousand year old Chinese puzzle. In this a square is cut into seven pieces. Then all the seven pieces are joined together to create different patterns - geometric designs, humans, birds, animals. All the seven pieces have to be used for each design. There are thousands of different designs to make.



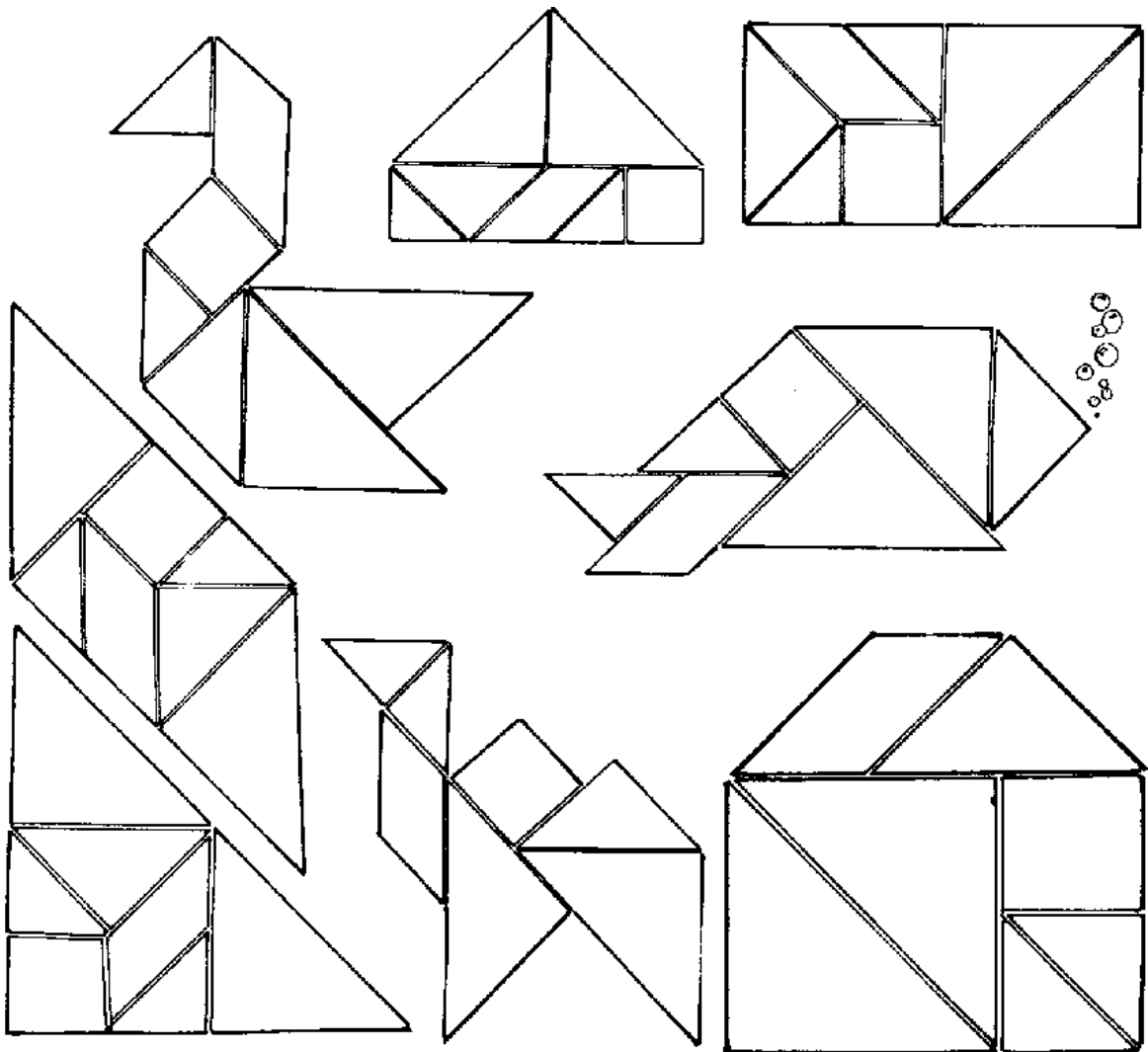
1. Mark 16 small squares in a cardboard square of edge 10cm.



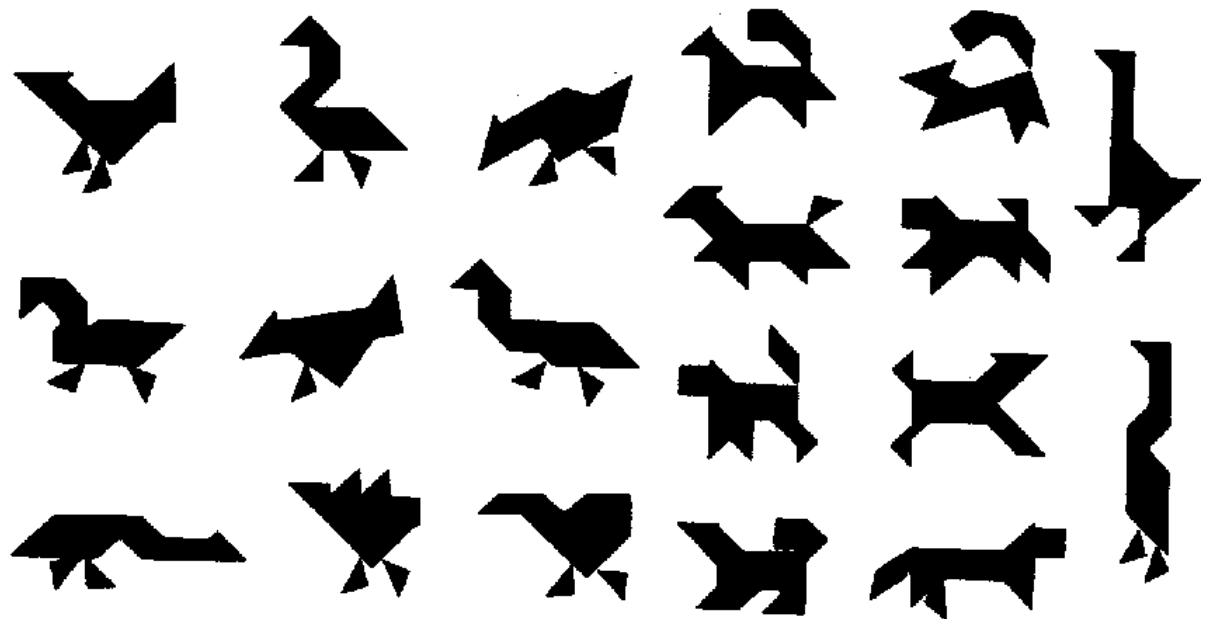
2. Draw the lines as shown.



3. Cut along the lines and you have the seven pieces of the tangram.



Make all these humans, birds, animals using all the seven pieces of the Tangram in each case.



## BEST PEST

Lessons are mugged up for passing exams. Definitions and formulae are learnt by heart to score high marks in the tests. Often the lessons have nothing to do with real life. There is often no link between what is taught in science and the needs of the community. But this need not always be so.



An enlightened village science teacher in Andhra Pradesh got hold of an old mosquito net. With wire hoops and pieces of net he made a butterfly net for every child. Each child was allocated a particular small patch of the village paddy field. While coming to school the children had to once scoop the butterfly net through the paddy field. They had to bring their booty of insect pests to the school.

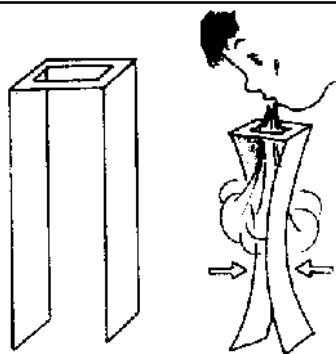
In the school the children separated and sorted out the various insects. They counted the insects and tried to know their names. They plotted a daily chart giving the number of insects found everyday. This simple bar diagram, would tell them about the increase or decrease in the insect population. It was like a frequency count. It would give them some inkling of the pest menace. When is the pest population at the maximum? What would be the best time to spray the fields with pesticide?

Children learnt a lot about insect pests and their plant hosts. Which insects attacked the paddy fields? Which insects attacked the black gram and ragi fields? Which was the best way to manage the pests? Would a solution made of crushed tobacco leaves, or of neem leaves work on a particular pest?

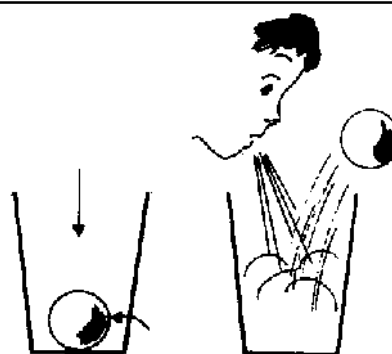
A conscious teacher was able to inspire the students to learn science from real life. The children were learning relevant science in a very interesting way. Not only were they doing great science but they were also helping the community in combating the pests for a sustainable livelihood.

## AIR

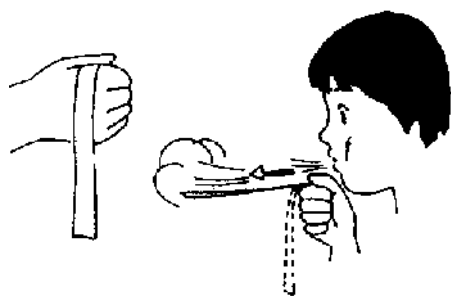
These simple experiments are fun to do. In each of these experiments whenever you blow air, its high speed creates a low-pressure zone, which makes things either come close or rise up in the air.



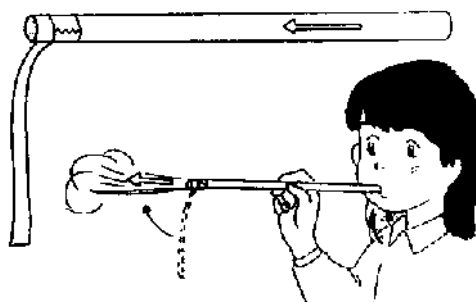
Take a strip of card 50-cm long and 5 cm wide. Cut a window in its middle and bend its two legs to make it stand like a table. On blowing through the window both the legs of the paper table come close together.



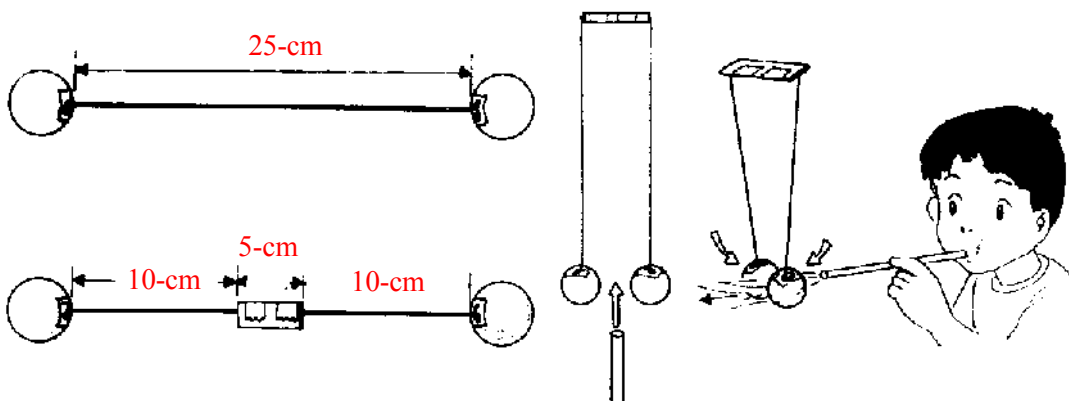
Can you remove a table - tennis ball from a glass without physically touching it ?  
Yes you can. Blow hard towards one wall of the glass and the ball will be ejected out of the glass.



Take a thin strip of paper and hold it in the gap between the thumb and the index finger. Then bring the thumb close to your mouth and blow horizontally. The strip will rise and float in the air.

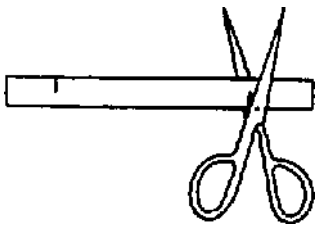
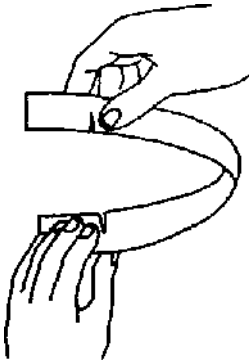
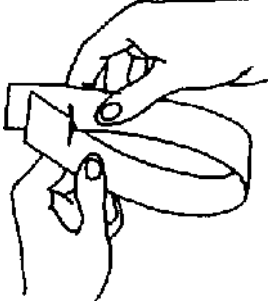
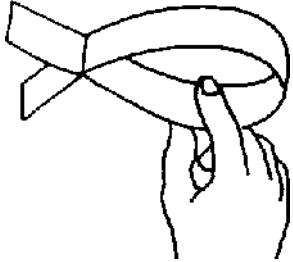
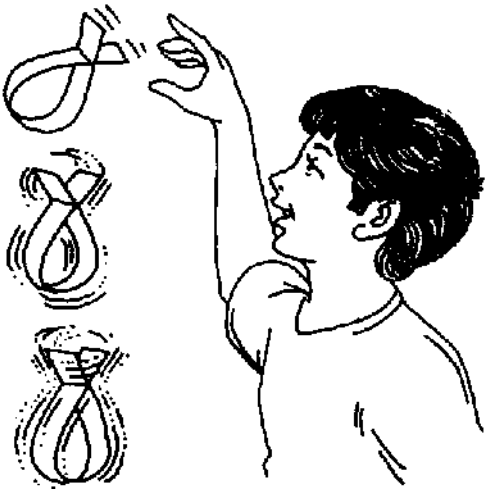


You can also tape the paper strip to the end of a plastic straw and blow through it. The strip will rise up and float horizontally.

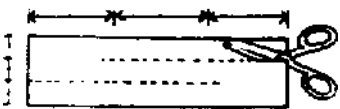
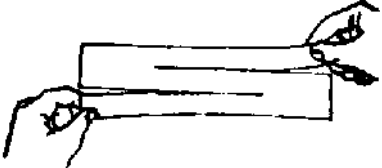
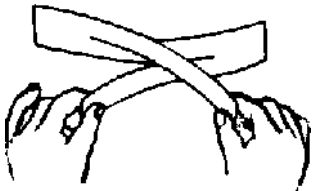
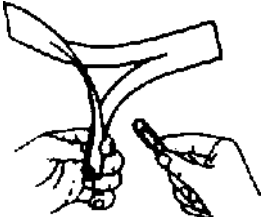



Tape two light plastic balls to the ends of a 25-cm long thread. Tape a 5-cm long paper strip in the middle to keep the balls apart. Hang the balls and use a plastic straw to blow air between them. The balls will come close and strike each other.

## FLYING FISH

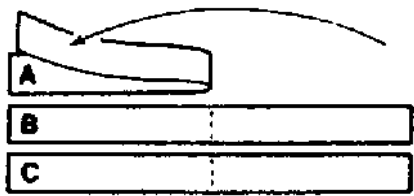
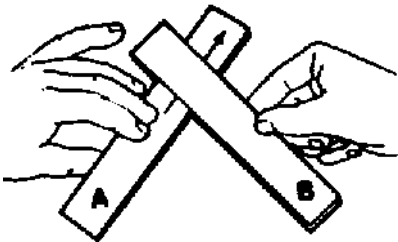
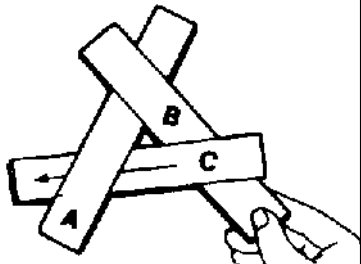
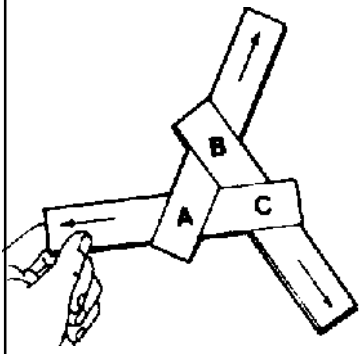
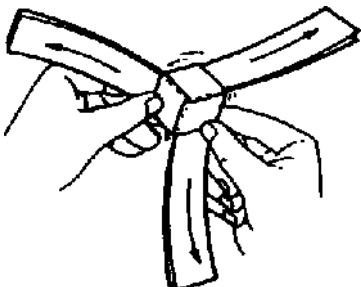
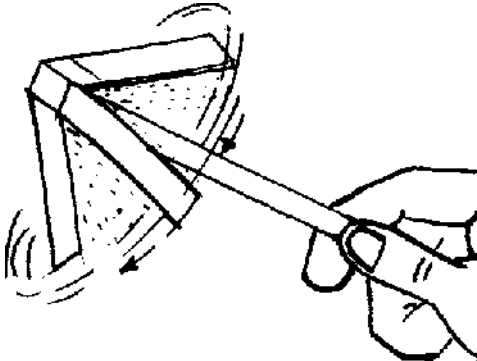
		
<p>1. To make it all you need is a strip of old newspaper. The strip should be 2-cm wide and about 12-cm. long. Place the strip in a horizontal position. On the lower right-hand side, about 1.5-cm. from the end, cut a slit half-way across the strip.</p>	<p>2. Make a similar cut on the upper left-hand side.</p>	<p>3. Slip both the slits into each other so that they interlock together.</p>
		<p>5. Throw it high in the air and it will twist and turn around on its way to the ground. Try making Flying Fishes of various sizes and colours. This is the simplest and the most amazing flying object that you can make. The fish will twist and turn round and round as it comes to the ground.</p>
<p>4. The fish is now complete.</p>		

## HELICOPTER

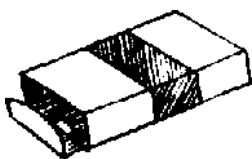
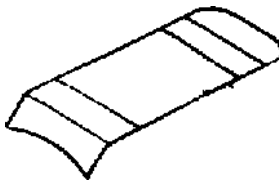
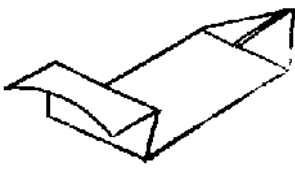
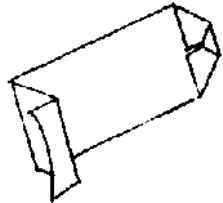

		
<p>1. Cut a long strip of paper 12-cm. long and 3-cm. wide. Cut two-thirds of the length along the dotted lines.</p>	<p>2. Hold the upper right-hand and the lower left-hand and bring them together.</p>	<p>3. To form a 'V' shape.</p>
		<p>5. Now drop the helicopter from a height and watch it whirl round and round. Make a loop with the thumb and first finger of your right hand. Try and catch the vertical tail of the falling helicopter in this loop.</p>
<p>4. Fasten the two ends with a paper clip, and that the helicopter will stay vertical while flying.</p>		

## THREE BLADE FAN

This is a two minute toy. It is a very simple toy to make and it is great run to play with.

 <p>1. Cut three long strips from an old postcard each about 1.5 cm wide. Fold each strip A, B, C in half from the right to the left.</p>	 <p>2. Take strips A and B and put A inside B like this.</p>	 <p>3. Weave strip C into place.</p>
 <p>4. Pull the strips in the direction as shown ...</p>	 <p>5. to make a tight paper knot. The interlocking of the three strips makes a bowl like form.</p>	 <p>6. Put this fan on a blunt point of a pencil and run with it. The fan will rotate.</p>

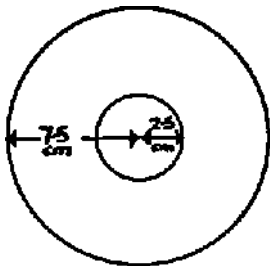
## LEAPING FROG

 <p>1. Take an old cigarette packet and...</p>	 <p>2. remove its inside drawer made of thin card sheet.</p>	 <p>3. Fold the two corners on the top to the middle to make a triangular head.</p>	 <p>4. Fold the tip of the triangular head inwards.</p>
			<p>5. The folds on the left side of the drawer act as a very fine spring. Turn the frog upside down and press the spring with your index finger to make it leap. Paint the frog green and stick two eyes to make it look like a real frog.</p>

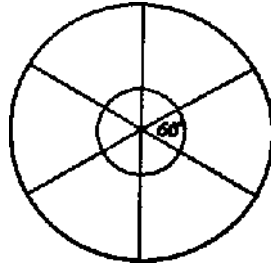


## DANCING DOLL

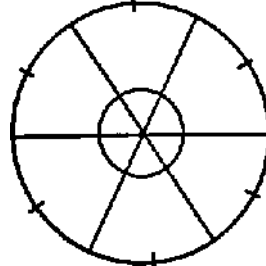
You will need one sheet of paper, pencil, ruler, scissors and craft knife, glue, compass and protractor.



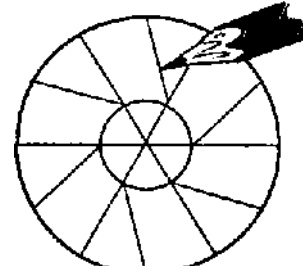
1. To make the skirt draw two concentric circles of 2.5 and 7.5 cm radius. Draw a horizontal line through the centre of the circles.



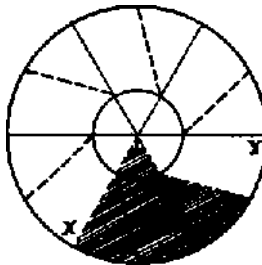
2. Draw 60 degree angles above and below the line from the centre. The circle will be now divided into six segments.



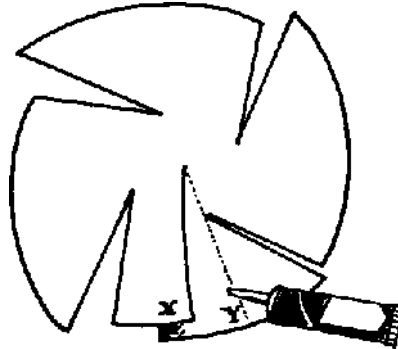
3. Mark the circumference of the outer circle at points half-way between each radial line.



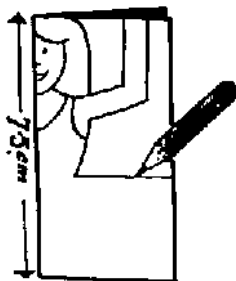
4. From these mid-points draw six slant lines as shown.



5. Cut along five of these lines. Make further cuts as shown and discard the shaded area.



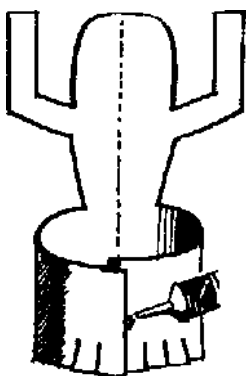
6. Form a cone by bringing points X and Y together. Glue them to complete the skirt.



7. To make the doll: cut a 7.5 cm square of paper and fold it in half. Draw half the doll as shown.



8. Cut through both the layers of the paper in one go. Discard the shaded area. Cut along the slit lines.



9. Unfold and shape the lower part. Overlap the two ends and glue them together.

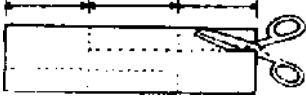
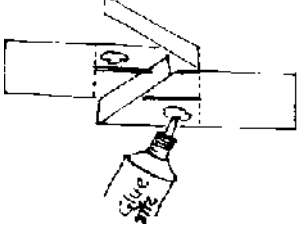
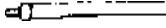

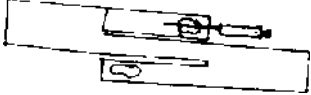
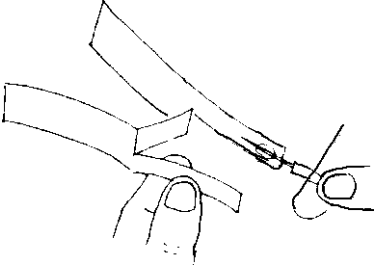
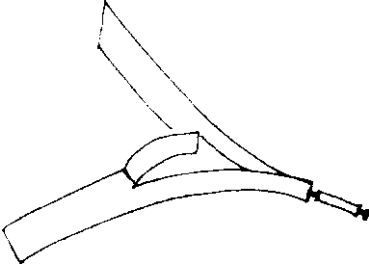
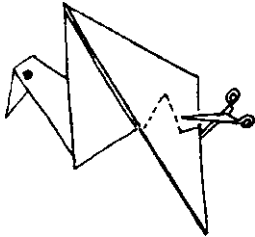
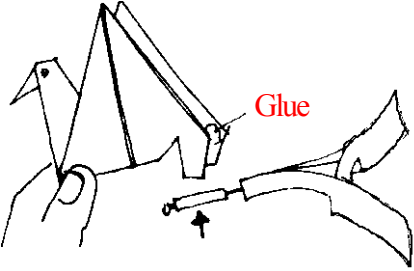
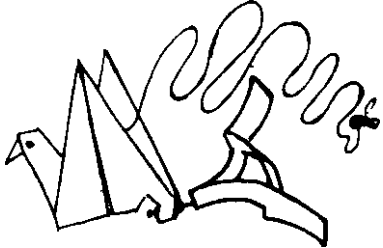
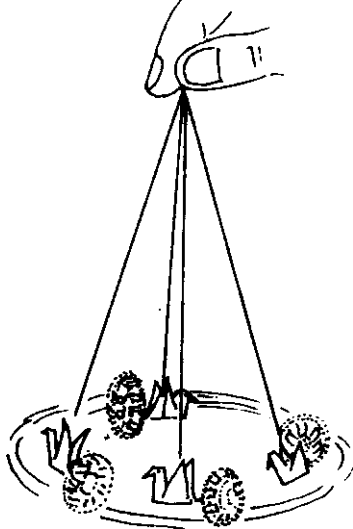


10. Raise the little tabs and glue them on the underside. Then fix the upper body to the skirt. Rearrange the arms.

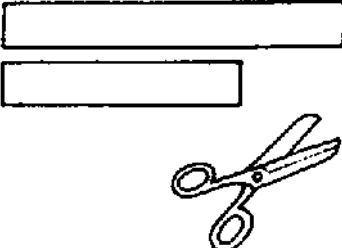
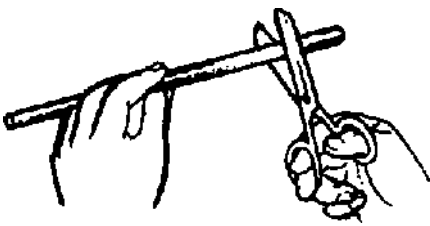
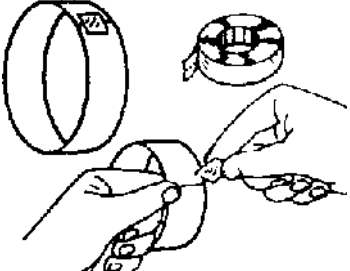
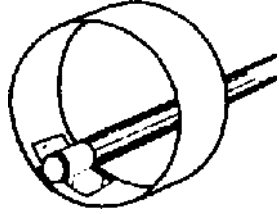
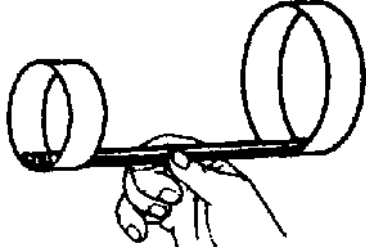
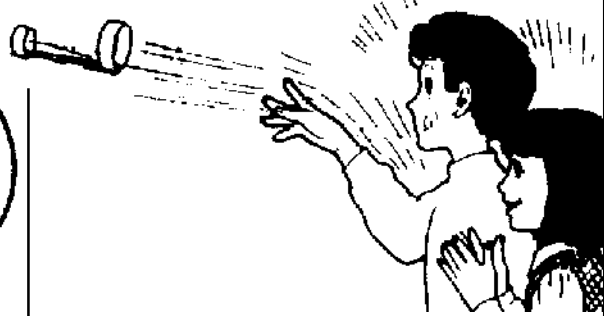


11. Balance the doll on a tip of a pencil. Blow on the skirt and the doll will spin round and round.

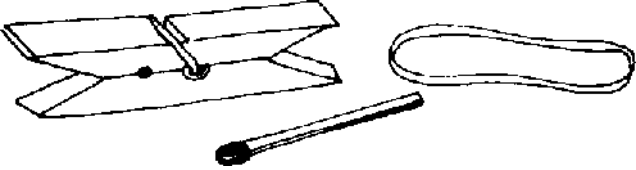
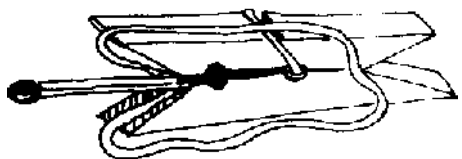
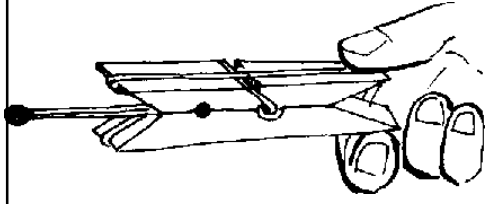
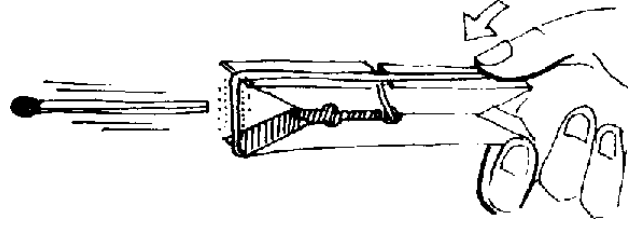
## FAN TAILED BIRD

 <p>1. Take a 7.5-cm x 3.0-cm strip of bond paper. Fold its length into three equal parts. Leaving one third of the width cut two sectors along the length Repeat the same at the other short edge.</p>	 <p>2. Fold one third of the end strips inwards and glue them.</p>	 <p>3. Cut a one centimetre long piece from an old ball pen plastic refill and flatten one of its ends by pressing it between your teeth.</p>
 <p>4. Put a pin through this end. The oval refill end prevents the pin from going through.</p>	 <p>5. Apply glue (Fevibond / Vamicol is best) on the doubled up ends. Stick the end of the pin as shown in the picture.</p>	 <p>6. Now turn the strip and stick the two glued portions together.</p>
 <p>7. If you now hold the refill and blow through the wide side of this Y shaped propeller then it will rotate very fast.</p>	 <p>8. Fold a <b>FLAPPING BIRD</b> using a 10-cm square of thick paper. Cut the bird's tail as shown by the dotted lines.</p>	 <p>9. Apply glue on both the inner portions of the tail and stick the plastic refill of the fan. Take care so that the glue does not touch the head of the pin.</p>
 <p>10. Tie a thread to the bird and then rotate it.</p>	 <p>11. The tail fan will rotate giving a feel of the bird in flight.</p>	

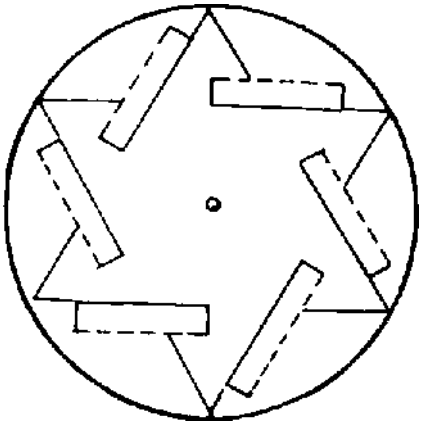
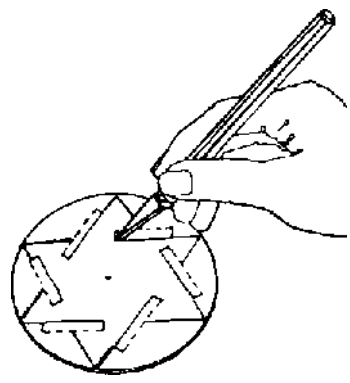

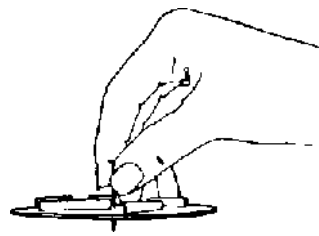
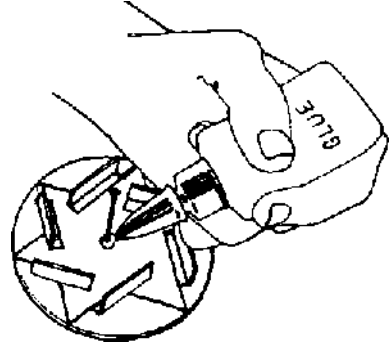
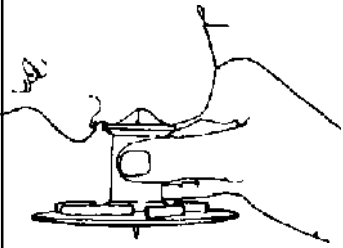
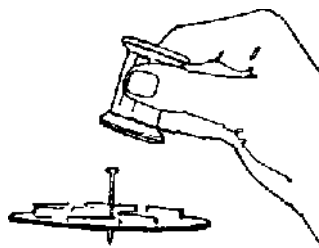
## LOOP GLIDER

 <p>1. Cut two strips of paper, one measuring 2-cm. x 16-cm. and the other 2-cm. x 10-cm.</p>	 <p>2. Cut a stiff drinking straw or a light reed of 15-cm. long.</p>	 <p>3. Bend the small strip into a loop so that its ends overlap a bit. Tape the overlapping ends together. Do the same with the large strip.</p>
 <p>4. With a piece of sticky tape attach the small loop to one end of the straw.</p>	 <p>5. Attach the large loop to the other end.</p>	 <p>6. To fly the glider, hold it high with the small loop in the front and throw gently. The loop glider will glide through the air. If the glider wobbles, adjust the position of the loops.</p>

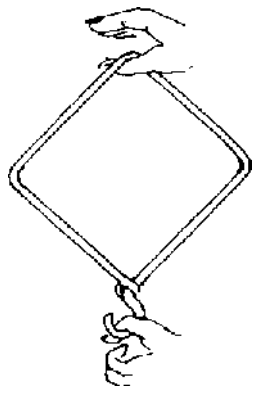
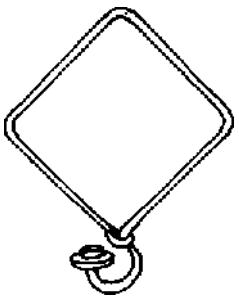
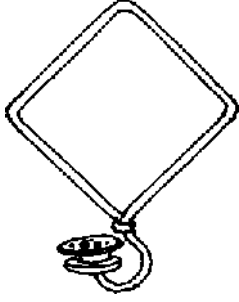
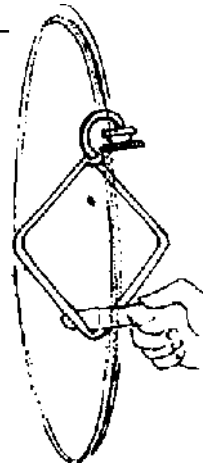
## CLOTHES CLIP PISTOL

 <p>1. To make this ingenious pistol you will require a wooden or a plastic clothes clip, a rubber band and a matchstick.</p>	 <p>2. Place the matchstick and the rubber band as shown in the picture.</p>
 <p>3. The rubber band will be in tension. If you press the clip in this position then...</p>	 <p>4. The matchstick will shoot forward. A wooden clothes clip and a thicker stick works better.</p>

## AIR TOP

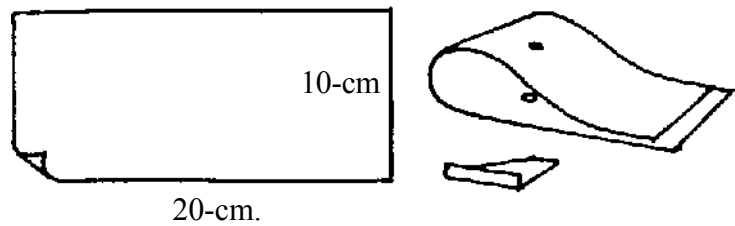
		
<p>1. Take a thick card disc 7-cm in diameter. Mark out the lines as shown.</p>	<p>2. Cut along the three sides of the flaps with a sharp blade.</p>	<p>3. Bend the flaps upwards as shown.</p>
		<p>4. Stick a pin or a thin nail through the centre of the disc, leaving about 1 cm projecting below. This will be the pivot point of the top.</p> <p>5. Apply glue, or Fevicol around the pin to hold it in place.</p>
		<p>6. Now hold the disc lightly against one end of an empty thread spool with your finger, letting the long end of the pin stick up through the hole in the spool. Blow through the other end of the spool.</p> <p>7. The stream of air you blow strikes the vanes radially and makes them spin. The stream of air also creates a low-pressure zone, that holds the disc against the spool. Once you stop blowing, the top will drop from the spool and continue to spin on the table.</p>

## Funny Money

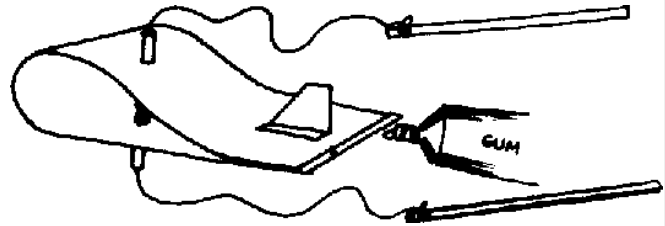
			
<p>1. Pull an aluminium hanger into a diamond shape.</p>	<p>2. Make a hole in an injection bottle cap and insert it in the hook.</p>	<p>3. Place a coin on the rubber cap. Swing the hanger in a full circle. Continue spinning fast. The coin will not fall.</p>	<p>4. When you stop the coin will still be perched on the cap. This is a very dramatic way to demonstrate centripetal force.</p>

## Aeroplane Wing

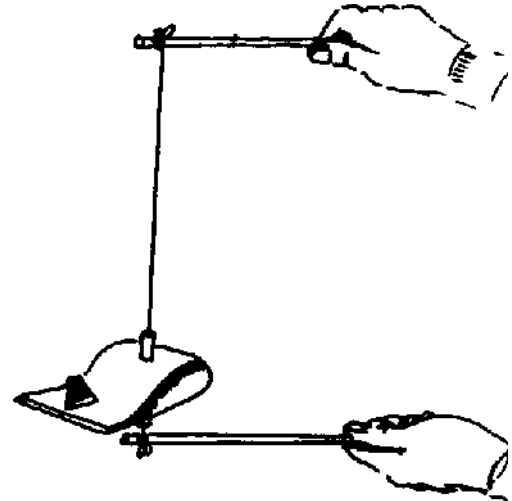
1. Cut a piece of paper 20-cm. long and 10-cm. wide. Bend it in half and stick the edges together. Run a fold along the edge with your fingernails so that it bends, curved at the top and almost flat underneath. The flat end of the wing is the leading edge, and the thin edge is the trailing edge.



2. Make a straight hole through both the parts of the wing about 3-cm. from the leading edge. Pass a piece of empty straw or ball pen refills through it and fix it with a dab of glue. Stick a piece of paper on the centre line of the trailing edge. This fin will stand vertically and help in stabilising the wing.

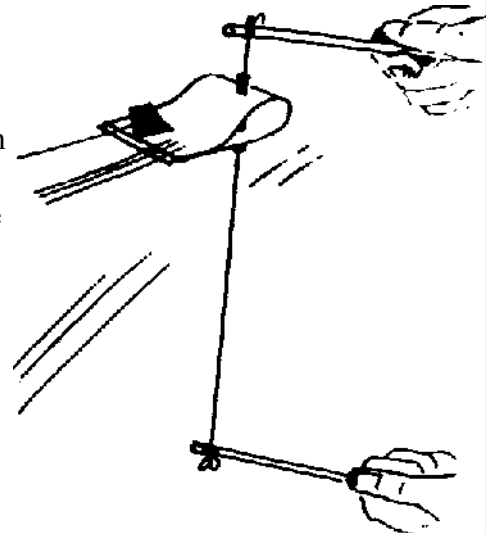


3. Pass a thin thread through the refill and tie the two ends of the thread to two sticks. Now hold the sticks in your two hands and pull them so that the thread is in tension. As you swing the sticks through the air the wing will rise on the thread.



4. How does an aircraft fly? How does the aircraft's wing produce lift? How does the heavy aircraft with such a load of passengers and cargo fly in the air? This simple paper model of the aeroplane's wing will help you understand the principle of flight.

As you pull the thread and run with both the sticks the paper wing lifts up on the thread. There is a hump on the top portion of the wing. The top portion of the wing is longer than the bottom portion, which is almost flat. As the wing moves in the air, its leading edge divides the air stream into two parts. One air stream goes over the top and the other goes along the bottom of the wing. Both the air streams meet after the same time at the trailing edge. The upper air stream has to go over a hump and hence has to travel a much larger distance as compared to the lower stream. Since both air stream meet at the trailing edge at the same time the upper stream has to move faster. This higher speed of airflow on the top of the wing produces a low-pressure on the top of the wing, thus producing lift from below. This is how a wing helps an aeroplane to rise in the air.



## TEACH MY SON

Abraham Lincoln

Abraham Lincoln wrote this letter to his son's teacher. This letter is a timeless classic.

... He will have to learn, I know, that men are not just, all men are not true. But teach him also that for every scoundrel there is a hero; that for every selfish politician, there is a dedicated leader. Teach him that for every enemy there is a friend. It will take time, I know, but teach him if you can, that a dollar earned is of far more value than five found.

Teach him to learn to lose and also to enjoy winning. Steer him away from envy, if you can, teach him the secret of quiet laughter. Let him learn early that bullies are the easiest to lick.

Teach him, if you can, the wonder of books, but also give him quite some time to ponder the eternal mystery of birds in the sky, bees in the sun, and flowers on a green hillside.

In school teach him that it is far more honourable to fail than to cheat. Teach him to have faith in his own ideas, even if everyone tells him they are wrong. Teach him to be gentle with gentle people, and tough with the tough.

Try to give my son the strength not to follow the crowd when everyone is getting on the bandwagon.

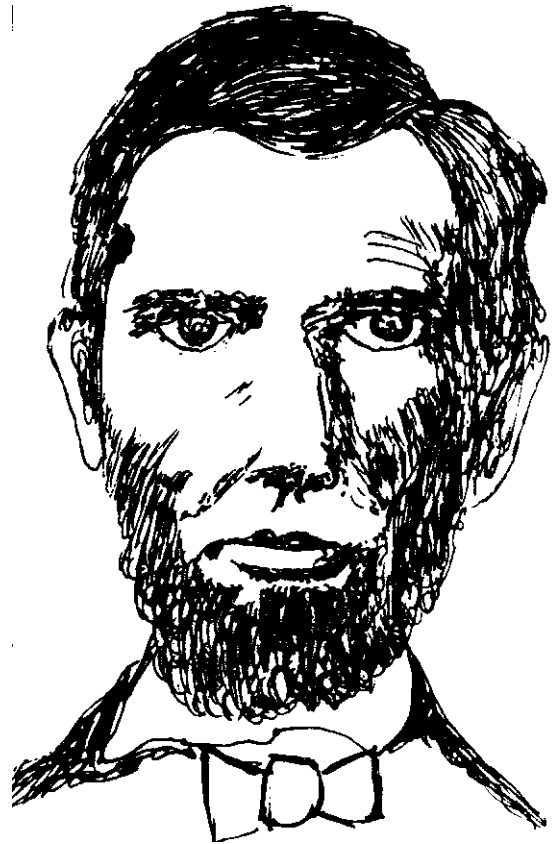
Teach him to listen to all men but teach him also to filter all he hears on a screen of truth and take only the good that comes through.

Teach him if you can, how to laugh when he is sad.

Teach him that there is no shame in tears. Teach him to scoff at cynics and beware of too much sweetness.. Teach him to sell his brawn and brain to the highest bidders, but never to put a price tag on his heart and soul. Teach him to close his ears to the howling mob and to stand up and fight if he thinks he is right.

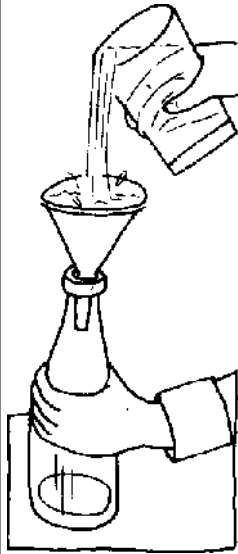
Teach him gently, but do not coddle fine steel. Let him have the courage to be impatient, let him have the patience to be brave. Teach him always to have sublime faith in mankind.

This is a big order, but see what you can do. He is such a fine fellow, my son.



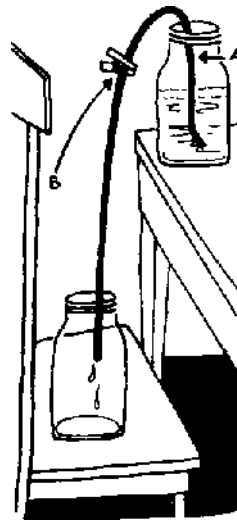
## FUN WITH WATER

### Can you fill the empty bottle?



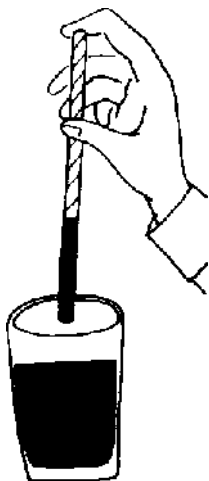
Place a funnel in the neck of an empty soda bottle. Pack clay around the neck of the bottle so that there is no space between the bottle and the funnel. Pour water into the funnel. Notice what happens. Then take the clay off the bottle and funnel. The clay seals the neck of the bottle outside of the funnel. When water flows into the funnel, the air cannot escape, except by going through the water very slowly. The air in the bottle takes space and prevents the water from coming in. When the clay is removed the air can escape, and water flows in easily.

### The Siphon



Place a tall jar full of water on a high table and an empty jar on a lower chair. Fill a tube with water and hold the water in by pinching both ends of the tube or with a clothespin. Place one end of the tube in the top and the other end in the lower jar. Open the two ends. The water will flow as long as the level of water in one jar is lower than the level of water in the other jar. The pull of gravity causes water to flow from the tube and reduces the pressure within it (at B). The air pressure is greater at A and water is forced into the tube. Try to use the siphon without filling the tube. Does it work?

### How does a straw work?



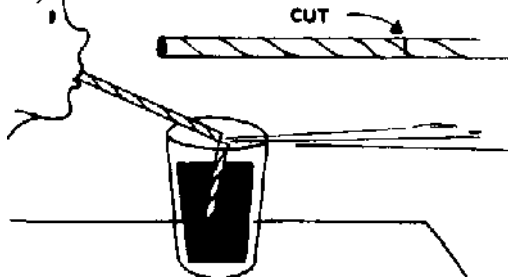
Mix a few drops of ink in half a glass of water. Place a transparent straw in the glass with coloured water. Suck up a little of the water into the straw. Then hold your finger across the top of the straw and pull the straw out of the liquid. What happens? Then remove your finger from the straw. While your finger covers the top of the straw, the liquid remains in the straw. When you remove the finger, the water flows out. When you cover the straw with your finger you are lessening the pressure of air over the straw. The greater pressure of air under the straw can hold the liquid inside the straw.

### How many coins will it hold?



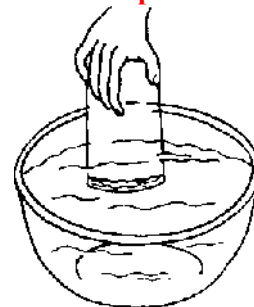
Place a jar or a glass in a basin. Fill the jar to the brim with water. Drop in 25 paise coins or paper pins, holding them from their edges. You will see that you can drop in a surprising number of coins into the jar before the water flows over. The explanation for this is that there is almost an elastic rubber like membrane on top of the water surface. This surface tension permits you to heap the water quite high before it breaks and the water runs over.

### Make an atomiser



Make a slit in a plastic straw about one-third from one end. Bend the straw at the slit and place the short section in a glass of water. Make sure the slit is no more than 0.5 cm above the surface of the water. Blow hard through the straw. You will see that water enters the straw from the glass and comes out through the slit like a spray.

### How to compress air

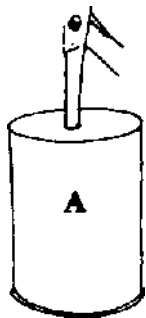
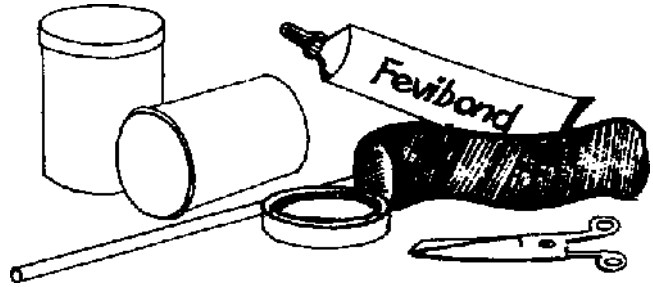


Hold a glass with its mouth down and push it into a deep bowl or bucket of water. You will see that the water enters the glass a little way. No bubbles of air escape. The water forces the air into a smaller space. The molecules of air are forced closer together.

## BELLOWS PUMP

With this very efficient pump you can inflate a balloon with air or fill it with water. This pump will also make a great Pichkari for Holi, for with every down stroke 40-ml of water comes gushing out.

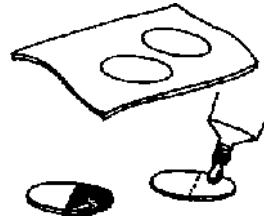
1. For making the pump you will need two film-reel bottles, 15-cm of old cycle tube, an old refill or a Frooti straw, and some rubber based adhesive like Fevibond or Vamicol



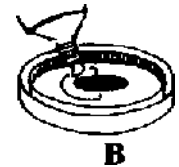
2 Make a hole in the base of film-reel bottle A by using a divider point. Widen this hole by gently rotating the pointed end of a scissors The hole should be about 1-cm in diameter and should not have any burrs.



3. Make a similar hole in cap B.



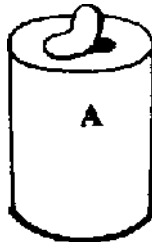
4. Cut two circular washers about 1.5-cm in diameter from a cycle rubber-tube. Apply Fevibond on half of the area of the two washers.



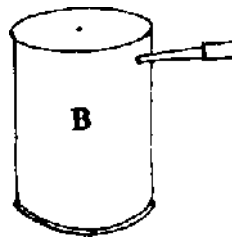
5. Apply Fevibond to the cap and paste one washer.



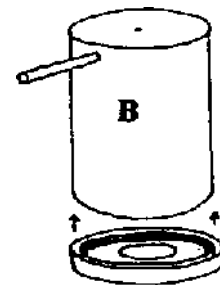
6. The washer which is stuck on one side only will act like a hinge. It can open and close like a valve. This is the **DELIVERY VALVE**.



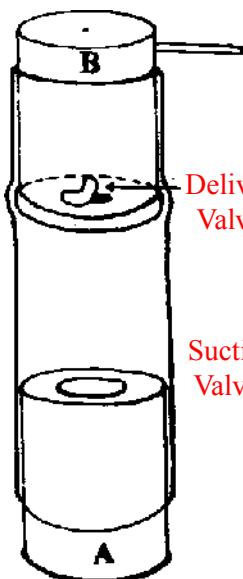
7. Paste the other valve on the base of the film-reel bottle. This is the **SUCTION VALVE**.



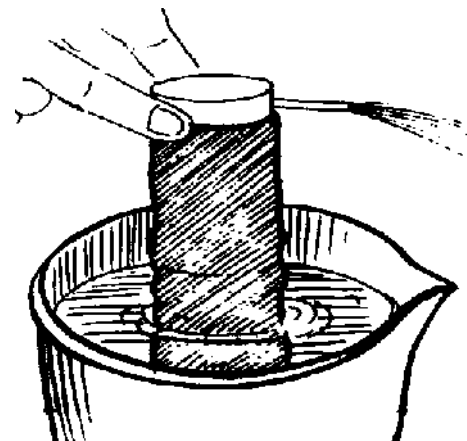
8. Take another film-reel bottle B and make a small hole on its cylindrical surface.



9. Press fit a short thick Frooti straw or a ball-pen refill in it for the delivery pipe. Fix the cap with the delivery valve (Fig 6) to bottle B.



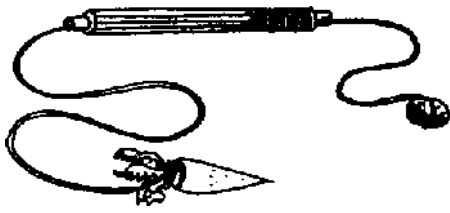
10. Cut a 15-cm long piece from an old bicycle tube. Stretch and slide the tube over both the bottles as shown. The bottles will be separated by 7-8 cm of cycle tube. This rubber tube acts like a pair of bellows.



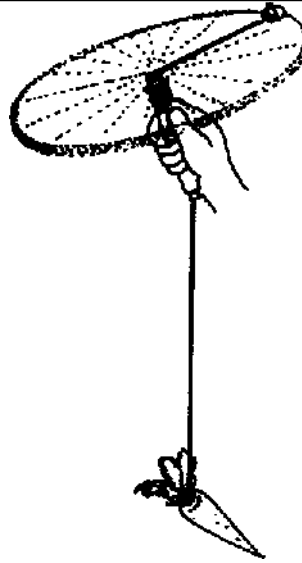
11. Now hold the lower bottle in water and press the top bottle B downwards. After a few initial strokes water will start gushing out of the delivery tube.



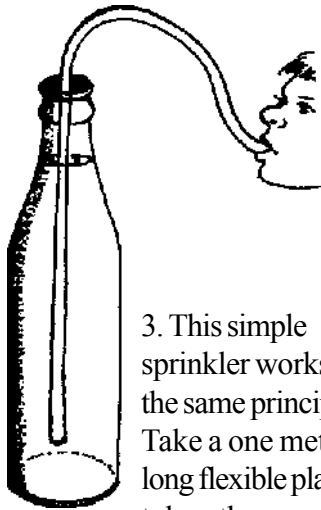
## SPRINKLER



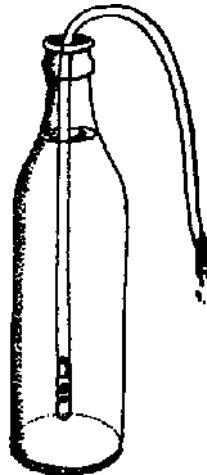
1. Tie a metre long string to the top of a carrot. Slip the free end of the string through an empty ball pen body. Then tie it to a small potato.



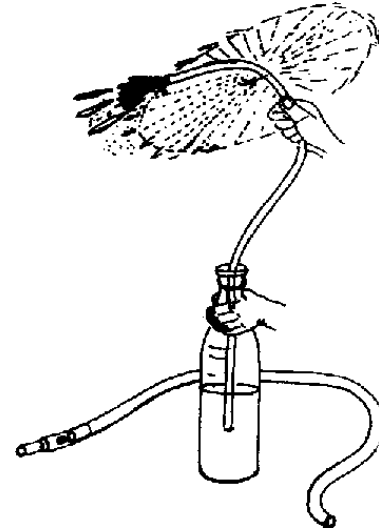
2. Hold the pen body in your hand and begin making circular motions - the potato must swing in a circle. As you increase the speed of rotation the carrot will rise. There is a force associated with the rotation of the potato. This force pulls away the centre of the circle and is called Centrifugal force.



3. This simple sprinkler works on the same principle. Take a one meter long flexible plastic tube - the one used as a petrol pipe or as a mason's level tube. Keep one end of the tube immersed in water and suck from the other end.



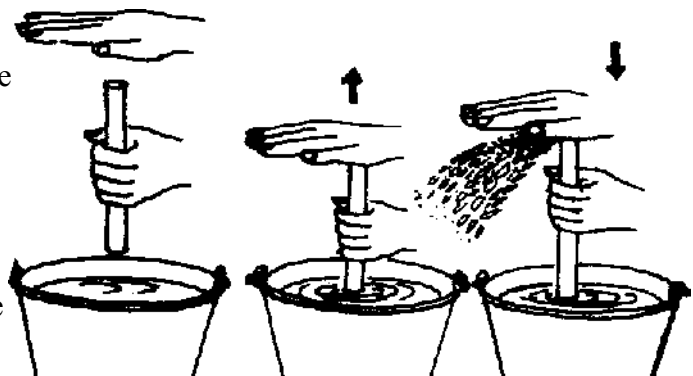
4. When water starts coming from the other end you start rotating it and slowly raise it.



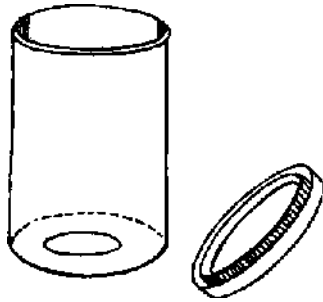
5. Water will keep sprinkling out as long as you continue spinning the tube. This way you can draw out the whole bottle. The Centrifugal force of rotation is enough to suck and lift water from a height of almost half a metre. You can make a simple foot valve using a cycle steel ball and a pen body as a seat.

### **Inertia Pump**

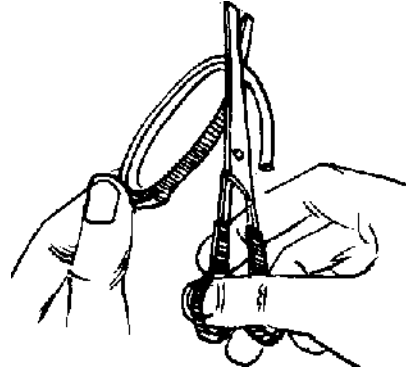
This simple pump was designed by Suresh Vaidyarajan. Any hollow tube - PVC, metal or even a 30 cm long Papaya stem can be made to pump up water. Hold the tube with your left hand and move it up and down into a bucket of water. Keep the palm of your right hand on the top of the tube and open and close it with each up and down reciprocation. Soon water will start squirting out. Here the up - down motion of the left hand does the pumping while the right palm acts like a valve.



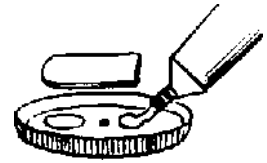
## HANDPUMP



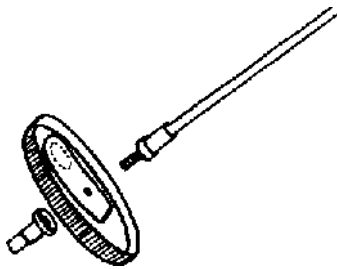
1. For making this pump you will require a black film-reel bottle, one more cap, a cycle spoke, old cycle tube, an old refill, simple hand tools and Fevibond - a rubber adhesive.



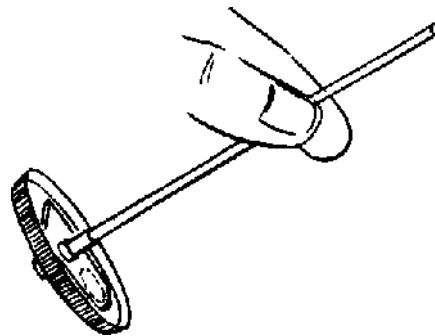
2. With a sharp scissors cut and remove the outer circle of the cap. The inner circle will make a superb piston. Rub it a little on sandpaper so that it is free inside the bottle - **the cylinder**.



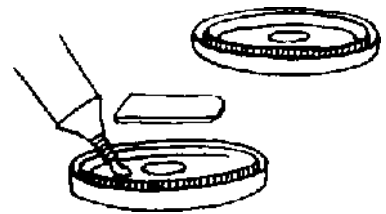
3. Make a 2-mm hole in the centre and a 6-mm hole for the **delivery valve** port. Apply Fevibond to a 2-cm x 1-cm piece of bicycle rubber tube and stick it to cover the hole. This rubber will act like a hinge and open and close like a valve.



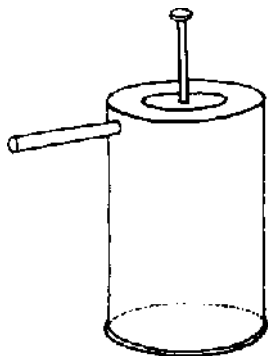
4. Cut a 12-cm long piece from a bicycle spoke. Fix the piston on the spoke threads with two nipple nuts.



5. This is the **piston, delivery valve** and **connecting rod** assembly.

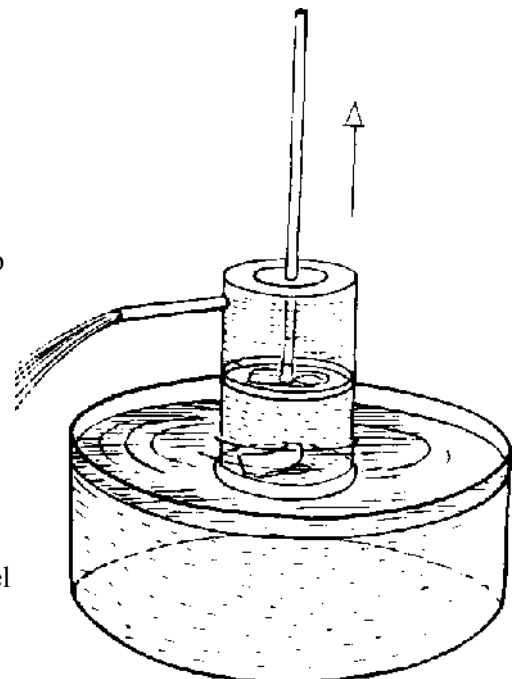


6. Take another film-reel bottle cap and make a 6-mm hole in it. Apply Fevibond to a 2-cm x 1-cm piece of tube rubber and stick it on one side to cover the hole. This is the **suction valve**.



7. Make a 3-mm hole in the centre of the bottle base so that the cycle spoke can move freely in it. Make another hole on the curved surface near the base and fix an old refill or Frooti straw in it. This is the **delivery pipe**.

8. Insert the spoke through the bottle base and snap the suction valve lid to complete the hand pump assembly. Keep the pump in a bowl of water and move the spoke up and down. After a few priming strokes large quanta of water will gush out of the delivery pipe with every upward stroke of the spoke. Both the rubber washers - stuck only on one side as hinges, act as very efficient valves. This is a superb model to understand the working of a real hand pump.



## BAREFOOT PATHOLOGISTS

Often the school science curriculum is cut-and-dry and divorced from real life. It is no wonder that such lessons are unable to sustain interest and capture the imagination of the children. A number of experiments have proven that when science curriculum's are designed with the community's needs in mind, then they spark a great deal of interest and are able to galvanise the community into action.



Vigyan Ashram an NGO near Pune, devised a unique curriculum for ninth class girls. The girls were trained to conduct blood, urine and stool tests by professional pathologists. They were also taught a course on food, nutrition, health and hygiene.

These girls were then asked to visit all the village homes and examine the health of the children. They had to make a note of the number of children in every house. Also the age, sex, height and weight of the children. These girls also took blood samples of pregnant mothers and children. Whenever the haemoglobin count was found low, the patients were advised to eat green leafy vegetables and other iron rich foods. These girls gave the families simple tips on cleaning the water. The girls periodically visited the homes and monitored the progress of their patients.

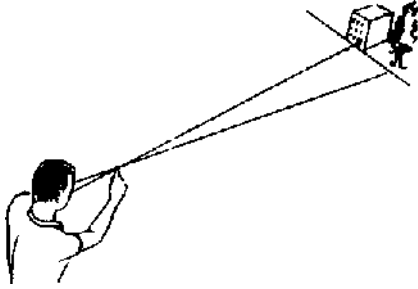
The village families were very happy by the help rendered by these girls. Slowly these girls became so skilled that soon they were doing simple pathological tests for the local doctors for a fee!

One day these girls will marry and have their own families. They will be very conscious mothers and will pay a lot of attention to the health of their family.

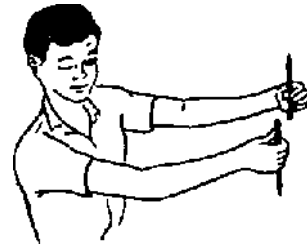
At present these girls are offering a great service to their community and at the same time learning the rudiments of science in a very creative way.

## OUR SENSES

### Sight



1. Look at a distant object. Then hold up your finger at arm's length. With one eye closed, look at the scene just over the top of your finger. Note the object that you see. Without changing the position, look at the scene with the other eye. The background shifts. You see a different object beyond your finger. This shows that a different image is observed in each eye.

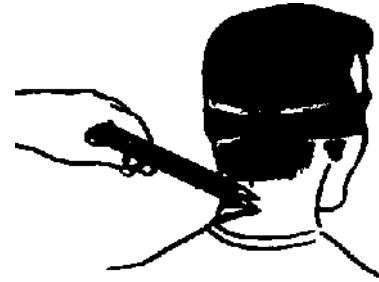


2. Try to bring the wide end of a pencil down to touch another wide end of a pencil held in front of you. First try it with one eye closed. You miss quite easily. But with two eyes, you can do it all the time. Both eyes are needed to sense the distance of an object.

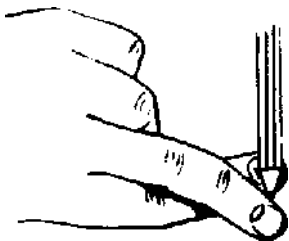
### Touch



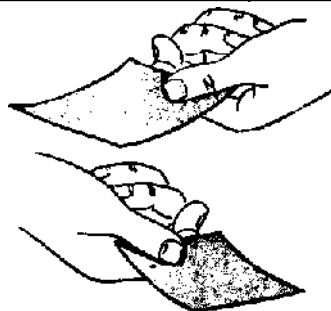
1. Touch different points of a tooth-pick or thin nail to different spots on the back of your middle finger. You will feel the pressure of the nail points wherever you touch it to the skin. But at some points, you feel the point more sharply than the others. These are the spots that feel pain.



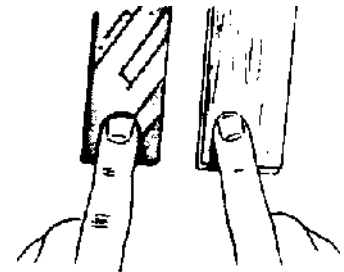
2. Place the points of two pencils held closely together against the back of a blindfolded person's neck. He feels them as one point. But when touched to his finger, he feels two. The sense of touch is much more sensitive in the fingers than on the back of the neck.



3. Touch a pencil to the crossed fingers of a blindfolded person. He thinks there are two pencils because he feels them on opposite sides of the fingers that are normally in a different position.



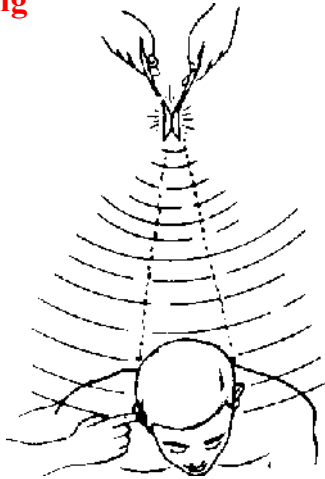
4. Paste two thin sheets of paper together. Cut out a square of this paper and another of a single thickness. Ask a person to tell if they are the same or of different thickness. Most people can tell by feeling them, which is thicker. This experiment shows how sensitive our sense of touch is.



5. Feel a metal surface and a wooden one. The metal feels colder because it conducts heat away from your body faster. It is actually at the same temperature as the wood.

## OUR SENSES

### Hearing



1. Close one ear with your finger. Ask a friend to click two spoons together anywhere behind you. Try to guess how far away the spoons are and in what direction from you. As your friend moves around you will find it very difficult to tell where he is and how far away.



2. Blindfold one child and let the other children stand in a circle around her. One at a time each child in the circle makes a small noise. Each time the blindfolded person has to point out towards the direction of the sound. How accurately can the child detect the direction of the sound? Put a cotton plug in one of her ear and try again.

### Smell

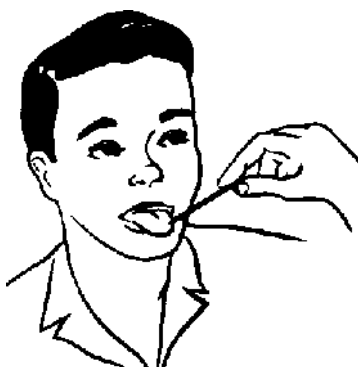


1. Blindfold a friend and feed him small pieces of apples and onions while he holds his nose. Ask him what he is eating. He will find that the onion and the apple taste the same! Let him smell onions while he eats apples! Smell is very important in identifying foods.



2. Collect some things, which have a strong smell - like tea leaves, orange, cloves, mustard oil, crushed leaves etc. Blindfold a friend and give him each thing to smell and ask him to tell you what it is. Make a list of pleasant smells and unpleasant smells.

### Taste



Dip a toothpick in a sugar solution and touch it to different parts of the tongue. You will find that sweetness is detected by taste buds mainly at the tip of the tongue. Saltiness will be detected mainly at the sides of the tongue.

### Sight and Balance

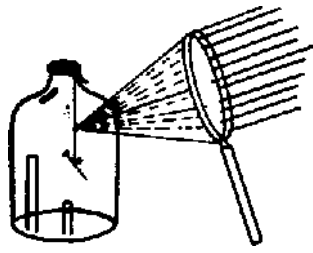


Try balancing on one leg with both eyes closed. Now try with the eyes open. It is much easier with the eyes open. Sight is an aid to balance. Try spinning around and see whether it is easier to regain balance when the eyes are open.

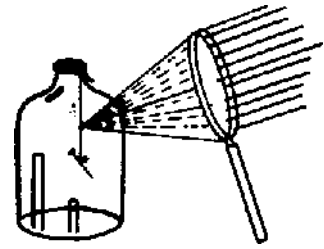
## FUN WITH LIGHT



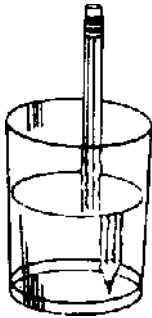
1. Put a mirror in a bowl so that it is at an angle of 30 degrees to the level of the water. When it is dark in the room, shine a torch on the mirror. A small spectrum of colours will appear on the ceiling.



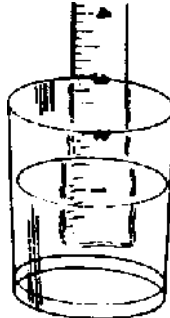
2. Use a magnifying glass to focus rays of sunlight onto a black thread holding a nail in the bottle. The thread burns and the nail drops. But it won't work with a white thread



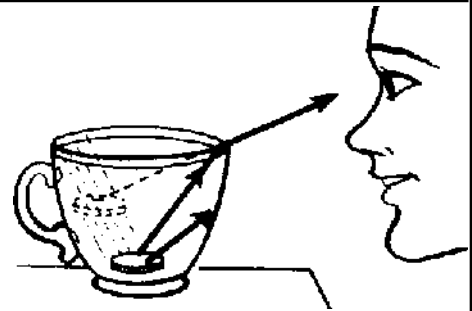
3. Let the sun rays focus onto a dark ink spot on the paper. The black colour of the ink spot absorbs the rays of the sun. The paper soon begins to smoke and may even catch fire.



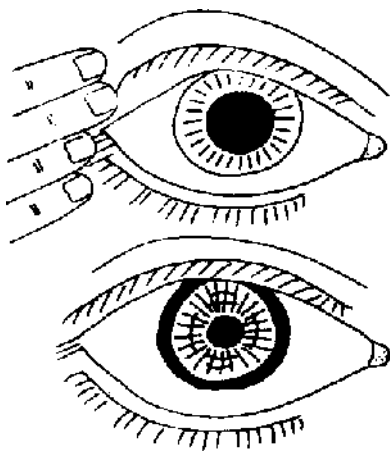
4. Place a pencil in a glass half filled with water. In a certain position the pencil looks as though it has been broken in two.



5. Look through a thin glass of water at your ruler. The glass acts as a magnifying glass and makes an enlarged image.



6. Put a coin in an opaque teacup. Move away from the cup, and down, until the edge of the cup blocks the coin from sight. Now slowly pour water into the cup without moving your head. The coin gradually comes back into view!



7. Cover one eye and look into a bright light. After the eye has adjusted to the light open the other eye. Quickly compare the sizes of the pupils in each eye. In dim light the pupil is enlarged to let in more light.



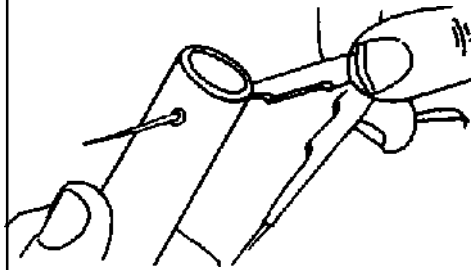
8. Take a shining tablespoon. Hold the convex (outward bulging) part of the spoon towards you. You will see an erect and shiny image of yourself.



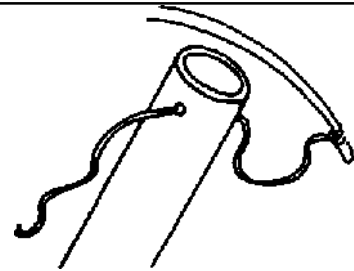
9. Now turn the spoon around so that the concave (inward curving) side faces you. This time you see a small upside-down image of yourself.

## BIRD IN A CAGE

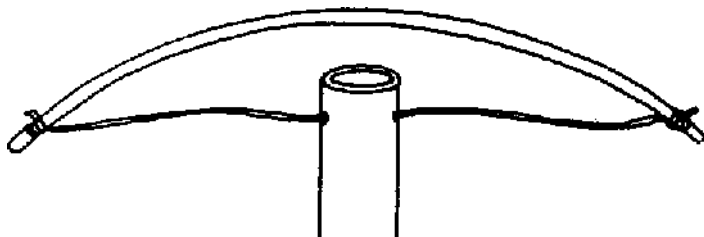
We see things with our eyes. But we continue to see a thing for a little while longer even after it has been removed from sight. This is called persistence of vision. The principle of the bow-drill, still in use by carpenters can be incorporated into an ingenious folk toy to demonstrate the persistence of vision.



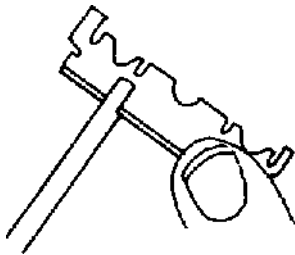
1. Take an empty cotton thread reel. Make a hole through the reel at one end using a divider point.



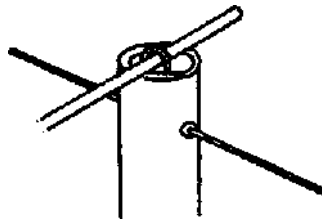
2. Weave a thread through this hole.



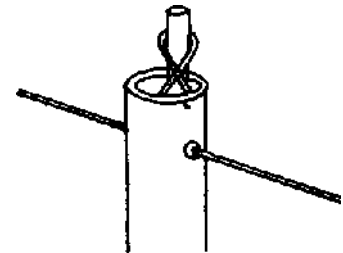
3. Tie the two ends of the thread to the two ends of a strong coconut broomstick bent into an arc. The bowstring should be slightly loose.



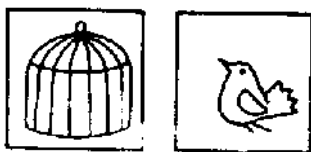
4. Take a 10-cm. long reed from a *phooljhadu* (broom) and split it at one end for about 1 cm in length.



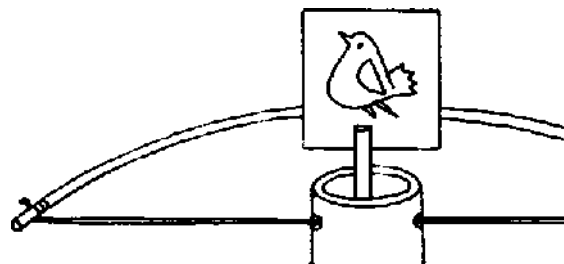
5. Insert the other end of the reed inside the reel and remove out the thread.



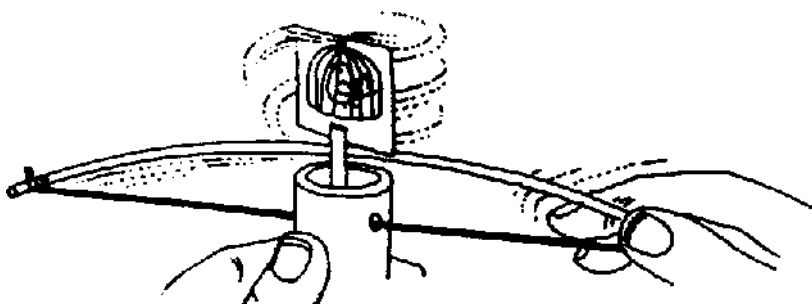
6. Rotate the reed by 180 degrees and insert it inside the reel so that the thread loops once around the reed.



7. Make a bird and a cage on either side of a 3 -cm. square card sheet.



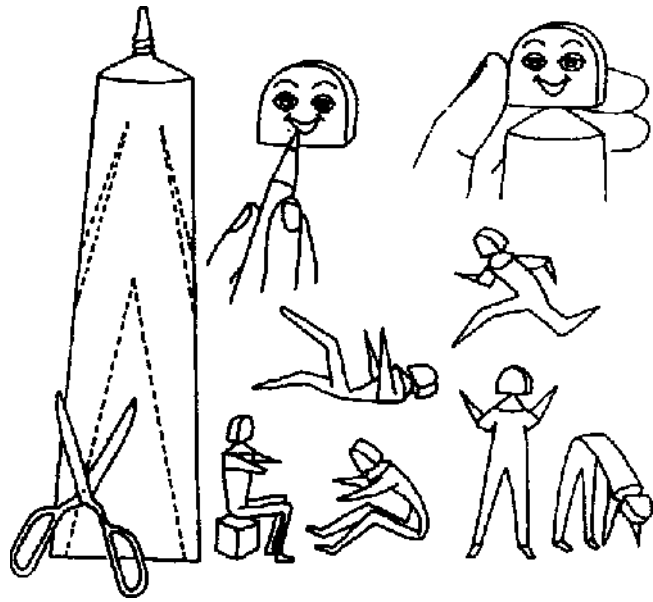
8. Wedge the card in the slit on top of the reed and apply some glue to stick it.



9. Hold the thread reel with the left hand and move the bow to and fro with the right hand. The reed will turn round and round and the bird will appear to be encaged. The bow drill is a beautiful mechanism. It converts the straight-line motion of the bow, into the rotary motion of the reed.

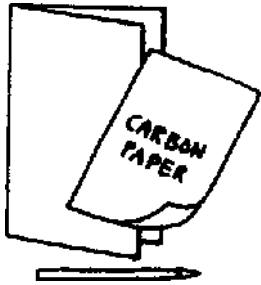
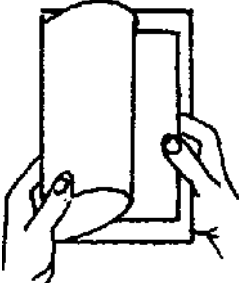
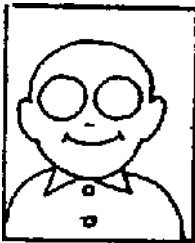
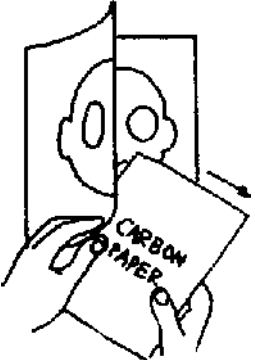

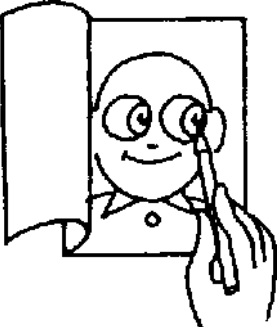
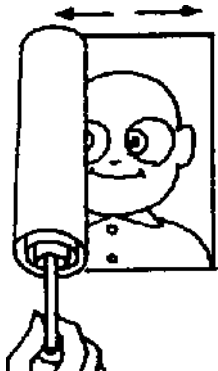
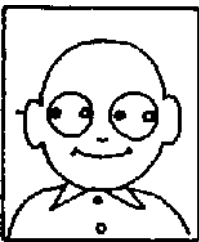
## ALUMINUM ACROBAT

Old toothpaste tubes need not be thrown away. They can be transformed into attractive acrobats. Just flatten an old aluminium tube and cut along the dotted lines shown in the picture. Attach a rubber face to give it a character. The flexible legs of the acrobat can be bent at different angles. You can make the acrobat sit, bend down, run, jump or simply lie on the ground.



## DANCING EYES

Even when an object is removed from in front of our eyes, we still keep seeing it for a fraction of a second. This is the principle of persistence of vision. It is because of this optical illusion that we are able to see a film in a cinema hall. There are individual frames in the film reel. But these frames come so quickly before our eyes that we see a continuum.

			
<p>1. Fold a piece of paper in half and place a carbon in between.</p>	<p>2. Draw the outline of a face but do not make the eyeballs.</p>	<p>3. The face is ready.</p>	<p>4. Now remove the carbon.</p>
			
<p>5. Draw the eyeballs to the left of the eyes on the top sheet.</p>	<p>6. Make the eyeballs to the right on the bottom paper.</p>	<p>7. Now quickly move the top paper back and forth on the bottom sheet.</p>	<p>8. You will now see eyeballs dancing from the left to the right.</p>



## SHADOW CREATURES

A shadow is formed in the shape of the object blocking the light. Shadows have many interesting properties. For example, the closer an object is to the light source, the larger and less distinct is its shadow. Try making some of these wonderful shadow creatures using your bare hands and a candle!



**GIRAFFE**



**JUNGLE DOG**



**CAMEL**



**RABBIT**



**BIG RABBIT**



**GOAT**



**BEAR**



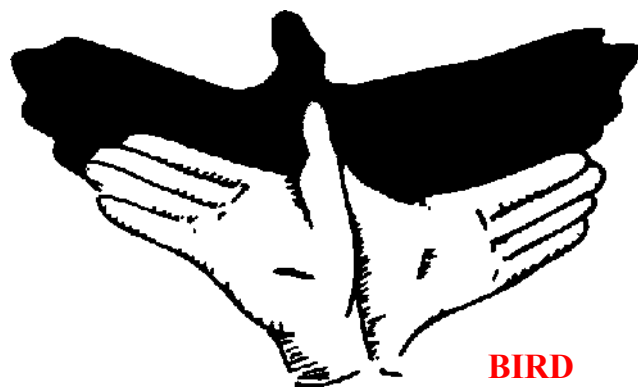
**DOG**



**WOLF**



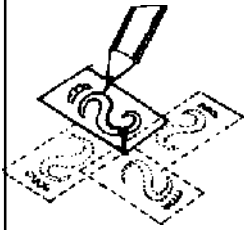
**ELEPHANT**



**BIRD**

## SYMMETRY

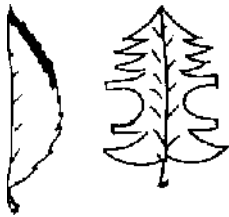
Nature is replete in symmetry. A butterfly's wings are a good example. One half of the wings can be folded on to the other half to match exactly. The fold then becomes the line of symmetry.



1. Cut a pattern on a postcard. Push a pin in one corner and draw the pattern. Rotate a quarter turn and draw again. You will get a beautiful pattern showing rotational symmetry.



2. Fold a paper in half. Cut shapes on its two edges. Open the paper to see a symmetric pattern. Which is the line of symmetry?



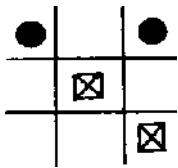
3. You can also cut symmetric shapes and patterns in leaves. Invent a lot of new shapes.



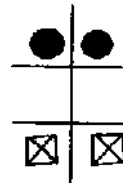
4. Draw a shape and put a mirror besides it so that the shape doubles itself.



5. Search for compound leaves that look as if they have been doubled up in a mirror.

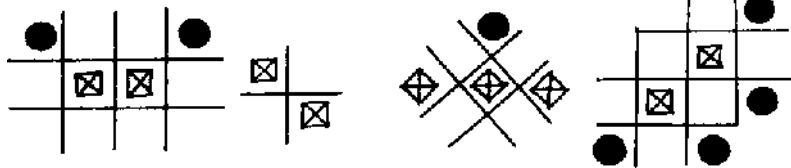


6. Stand the mirror on this master figure. Slide and turn the mirror to see the patterns change. Now orient the mirror in such a way so that you can see the pattern, which matches with figure (7).



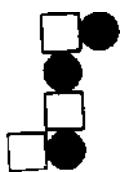
7. Is your mirror on a vertical line facing to the right?

8. Again place the mirror on the master pattern Fig (6) in different orientations to get all these patterns.

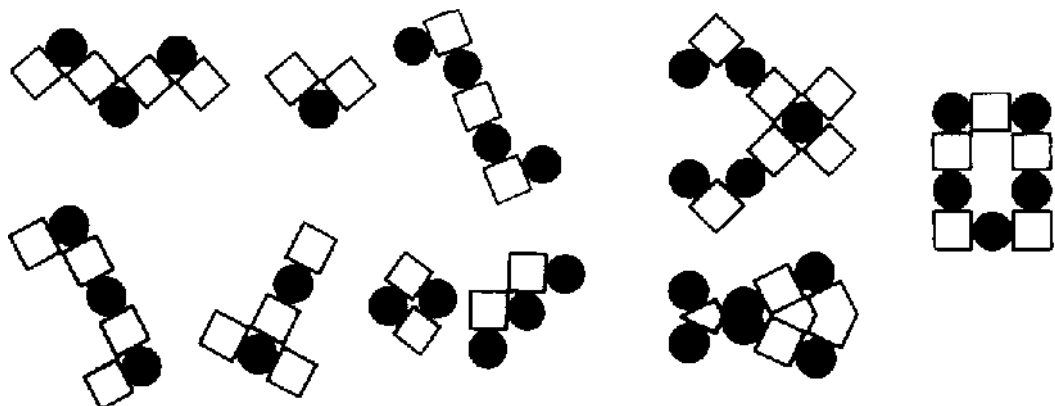


### Mirror Puzzle

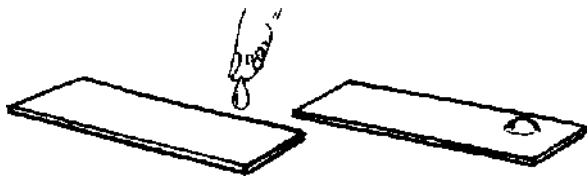
9. Stand your mirror on this master pattern each time, in different orientations, to get the rest of the patterns. You will be able to get most of them. But some of the patterns have been included to trick you. They are not simply hard, but impossible. Can you locate the impossible ones? If you have enjoyed these mirror puzzles why not make some of your own.



Master Pattern



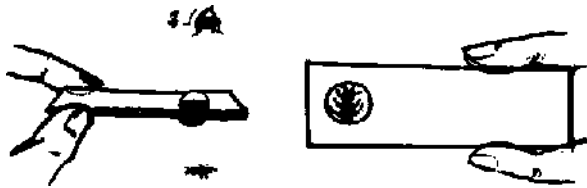
## DROP MICROSCOPE



1. Take a glass slide and rub it on your hair to apply a thin layer of oil. Gently place a drop of water on the slide. The water drop 'sits' on the slide and makes a lens.

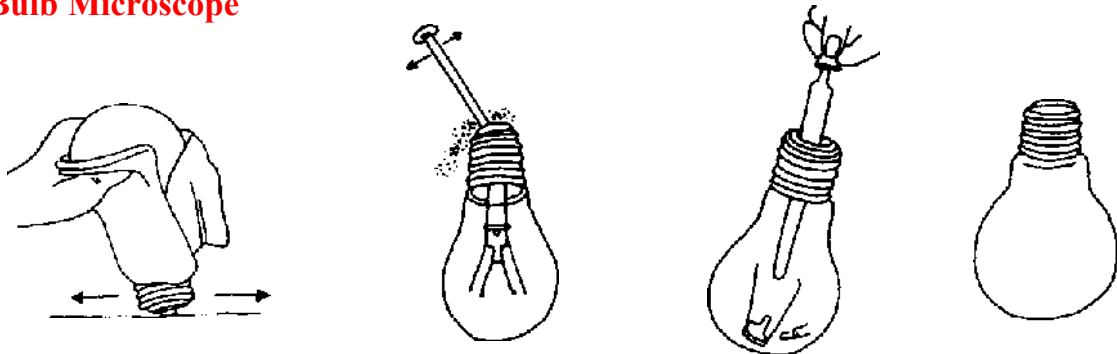


2. Look at some small print or an ant through the drop lens. Do the ant's legs appear any bigger? Now quickly invert the slide and place another drop over the 'hanging' drop. Does this 'sitting-hanging' combination make any difference to the magnification?



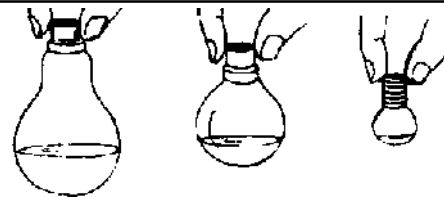
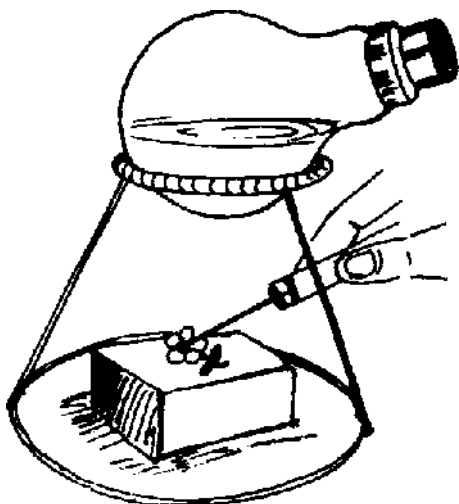
3. Repeat the experiment using drops of glycerine and coconut oil, instead of water. Does it make any difference to the magnification or clarity?

## Bulb Microscope

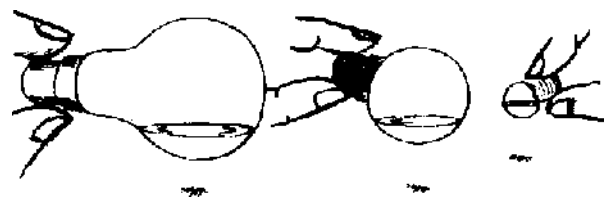


Carefully cover a used electric bulb with cloth and tape its resin end on the ground. Remove the glass pieces and the filament from inside the bulb using a nail. Ensure that there are no sharp edges.

1. Put a little water in the bulb. Make an improvised wire stand for the bulb. Place the bulb on the stand and view a small flower through it. Does it appear enlarged?



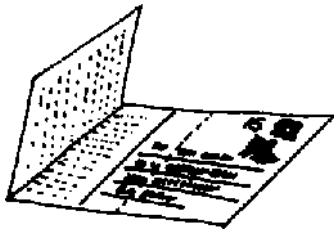
2. Remove the filaments of a 40-Watt, Zero-Watt and a torch bulb. Half fill the bulbs with water. The water surface in combination with the curvature makes a plano-convex lens.



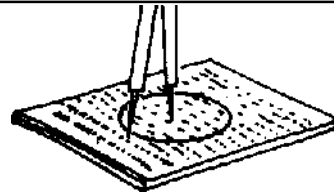
3. Observe the same object through all the three bulbs. Which bulb magnifies the most? You'll see that the smallest bulb - the torch bulb magnifies the most. The 40-Watt bulb magnifies the least. You can see very clearly that the magnification is inversely proportional to the radius of curvature.

## COLOUR MIXERS

1. You will require an old post-card, card-sheet, a press-button, needle, thread, a divider, scissors, glue and different colours of gelatine paper (blue, red and yellow are essential).



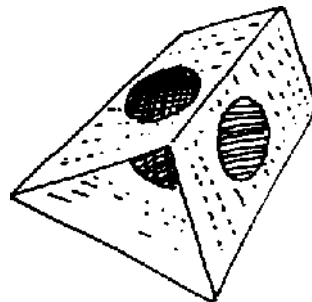
2. Fold an old postcard into three equal parts.



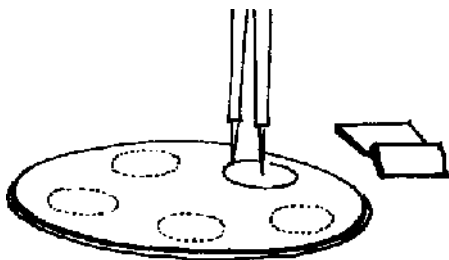
3. With the help of a divider cut three overlapping windows on the postcard.



4. Stick three different colours of gelatine paper on the windows. Blue in the middle and red and yellow on the sides. View through these windows one at a time.



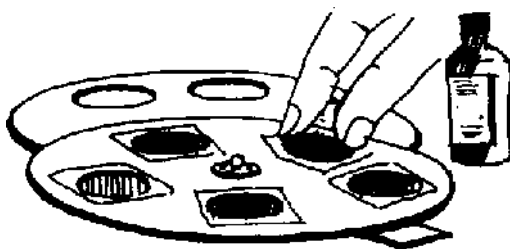
5. Then fold the red window on the blue one. Do you see purple now? Fold the yellow window on the blue. Do you see green now?



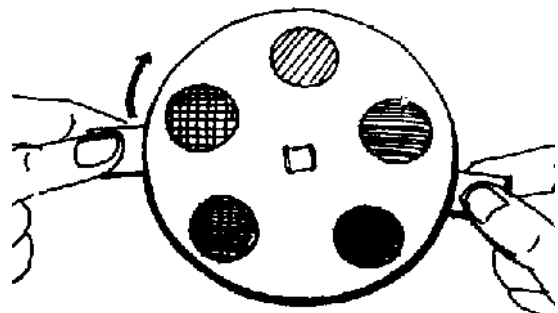
6. Cut two 10-cm. discs from card-sheet. Cut five circular windows in each disc with a divider.



7. Stitch one half of the press-button in the centre of one disc and the other half in the second disc.

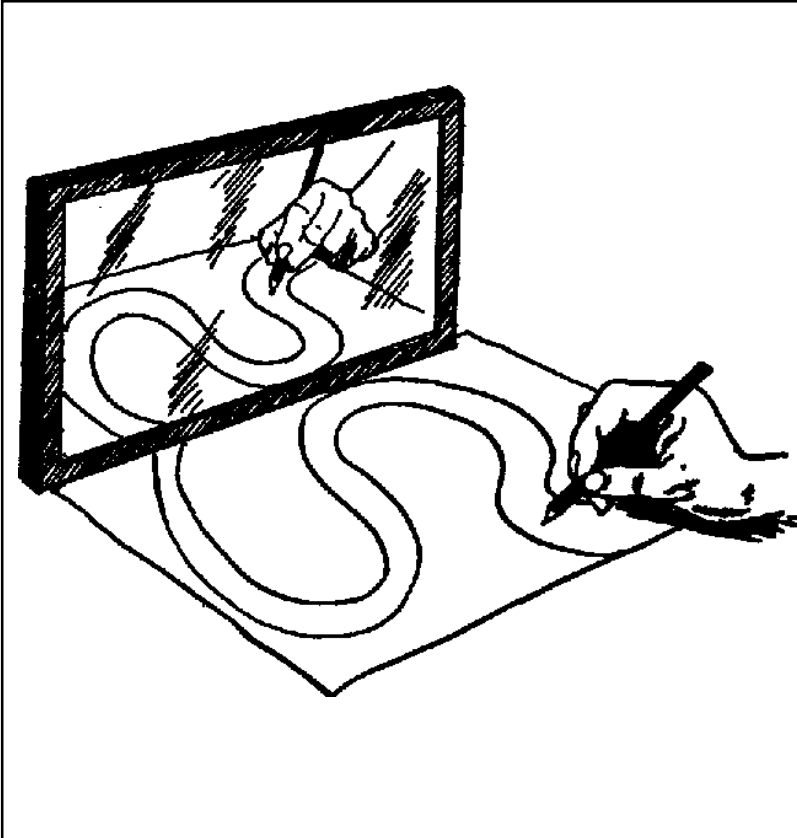


8. Stick different colours of gelatine papers on the windows. Now assemble the discs by snapping the press-button. Attach two cardboard handles to the discs. The handles will help in rotating the discs.



9. Rotate one disc while keeping the other stationary to see a motley rainbow of colours on your colour wheel.

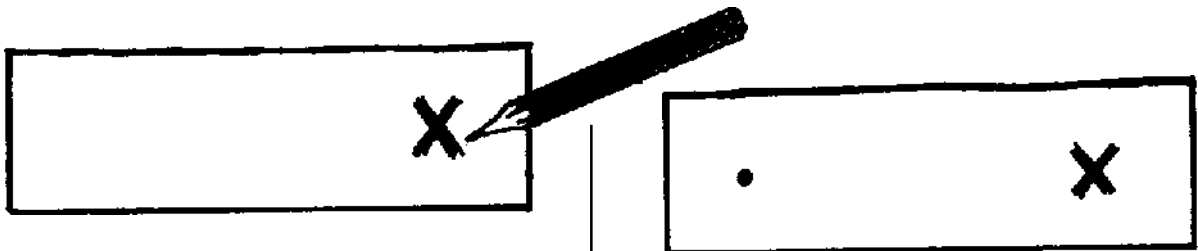
## MIRROR RACING



To do this experiment you will require a large sheet of paper, a mirror, pencil and a sketch pen. To represent the road, draw a big 'S' shaped curve on your sheet of paper. Place this on a table, or any other flat surface, in front of a mirror.

Point your pencil at the start of the road and look at its reflection in the mirror. With your eye on the reflection only, see if you can trace a line around the track without moving the pencil over the edge. To make it more interesting, you can draw a track with extra twists and turns in it and surround it with hazards too, such as buildings, bridges and tunnels.

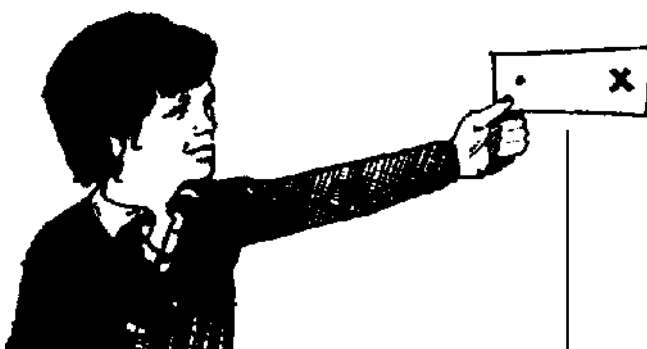
## DISAPPEARING DOT



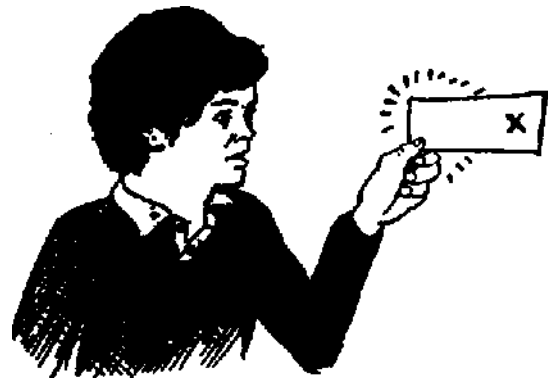
1. You will need a piece of card sheet, a sketch pen and a ruler. Draw an **X** on the right side of the card.

← 10cm →

2. Draw a dot 10-cm to the left of the **X**.



3. Hold the paper at arm's length in front of you and look hard at the **X**; you will now be able to see the dot out of the corner of your eye.



4. Keep concentrating on the **X** and slowly bring the paper closer to your eyes. Suddenly the dot will disappear completely from view.

# A B C OF FAILURE

BY JOHN HOLT

Most children in school fail.

For a great many, this failure is avowed and absolute. Close to forty percent of those who begin high school drop out before they finish. For college, the figure is one in three.

Many others fail in fact if not in name. They complete their schooling only because we have agreed to push them up through the grades and out of the schools, whether they know anything or not. There are many more such children than we think. If we “raise our standards” much higher, as some would have us do, we will find out very soon just how many there are. Our classrooms will bulge with kids who can’t pass the test to get into the next class.

But there is a more important sense in which almost all children fail: Except for a handful, who may or may not be good students, they fail to develop more than a tiny part of the enormous capacity for learning, understanding, and creating with which they were born and of which they made full use during the first two or three years of their lives.

## Why do they fail?

They fail because they are **afraid** (A), **bored** (B) and **confused** (C).

They are afraid, above all else, of failing, of disappointing or displeasing the many anxious adults around them, whose limitless hopes and expectations for them hang over their heads like a cloud.

They are bored because the things they are given and told to do in school are so trivial, so dull, and make such limited and narrow demands on the wide spectrum of their intelligence, capabilities, and talents.

They are confused because most of the torrent of words that pours over them in school makes little or no sense. It often flatly contradicts other things they have been told, and hardly ever has any relation to what they really know - to the rough model of reality that they carry around in their minds.

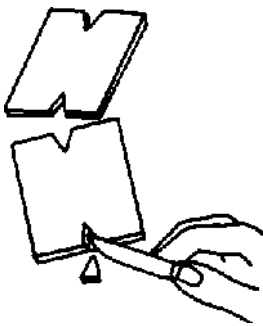

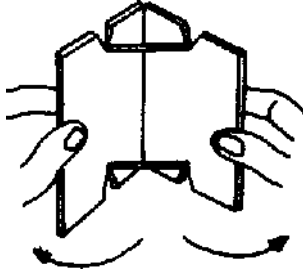
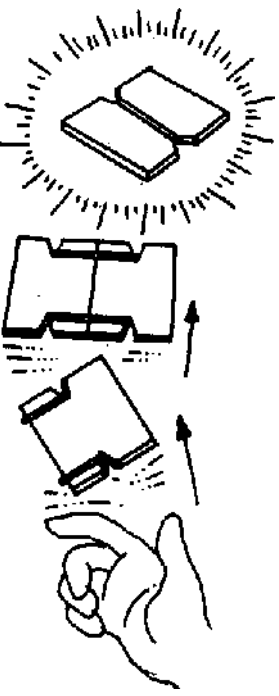
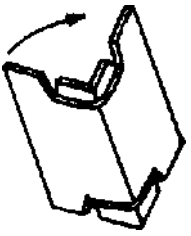
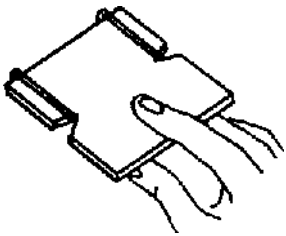
How does this mass failure take place? What really goes on in the classrooms? What are these children who fail doing? What goes on in their heads? Why don’t they make use of more of their capacity?

You can find answers to some of these questions in a book titled **How Children Fail** by John Holt. When it was first published in the mid 1960s, *How Children Fail* sparked off a whole series of educational reforms. It established itself as a masterpiece in the field of learning. Until his death in 1985, John Holt continued his crusade to help children grow and learn to the fullest of their potential. His recent books have explored home schooling and learning in adulthood.


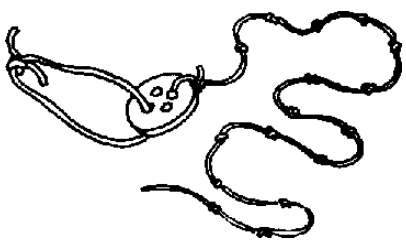
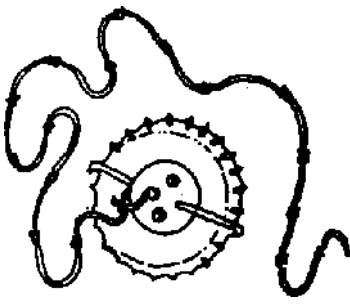
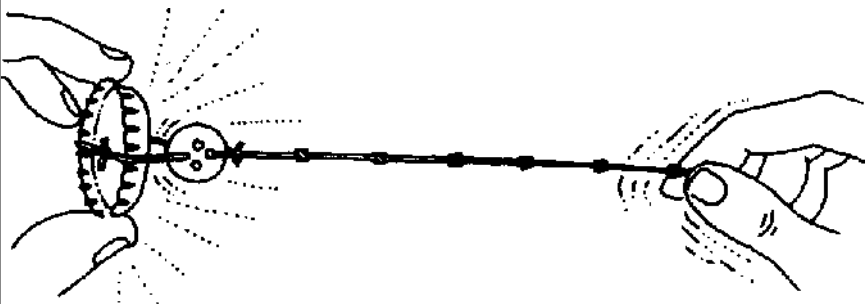
The Hindi translation of **How Children Fail** is available from  
Eklavya, E7 - 453, Arera Colony, Bhopal 462016 (MP), India

## CLAP IN THE AIR

Generations of children have made this simple toy and enjoyed playing with it.

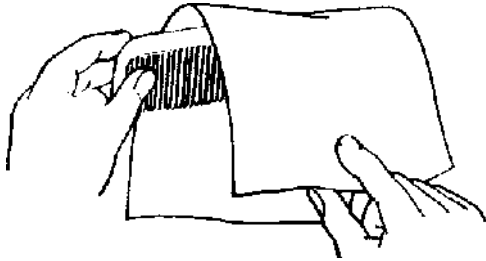
 <p>1. Take two cardboard squares of edge 6-cm. Cut V notches in the middle of two opposite sides.</p>	 <p>2. Place one piece on top of the other. Align the notches and place a rubber band in its groove.</p>	 <p>3. Now open the cardboard pieces with both the thumbs and fold them in the reverse direction.</p>	 <p>6. You will hear a nice clap in the air.</p>
 <p>4. This stretches the rubber band and keeps it in tension.</p>	 <p>5. Now throw these refolded cardboard pieces upwards.</p>		

## TIK-TIKI

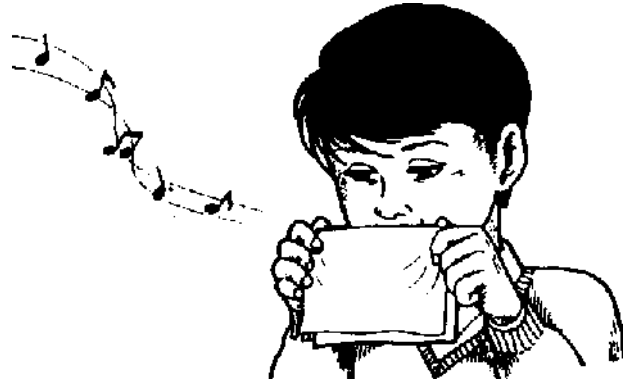
 <p>1. Cut a small rubber band and weave it through a shirt buttonhole Tie a knot in the two ends of the rubber band</p>	 <p>2. Take a 50-cm long piece of thick string Tie a series of knots along the whole length of the string. The distance between the knots should be 2 to 3-cm. Tie one end of the string to the button-hole.</p>
 <p>3. Stretch the rubber band and slide it on a soda water bottle cap.</p>	 <p>4. Hold the cap in your left hand. Gently press the string with your right thumb and index finger, and run them along the length of the string. At each knot the fingers slow down and the button hits the cap and makes a metallic tap. As the hand runs along the string there will be a series of tik-tikis.</p>

## HARMONICA

For making this simple harmonica you will just need a sheet of tissue paper and a comb.



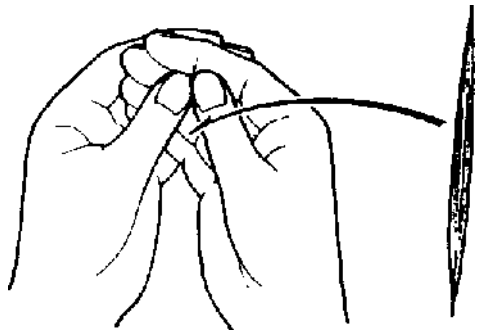
1. Fold the tissue paper over the comb



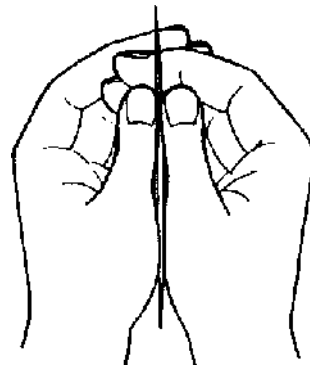
2. Place your lips on the tissue paper.  
Blow and hum to make different tunes.

## WHISTLE

This is a very simple way to make a very loud whistle.  
For making it you just need a clean blade of grass.



1. Cup your hands together, with your thumbs facing you. Place the clean blade of grass in the space between your thumbs. (You may have to take someone's help to put the blade of grass).



2. The blade of grass has to be held very tightly in place by the tip and base of each thumb.

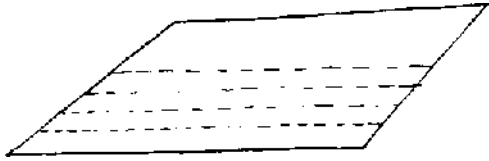
3. Bring your hands close to your lips. Blow into the space between your thumbs so that the blade of grass starts to vibrate. The vibrating blade will produce a shrill whistle like sound.



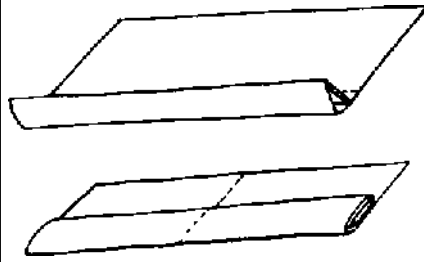


## PAPER CRACKER

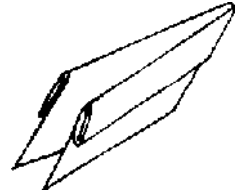
Crackers used during the festival of *Diwali* produce a lot of toxic gases, which are injurious to health. This paper cracker does not cost any money. You can make it yourself whenever you want.



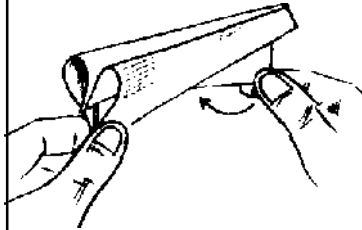
1. Take a 20-cm x 30-cm sheet of rectangular paper. You could also use a magazine cover or a coloured newspaper. Mark out six equal sectors along the width of the paper.



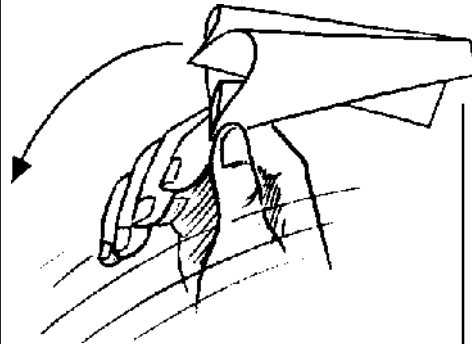
2. Keep folding the sectors until just two remain



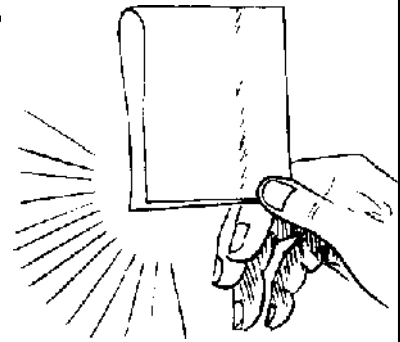
3. Crease the model in half so that the folds are exposed.



4 Push the bottom right hand corner inwards to form two cones



5. Hold the lower left corner with your thumb and index finger and jerk the cones quickly into the air.

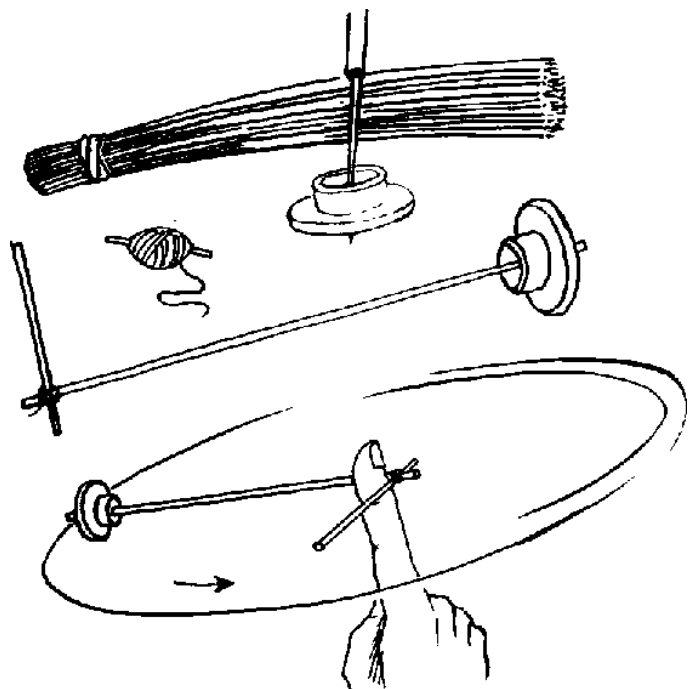


6. You will hear a loud BANG! And the cones will disappear.

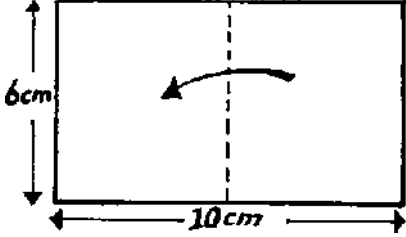
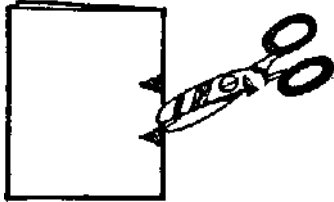
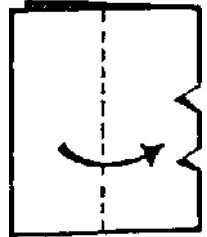
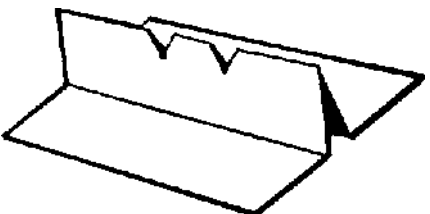

## SUDARSHAN CHAKRA

Cut two sticks from a broomstick - one long 15 cm and the other short 6-cm. Tie the sticks tightly with a string as shown in the drawing. Poke a hole in the rubber cap of an injection bottle, or else, in the eraser from your geometry box. Insert the rubber cap in the long broomstick. Now place the joint of the sticks on your right hand index finger and rotate the assembly as shown. You will be surprised to see that the sticks rotate around your finger like a *Sudarshan Chakra* without falling. As a matter of fact, the faster you rotate the sticks, the more stable and balanced is the assembly.

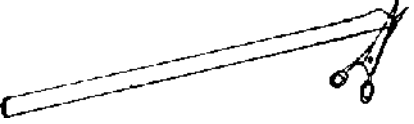
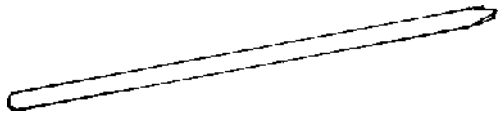
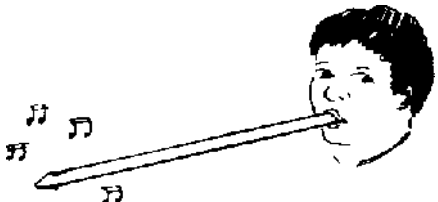

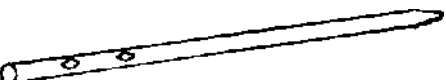
This simple toy will give children a good feel for Centrifugal and Centripetal force.



## SCREECHER

 <p>6cm 10cm</p>		
<p>1. For making the screecher you will need a piece of paper about 6-cm x 10-cm. Bring the shorter edges of the paper together and fold in the middle.</p>	<p>2. Cut two tiny V - shaped pieces from the folded edge.</p>	<p>3. Fold the left edge to the right. Do the same behind.</p>
		<p>5. Hold the paper vertically between the first and second fingers as shown and bring it to your lips. Blow hard and it will produce a piercing screech.</p>
<p>4. Now let the two side pieces stand out from the middle section</p>		

## SODA - STRAW FLUTE

	
<p>1. Take a slightly stiff plastic soda-straw. The very soft ones do not work well. Flatten out one end of a 15-cm long straw.</p>	<p>2. With a scissors nip both long edges of this oval end into a V point. This end will look like a pointed spear.</p>
	
<p>3. Keep the V end outside the mouth and suck in air from the other end. The V end will vibrate producing a musical note.</p>	<p>4. If you keep the V end inside the mouth and blow out air then the straw will sound like a flute. Now as you keep blowing also cut little lengths of the straw with a scissors. As the straw becomes smaller the sound becomes shriller.</p>
	<p>5. Cut a few holes on the straw to make it into a flute. By opening and closing these holes you can play a few notes on the soda-straw flute.</p>

## ON MICE AND CHILDREN

An American professor of psychology, Robert Rosenthal, once called two groups of his students. He gave each group 30 grey mice and a maze and asked them to teach the mice to negotiate the maze in a few weeks time. There was however, one important detail: he whispered to the first group that their mice had been especially picked for their particularly well developed sense of orientation, and told the other that, for genetic reasons no great success could be expected from their mice.

In reality, these differences existed only in the minds of the students, since the sixty mice were identical in every respect. When the training period was over, Robert Rosenthal found that the 'overrated' mice had performed surprisingly well, while the 'underestimated' once had hardly moved from the starting point.

Enthused by these results, Rosenthal wanted to try the same experiment in a training of a different kind—a school. In May 1964, Rosenthal and his team arrived at an elementary school in South San Francisco, a poor area offering low-wages, the home of many emigrants Mexicans, Puerto Ricans and families on welfare. The school had a large population of 'disadvantaged' children.

The research team blatantly lied to the school teachers. They posed themselves from Harvard and said that they were financed by the National Science Foundation to research on 'late developers'. Impressed by such grand sounding credentials, the teachers opened wide the doors of their classrooms. The teachers were asked to administer a new kind of a test for the pupils, in order to detect those who were capable of a spectacular spurt in performance.

In reality, this was all faked. The test—a standard IQ test was merely a pretext. The 'interesting' cases were chosen at random, 20% per class, and their names were given in a deliberately offhand manner to the teachers: "Anyway, in case you are interested in the results of the tests we have carried out for Harvard"... Having thus conditioned the teachers, without their realising it, the research team merely had to wait and see what transpired. A further test was given four months later, another at the end of the year and a final test one year later.

The results exceeded all expectations, leaving Rosenthal and his 'accomplices' gaping. The pupils, who had been artificially selected as promising better results, progressed much more rapidly than the others! To quote two examples from dozens: Jose, a Mexican child, had an IQ of 61 before he became a 'star' in the eyes of his teachers. One year later his IQ was 106. A 'backward pupil' the year before, he had become merely by the drawing of lots, a 'gifted' pupil. The same amazing change occurred in the case of Maria, another Mexican, whose IQ rose from 88 to 128. Asked to describe the behaviour of these 'interesting cases' the teachers emphasised their 'curiosity', 'originality', and 'adaptability'.

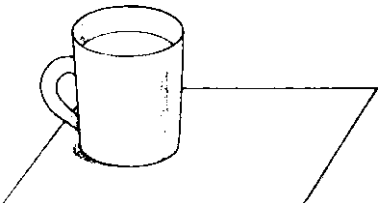

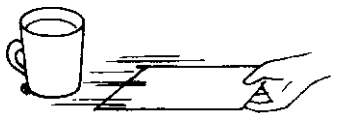
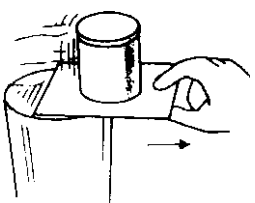
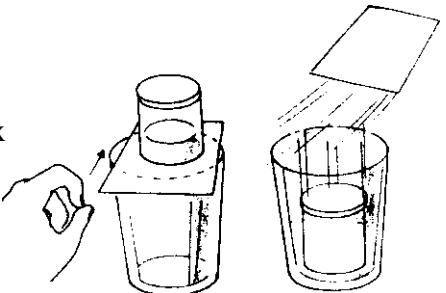
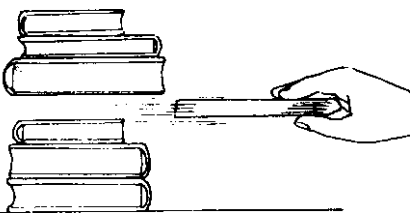
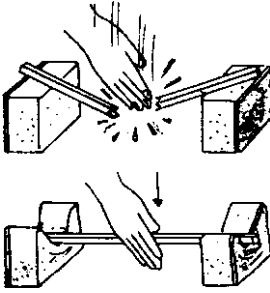
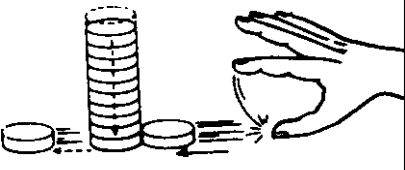
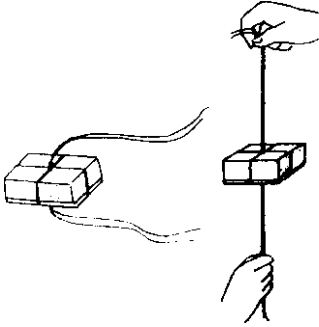
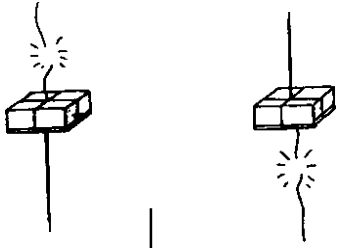
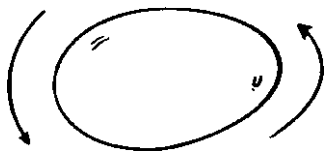
The progress of all the 'stars' was not uniform. The most appreciable gains were made by the youngest children. Probably, the young ones were most easily influenced by their teachers.

The investigation thus proved that, as in the case of the mice, the educator's artificial prejudices have a decisive influence on the behaviour of the pupil. In other words, good and bad pupils are the creations of the teacher. Rosenthal's team felt that students who had been pinned as 'stars' had benefited from more intense verbal communication with their teachers, which would have explained their progress. But they had to abandon this hypothesis. Various successive tests showed that these children had progressed, not in verbal intelligence but in reasoned intelligence. It was an artificial designation alone that had transformed these potential 'dunces' into brilliant students.

In brief, the essential prerequisite for the success of a pupil or of a class is the teacher's belief in success. This would be the most economical reform of all. But also the most difficult to put into effect.

(Extracted from *Danger School* published by The Other India Bookstore, Mapusa, Goa, India)

## INERTIA

		
<p>1. Place half a cup of water on a sheet of paper</p>	<p>2. If you hold the paper and try to pull it slowly, then the cup will also be pulled along with the paper</p>	<p>3. But if you pull the paper with a jerk then the cup will remain in its position and you will be able to remove the paper.</p>
		<p>Place a postcard on an empty glass and keep a plastic box or a coin on it. How do you put the box inside the glass without touching it? If you pull the card slowly then the box will also be pulled along with it But if you flick the card with your forefinger then the box will go straight into the glass.</p>
		
<p>How do you remove a book from below a pile of books? If you pull the book slowly then the pile above it will come crashing down. You will be able to remove it if you pull it out very quickly.</p>	<p>Place a thin stick on two soft cushions. If you strike the stick quickly with the edge of your hand it will break. If instead, you press the stick slowly then the cushion supports will get depressed.</p>	<p>Make a pile of 5 rupee coins. Shoot one coin so as to hit the bottom coin of the pile right in the middle. The bottom coin flies out of the pile and the coin with which you strike takes its place.</p>
		
<p>1. Take a heavy wooden block. Tie it criss-cross with a string. Tie a 30-cm long at the top and bottom. Now lift the block by holding the ends of both the strings.</p>	<p>2. When you pull slowly the upper string breaks because it must support the weight of the block in addition to your pull.</p>	<p>3. But when you give a sudden pull the lower string breaks. In this case the lower string has more strain than the upper one because of the inertia of the rock</p>
<p>Spin a raw and a hardboiled egg. The raw egg will stop spinning sooner because the loose material inside causes more friction.</p>		

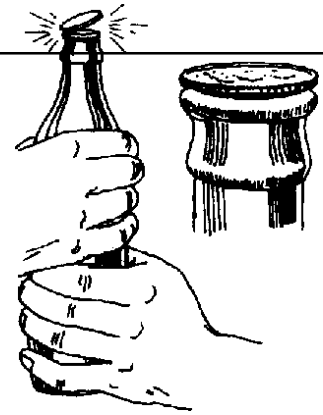
## FUN WITH HEAT

### Hot or Cold?

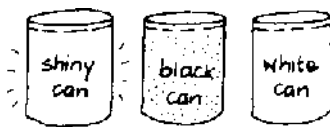


Take three glasses, one with very hot water, another with very cold water and the third with water at room temperature. Then put one finger in the hot and the other finger in the cold water. Keep them for a minute. Then put both the fingers in the middle glass. You will find that the water is warm to the finger that was in the cold water, but is cold to the finger which was in the hot water.

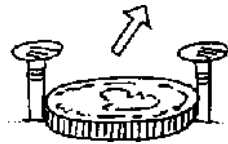
### Dancing Coin



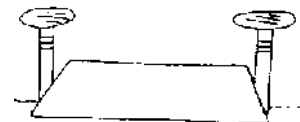
Take an empty glass bottle. Apply a few drops of water on the mouth of the bottle and cover it with a one-rupee coin. Then put your hands around the bottle and hold it for half a minute. The coin will begin to jump up and down. This shows that air expands when heated. When you hold the bottle with your hands, the cold air in the bottle becomes warmer. Warm air expands and comes out of the bottle and makes the coin dance.



Fill all 3 cans with the same volume of hot water. Cover them with lids and stand them in a cool place. Record the temperature of water in each can every 5 minutes. Black surfaces both absorb and radiate heat more quickly than shiny or white surfaces.

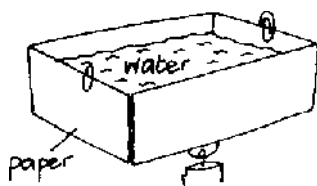


Place a coin between the nails, then heat the nails. The coin cannot be removed now as the nails have expanded.



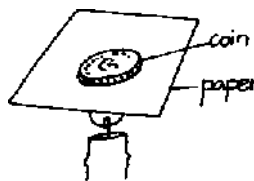
Cut a metal strip so that it fits exactly between two nails. Heat the strip and then try to fit it between the nails.

### Paper Pan



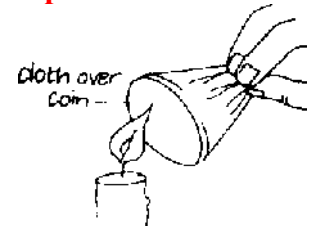
The pan will not burn, as the temperature of the paper never rises above 100 degrees Centigrade.

### Non-burning Paper



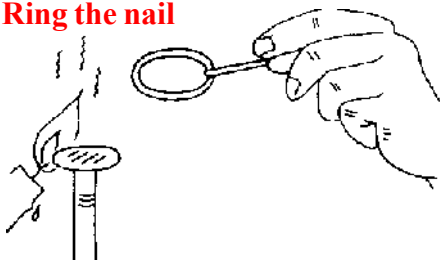
The coin on the piece of paper conducts heat away before the paper burns.

### Fireproof Handkerchief



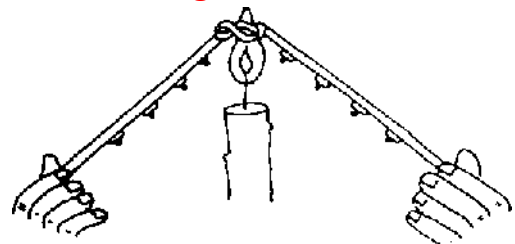
Take a cotton handkerchief and tightly rap a coin in it. Put the coin on a flame. The coin conducts heat away before the cloth can burn.

### Ring the nail

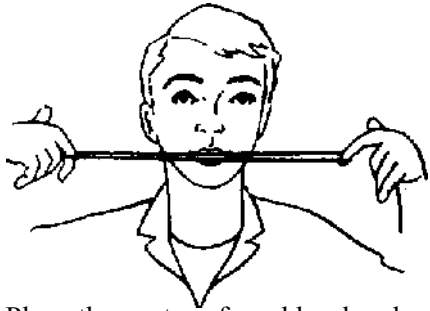


Make a wire loop which is just big enough to pass over the head of the nail. Now heat the nail. Ask the children why the loop will not fit over the hot nail head.

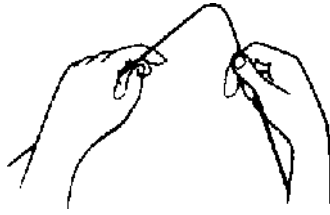
### Measuring conduction rates



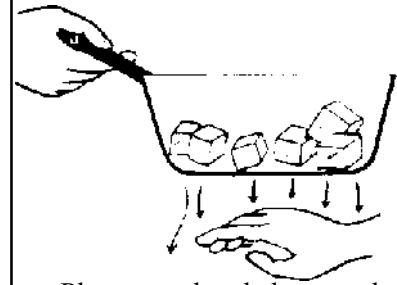
Take two wires of different materials - a copper wire and a steel wire. Stick small stones along the wires using candle wax. Hold the wires in the flame and record the time each of the stones drops off each wire. This will tell you which of the two materials is a better conductor of heat.



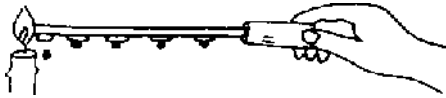
Place the centre of a rubber band against your lips and pull both ends apart quickly. It feels warm because your motion causes the molecules to move faster. Relax the rubber band. Now it feels cool.



Bend a piece of wire rapidly back and forth until it breaks. The broken part gets very hot because its molecules are made to move more rapidly by your motion.



Place your hand above and below a metal pan containing ice cubes. Your hand feels colder under the pan than on top because cold, heavy air falls.



Use wax to stick small stones at regular intervals on a cycle spoke. Put a small handle and heat the spoke in a candle flame. As heat travels in the spoke the stones fall off one after the other.

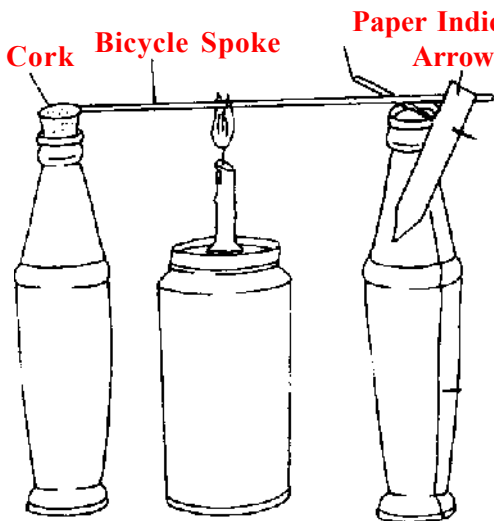


Put a small amount of sawdust in a container of water. As the container is heated the convection currents will be visible.



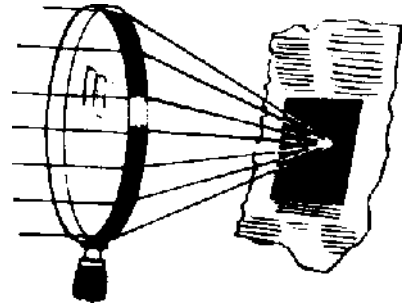
When air is heated it expands and becomes lighter. Cooler air around it then moves in and pushes up the lighter air.

### Measuring Expansion

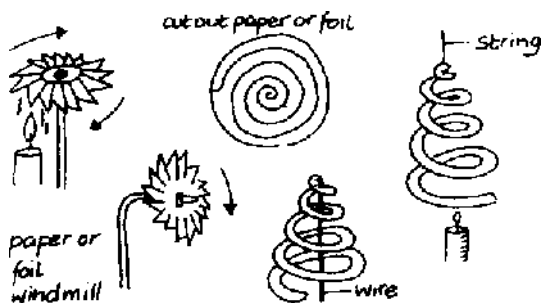


Push a spoke into a cork so it is held firmly. Arrange the rest of the equipment as shown. As the metal spoke is heated it expands and the indicator moves. With this apparatus you could compare the expansion of different metals and different thickness of metal.

### Sun Power

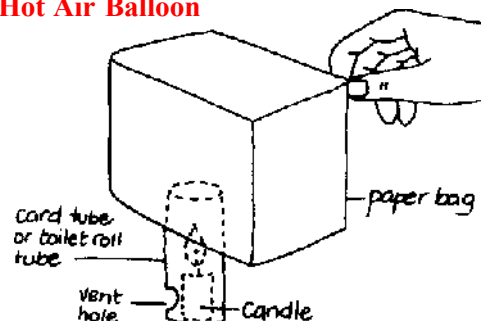


Set fire to the black print of a newspaper by focusing the infrared rays from the sun with a magnifying glass. The white part of the paper does not burn as easily because it reflects the rays.



Make these air flow or convection detectors. If they are held above the candle they will turn around.

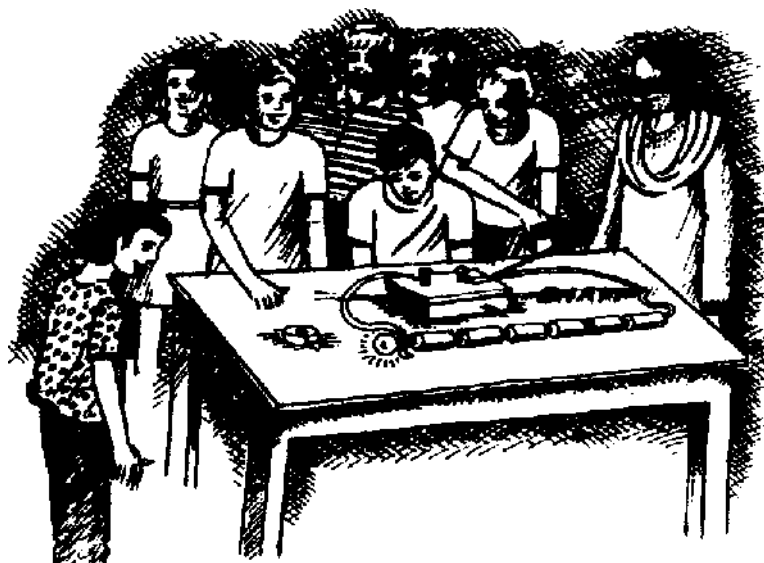
### Hot Air Balloon



Hold a brown paper bag over the candle. It will rise as the air inside heats up. This is because warm air is lighter than cold air. Children could design their own hot air balloons and test which flies the highest.

## BRIGHT IDEAS

Children learn a great deal by themselves. It is unfortunate that schools provide very little space for children to mess around and discover things for themselves. But whenever there is a pro-child atmosphere the results are simply electrifying.



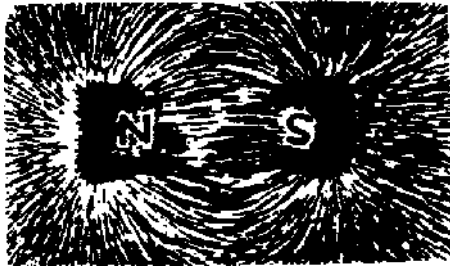
This happened in a Nuffield Science classroom in England. The junior science students were given a lot of torch batteries, bulbs, wires, resistance's etc. to experiment with. The children were sup- posed to familiarise themselves with these components and learn to make simple circuits. After the children had played with them and learnt to make a rudimentary torch etc. the teacher decided to test their knowledge about these components and gave them a practical quiz.

She gave them four identical wooden boxes with only two terminals on their top. Inside the box, the two terminals were either connected to a battery, a bulb, a resistance or nothing at all (i.e. an open circuit). Children could only experiment by touching only the two terminals on the top of the box. They could only attach wires to these two terminals. They had to find out which box had which component hidden in its belly. It was fairly simple if there was just a battery hidden inside. The battery being an active element, if one just attached a bulb from outside it would glow. If there was an open circuit inside that was also easy to find out. But how does one find out whether it was a bulb or a resistance, hidden inside the box? It was a tough question and not at all easy to crack. If you connected a bulb and a battery from outside, in both cases the bulb would light up. Even the teacher, who had set up the quiz, did not have a clue to the answer.

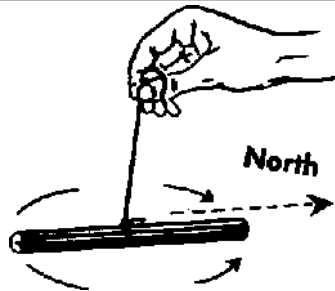
But a little boy found out the answer. When he connected a single battery and a bulb, to the two terminals, his bulb lit up. As the glow of the bulb was a bit 'dim' - it meant that there was either a resistance or a bulb inside the box. Then he attached two batteries, and his bulb became a little bright. Then he just kept on adding more batteries and every time the glow of the bulb became brighter. But when he attached six batteries, the high voltage busted something inside and the circuit became open.

The little boy had found the answer because while playing he had fused two bulbs by connecting several batteries to them.

## FUN WITH MAGNETS



Cover a bar magnet with a sheet of paper and sprinkle iron filings on it. The filings form a beautiful pattern around the magnetic field of the magnet.



Suspend a magnet from a thread so that it can rotate freely. The magnet always points to a definite direction. No matter what you do the magnet swings back to the same direction.



Paper clip, nails, tin cans, steel wool are attracted to magnets, but wood, wool, plastic are not. Make a list of all the things which are attracted to magnet and which are not.

### UNLIKE POLES ATTRACT



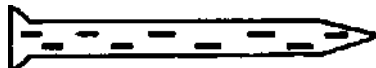
LIKE POLES REPEL

### ATOMS DISORGANISED



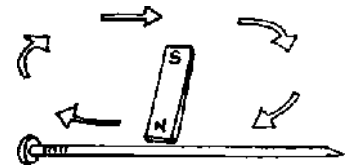
NOT A MAGNET

### ATOMS LINED UP



A MAGNET

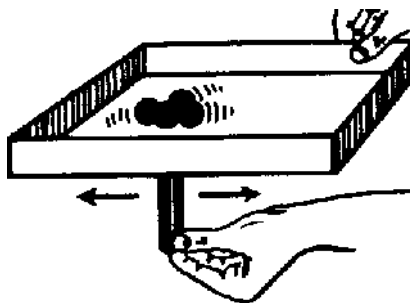
### Magnetising a Nail



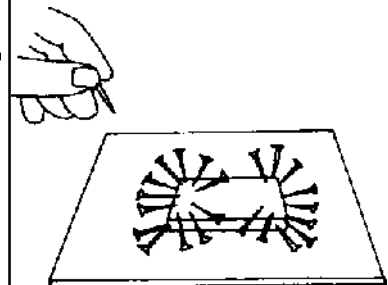
Stroke a nail from end to end with only one end of the magnet. After about 50 strokes the nail will become a magnet.



Magnetise a needle by stroking it with a magnet. When placed on a floating cork, the needle is turned by the earth's magnetism and points north - south.

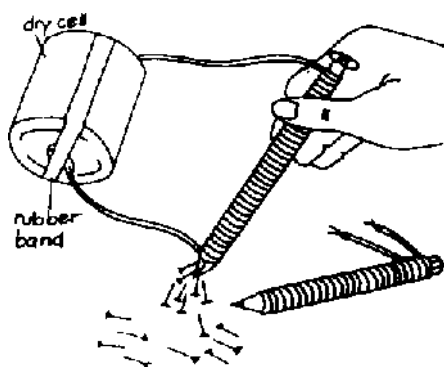


Place a few steel balls from a bicycle bearing in a cardboard box. The balls will roll mysteriously as you move a magnet under the box.

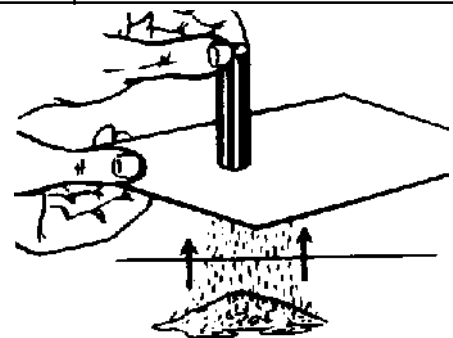


Place a glass cover over the magnet and let small nails, or pins fall onto it one at a time. The nails make a pattern following the lines of forces.

### Electro-magnet



Wrap 50 turns of insulated (enamelled) Copper wire around a nail. Connect the ends of the wire to an ordinary 1.5-volt torch cell. Pick up nails with the magnetised nail. Vary the number of turns of wire and investigate the effect on the strength of the magnet



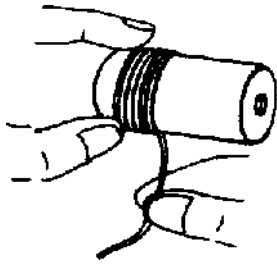
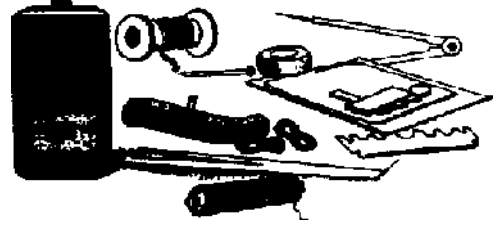
Mix some iron filings with salt. How can you get them apart. It's easy. Simply place a paper over them and pull the iron filing out with the magnet.



## A REVOLUTIONARY MOTOR

A rotating electric motor is amazing fan. And this is, by far the simplest electric motor on earth!

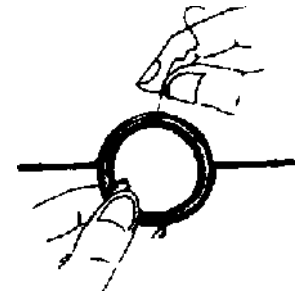
1. You will need a new, 1.5-volt normal torch battery, 1-metre of insulated Copper wire (about 20 gauge) used for motor rewinding, one magnet (one from an old radio speaker will be ideal), one old stove pin or metal file clip, two rubber bands 1-cm wide cut from an old bicycle tube, some thread and ordinary hand tools.



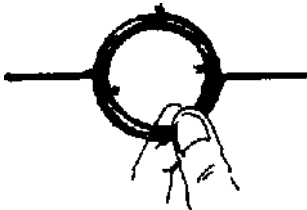
2. Take 1-metre of Copper wire (20 gauge). Straighten it by running it through a piece of cloth. Wind it tightly on a torch battery. The loops of the wire should be adjacent to one another. They should not overlap. The coil should have about 10 turns.



3. When the coil is removed from the battery it opens up like a spring.



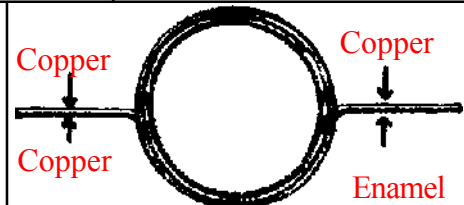
4. Tie the coil at several places with little bits of string. The string will keep the loops of the coil in place.



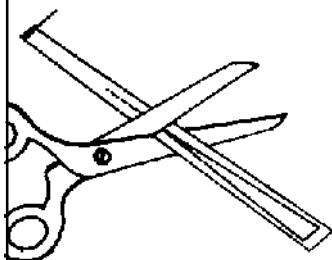
5. The two ends of the coil should jut diametrically outwards. The coil will rotate on these two ends. So, ensure symmetry and even distribution of the coil's weight.



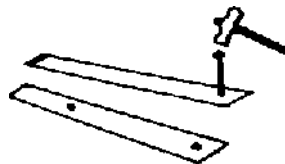
6. Now, scrape the enamel from three sides of the end leads using a blade. The enamel will remain only on the bottom of the end leads.



7. The copper / enamel sequence leads to make / break of the circuit. This **BRUSH** or **COMMUTATOR** is the heart of this simple motor. If all the enamel is removed from the end leads then the motor will not work. The coil is now ready.



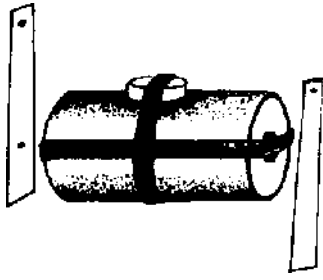
8. Cut an old stove pin into two or else take two metal file clips each 7-cm. long.



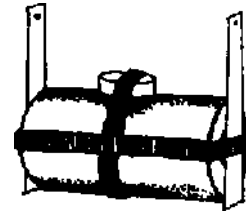
9. With a small nail, hammer a hole in each piece near one end. Hammer one more hole in one piece about 2.5-cm. from the other end.



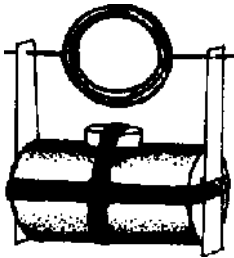
10. Salvage an old radio speaker magnet (standard laboratory magnets will do well) and place it on a new battery with the help of a cycle tube rubber band.



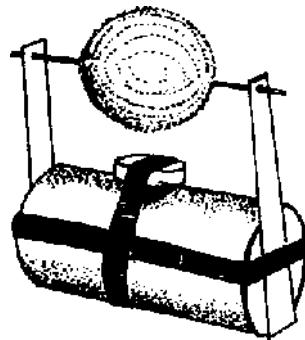
11. Stretch out another cycle tube rubber band (1-cm wide) along the length of the battery. Now insert the stove pins in the rubber band. The pin with two holes is placed next to the flat end of the battery. The second hole bites into the plane end of the battery and makes a good electrical contact.



12. The metal strips serve three purposes. They act as power leads, supplying current to the coil. They are also bearing supports for the coil. Finally, they also make a stand for the motor.



13. Now pull the metal strips a little apart and slip the motor coil in their holes.



14. Give the coil a gentle starting push and it will start rotating. However, if the push is in the wrong direction, then the coil will stop after a while, flip, and rotate in the right direction.

### How does the motor work?

How does this D.C. motor work? When an electric current flows through a wire, it produces a magnetic field around it. Similarly, when current flows through the motor coil, then the coil becomes an electro-magnet with two poles - a North and a South pole.

According to the Law of Magnetism - **like poles repel** and **unlike poles attract**.

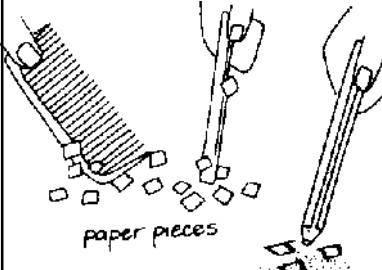
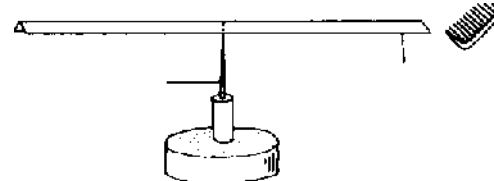
Following this law, the North pole of the electro-magnet is attracted to the South pole of the permanent magnet and is repulsed by its North pole. This mutual attraction - repulsion makes the motor coil turn. The coil will stop once its N and S poles align with the S and N poles of the permanent magnet. But just when this point reaches, something happens. Until now, the copper part of the coil ends were in contact with the metal strips. But now, the enamel part of the coil end comes in contact, and being an insulator, it switches off the current to the coil. The coil is no more a magnet, it becomes demagnetised. Momentum propels the coil on until once again the copper on its leads touches the metal strips. Once again the coil becomes an electro-magnet. In this way the coil continues to revolve, round and round.

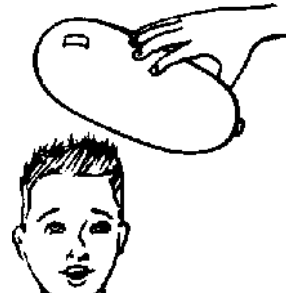
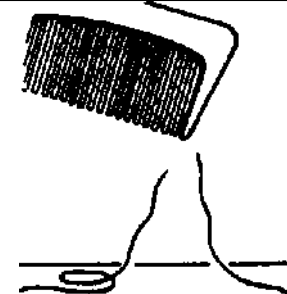
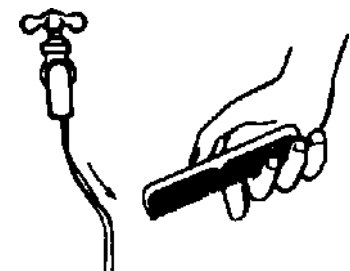
### Experiments with the motor.

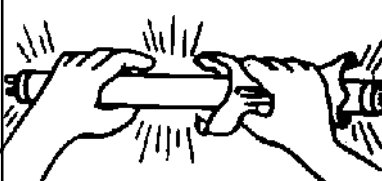
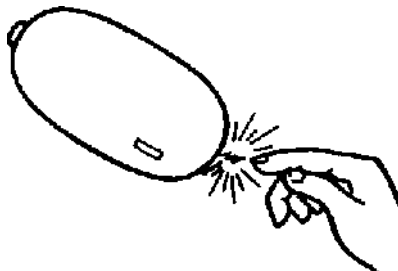
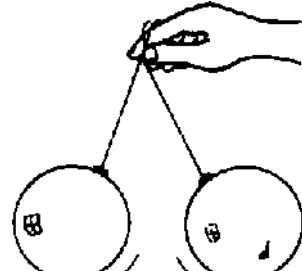
Several interesting experiments can be done with this simple electric motor. What happens if you reverse the permanent magnet? If the north and the south poles are interchanged then the direction of the motor also changes. What happens if another magnet is brought close by? If both magnets have opposite poles, then there is an increase in the magnetic field and a consequent spurt in the speed of the motor. The speed decreases, if the poles are similar.

You could experiment with different lengths and thickness of the copper wire. What happens if you take 2 metres of wire or half a metre of wire? What happens if you take thick wire or thin wire? What happens if there are fewer or greater number of turns in the motor coil? You can also make coils with different cross-sections like oval, square, rectangular etc. What happens if you add another battery? With these experiments you can learn a great deal about electric motors.

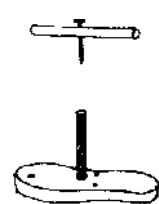
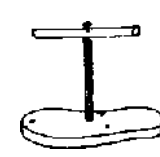
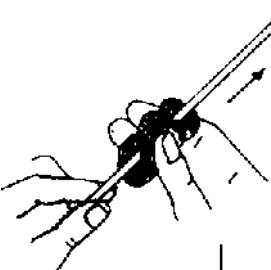
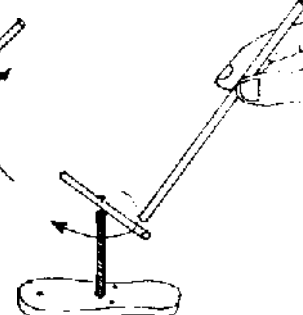
## SIMPLY ELECTRIFYING!

 <p>paper pieces</p>	<p>Add charge to a comb or ball pen casing by rubbing it with wool. Tear a paper into small pieces. Hold the comb or ball pen above the paper. The paper is attracted to the 'charged' plastic and sticks to it.</p>
	<p>Mount the needle as shown and balance the paper strip. When a charged object is held near the paper strip it moves.</p>

 <p>Rub a balloon with wool and bring it over the hair on your head. Watch your hair stand up on end!</p>	 <p>Cut some pieces of thin cotton and nylon threads. Bring a charged comb near them. The threads stand up like snakes being 'charmed' by music.</p>	 <p>Bring a charged comb near a thin steady stream of water from a tap. Watch the stream bend towards the comb.</p>
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 <p>Rub an old tubelight in the dark with a piece of nylon. Watch the tubelight glow as sparks go through it</p>	 <p>Rub an inflated balloon with a piece of nylon or wool. Watch it in the dark as you bring your finger near it. You will see a miniature lightning flash!</p>	 <p>Tie two blown balloons with long threads. Charge each balloon by rubbing it with wool. Let the balloons hang freely. Watch them repel each other.</p>
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### Magic wand

 <p>1. Cut a 4 cm long plastic soda-straw and insert a pin through its centre. Make a hole in an old rubber slipper and insert an empty ball pen refill in it.</p>	 <p>2. Rub the plastic straw with wool or nylon and then place the pin in the refill.</p>	 <p>3. Take a long plastic straw and rub it with wool or a nylon hair band.</p>	 <p>4. Now as you bring the long straw (magic wand) near the small one, the small straw rotates and turns.</p>
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## GLEAM IN THE EYE

Children are naturally curious and have an innate desire to learn. Children also have a tremendous power to concentrate. If they are interested in a particular thing they put their heart and soul into it. They want to know it. They have a tremendous desire to understand how it works. They don't have to be taught.



Maria Montessori demonstrated this over a hundred years ago. She was Italy's first woman doctor. After getting her medical degree, Montessori started working with the children of slum dwellers. Montessori is famous the world over for her deep pedagogical insights. She had designed hundreds of teaching-aids for children. Several of them are still in active use - for instance, the post-box. This is a hollow wooden cubical box. On each surface of the box there is a cut out of a particular geometrical shape - a circle, triangle, square etc. There are corresponding wooden blocks which have to be 'posted-in' the respective slots. A wooden ball, for instance, would go into the circular hole and a prism in a triangular slot.

There was an elderly priest who was very interested in Montessori's work. He would drop by on a Sunday to see the various experiments, which Montessori was doing with the children. One day, Montessori took the priest to one corner of the class, where a little girl, was playing with the post-box. The little girl was deeply absorbed in her work. Montessori asked the other children to encircle the little girl and to sing a song aloud so as to disturb her concentration. But the little girl was so absorbed in her work - in trying to figure out which block will go into which slot that she did not even look up.

After some time Montessori lifted the little girl and seated her on a table. As soon as the little girl got her berth she once again got absorbed in trying to figure out the block which will go into a particular slot. She was totally lost in her own world.

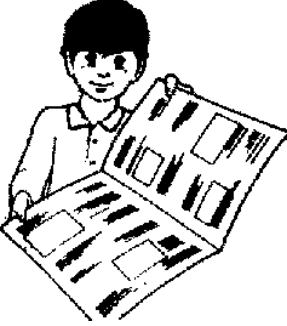
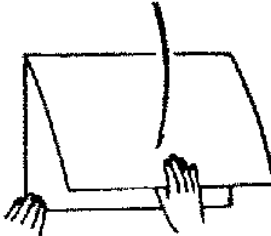
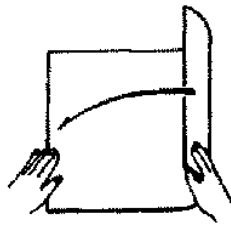
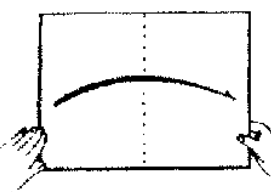
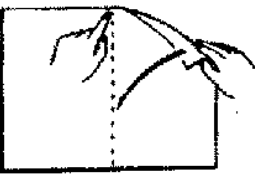
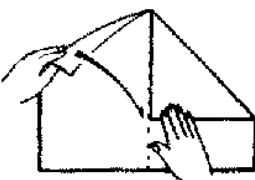
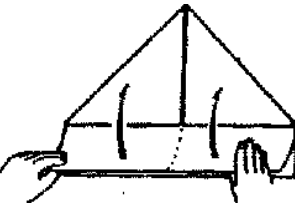
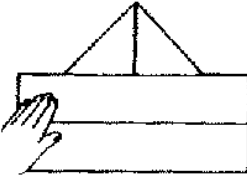
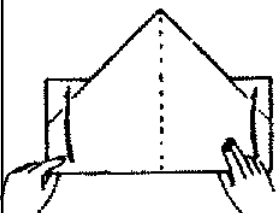
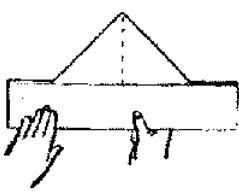

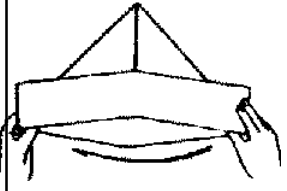

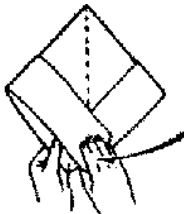
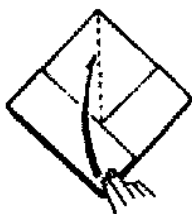
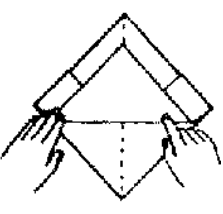
The priest - a good old Samaritan, often used to bring some toffees and chocolates for the children. On that day he had got a big box of biscuits. He started distributing biscuits to the children. He also gave the little girl a biscuit. The little girl reluctantly took the biscuit. She intently looked at it. She saw that the biscuit was rectangular in shape. So, she posted the biscuit in the rectangular slot of the post-box. Children do not learn through bribes. They learn because they want to understand the world. Marksheets, certificates, medals and prizes are bad substitutes for the real joy of knowing the world.

## THE CAPTAIN'S HAT STORY

Lillian Oppenheimer has been telling this delightful story to children for over 50 years. Lillian was the founder of the Origami Centre in New York.

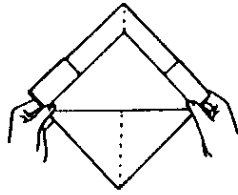
The Captain of the ship finds that all the passengers in his ship are getting seasick. So, everyday, he invites them all to the deck to sing and dance and make merry. The people wear their most colourful costumes and have great fun. The Captain has a big steel trunk in which he has different kinds of caps. He joins in the fun and wears a new cap everyday.

Take a full newspaper sheet, fold the Captain's hats, and wait for the big surprise!

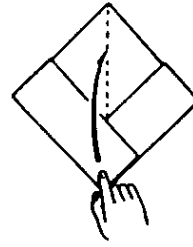
 <p>1. Take one full sheet of newspaper.</p>	 <p>2. Leave the sheet of newspaper folded in half along the middle line.</p>	 <p>3. Keep folded edge on top. Now fold from right to left.</p>	 <p>4. Unfold the paper.</p>
 <p>5. Fold down the top right - hand corner to meet the middle line.</p>	 <p>6. Fold down the top left - hand corner to meet the middle fold line.</p>	 <p>7. Fold up one single layer of paper, from the bottom up as far as it will go.</p>	 <p>8. Press the paper flat. Turn it over from side to side.</p>
 <p>9. Fold up this single layer of paper as far as it will go.</p>	 <p>10. Press the paper flat. From the inside open out the paper a little.</p>	 <p>11. This is the captain's first cap - a <b>SAILOR'S CAP.</b></p>	 <p>12. The captain used the same paper to make more caps.</p>
 <p>13. So, hold the cap and collapse it into...</p>	 <p>14. ...this shape.</p>	 <p>15. Fold up the top bottom point.</p>	 <p>16. Press the paper flat so as to make...</p>



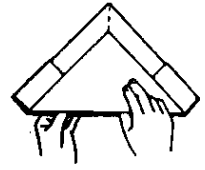
17. the **FIRE MAN'S HAT.**



18. Press the paper flat and turn it from side to side.



19. Fold up this bottom point.



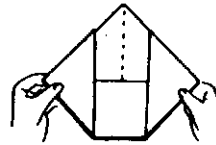
20. Hold the front and back of the hat. Carefully open out, and the hat will



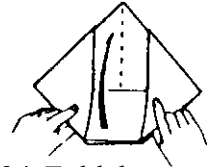
21. Again collapse to make



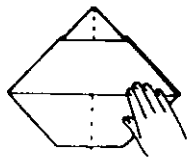
22. the **SHIKARI CAP.**



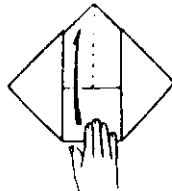
23. Press the paper flat.



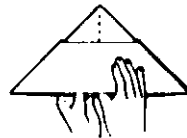
24. Fold the top layer from the bottom of the hat.



25. Press the paper flat and turn it over from side to side.



26. Fold up this bottom layer.



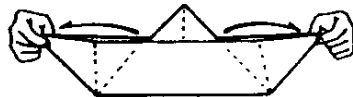
27. Open the paper out to make ...



28. An **AIRFORCE OFFICER'S CAP.**



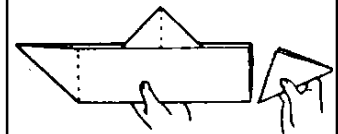
29. Well now, pinch the two side points



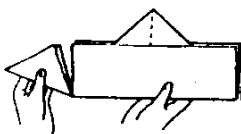
30. And pull them apart to make the traditional boat - the **CAPTAIN'S SHIP.**



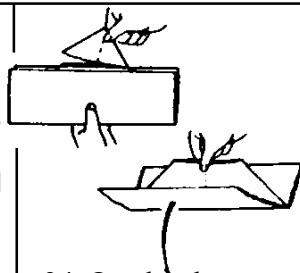
31. All of a sudden the ship gets caught in a fierce storm.



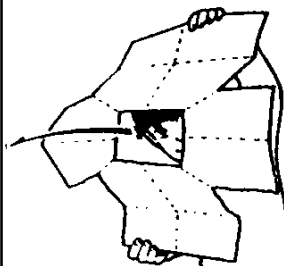
32. There is thunder and lightening. One huge wave knocks the stern (tear one corner).



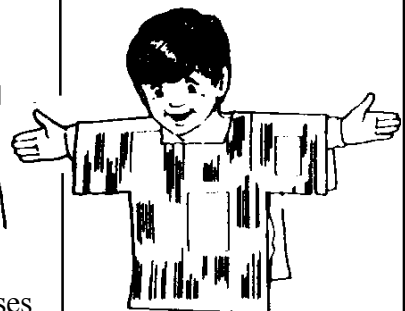
33. Another wave knocks off the bow (you tear the other corner off)



34. One last huge wave knocks off the bridge (you tear the triangle in the middle). The ship sinks.



35. The captain loses all his hats. The captain has nothing left! (put your head in the hole).

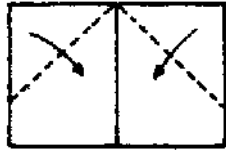


36 But a **TORN SHIRT.**

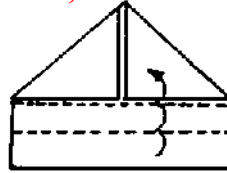
## RAJA CAP, NEHRU CAP, KULU CAP



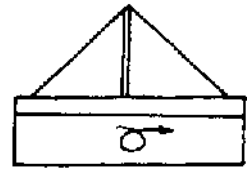
1. With a sheet of newspaper you can make three caps. Take a double spread news- paper sheet and fold it into half.



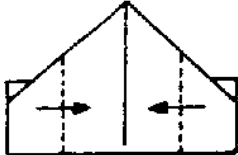
2. Keep the folded edge on top and fold the top left and right corners to the middle fold line.



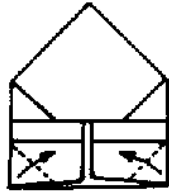
3. Fold up the top layer of paper from the bottom into half. Then double fold it.



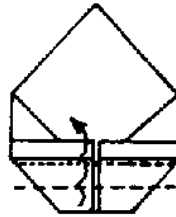
4. Now upturn the paper.



5. Bring the right and the left edges to the middle line and crease.



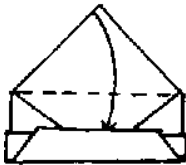
6. Hold the bottom right and left hand corners.



7. Fold the bottom portion into half and tuck the edge inside.



8. This cap looks like a **KING'S CAP**



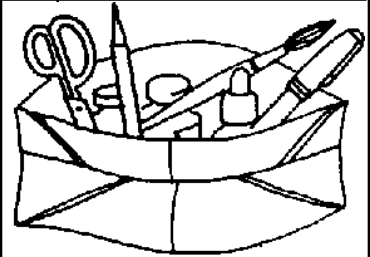
9. Now fold the top point of the King's cap to the mid- point on the base and tuck it in.



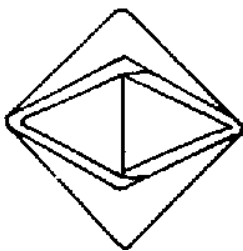
10 Open out the long edges and wear it like a ...



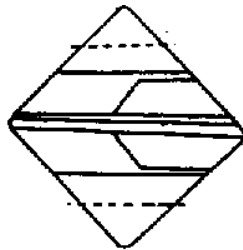
11. **NEHRU CAP.**



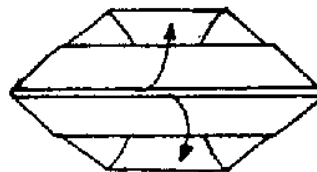
12 Invert the Nehru cap and use it as a very nice purse



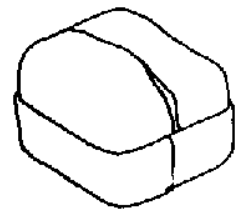
13. Slowly press the purse and squash to flatten it.



14. Fold top and bottom points along dotted lines and tuck them in the pocket.



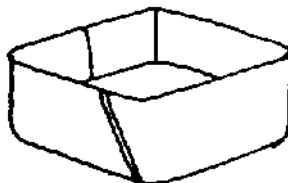
15. Open out the line in the middle to make a new cap.



16. This is a **BOX CAP** or a **KULU CAP.**



17. This famous cap is worn in Himachal Pradesh.



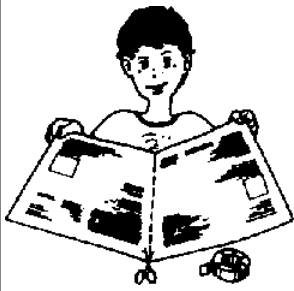
18. The corners of this cap can be straightened to form a square box. These boxes can be used for a variety of sorting out and storing activities.



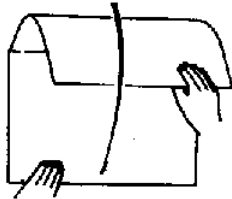
19. One box can be overturned as a lid on the other to make a closed gift box.

20. Using different sizes of newspapers you can make big and small boxes too. You can make a set of nesting boxes. Without any glue or scissors, you can fold these amazing boxes using ordinary newspapers.

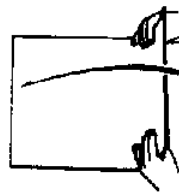
## CRICKET CAP



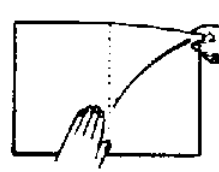
1. Cut a newspaper into two parts. The cap will be made from one part.



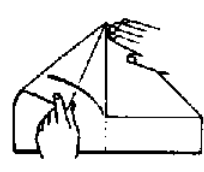
2. Fold one part in half from top to the bottom.



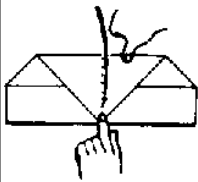
3. Then fold it from side to side and unfold it again.



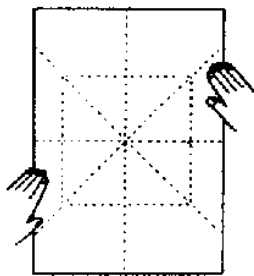
4. Fold one half of the top edge in so that it lies along the centre fold line.



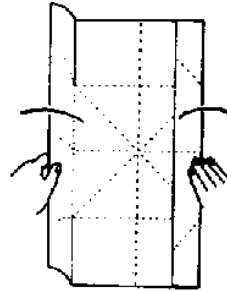
5. Repeat the same with the other half.



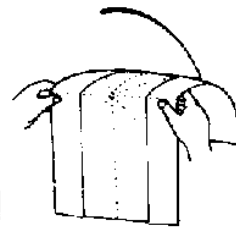
6. Fold the top down to meet the bottom edge of the paper.



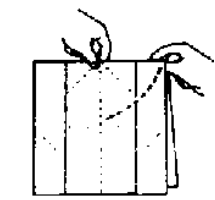
7. Unfold the paper again.



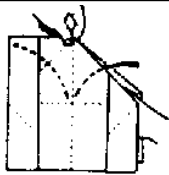
8. Fold each of the long sidelines along the fold lines.



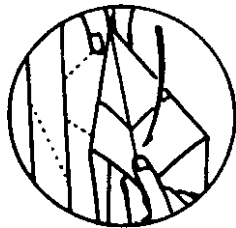
9. Then fold the paper in half away from you.



10. Push your thumb inside and forefinger on top.



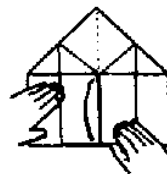
11. Push the top corner down inside itself, along the fold line.



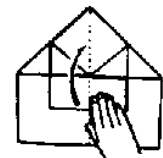
12. This is a detailed drawing.



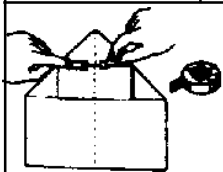
13. Fold both left and right edges to the middle line. Press them flat.



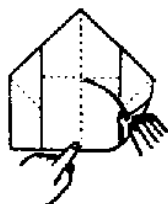
14. Then fold the bottom edge to meet the middle.



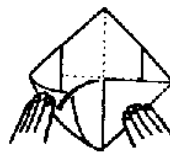
15. Fold them again over the middle.



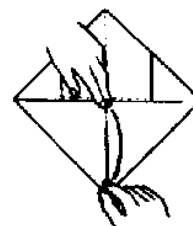
16. Fasten them down with sticky tape. Turn the paper over.



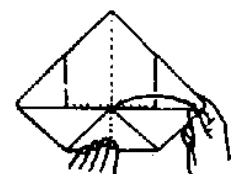
17. Fold up the bottom right-hand corner.



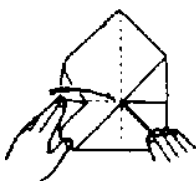
18. Then fold the left-hand corner as well.



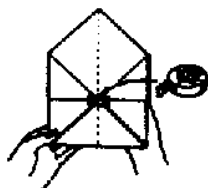
19. Fold up the bottom point to the middle.



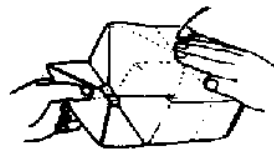
20. Then fold the right-hand corner to the middle.



21. Fold the left corner to the middle too.



22. Fasten the corners down with sticky tape.



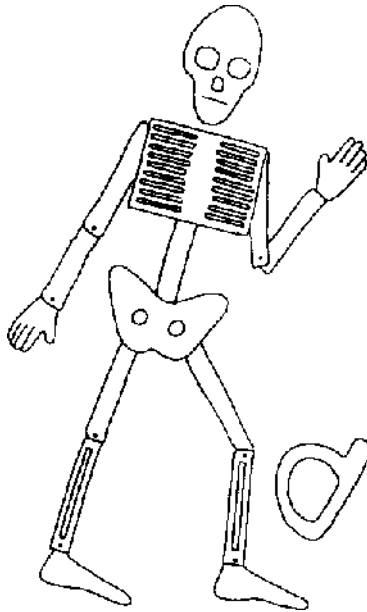
23. Open out and press it into shape.



24. And then wear your **CRICKET CAP**.

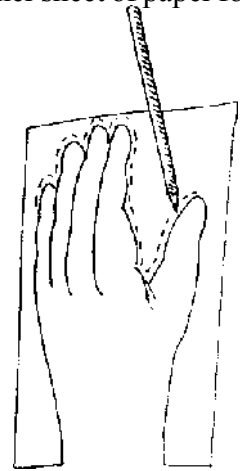
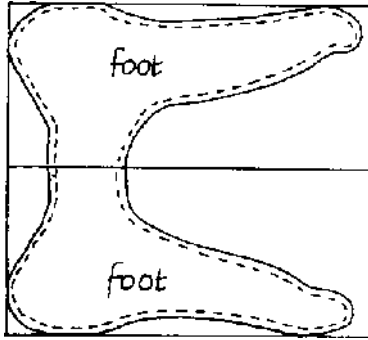
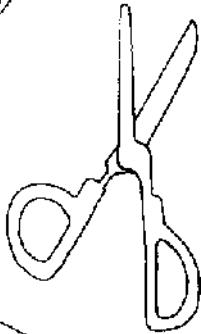


**Finished Skeleton**

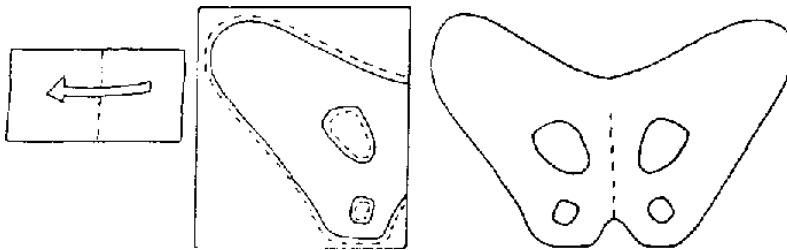


**PAPER SKELETON**

To make the paper skeleton you will need 8 sheets of paper. Fold and cut out the shapes as illustrated for each part of the body. The final result should look like the one shown. Fold the paper in half and ask children to draw around a hand. Use another sheet of paper for the feet.

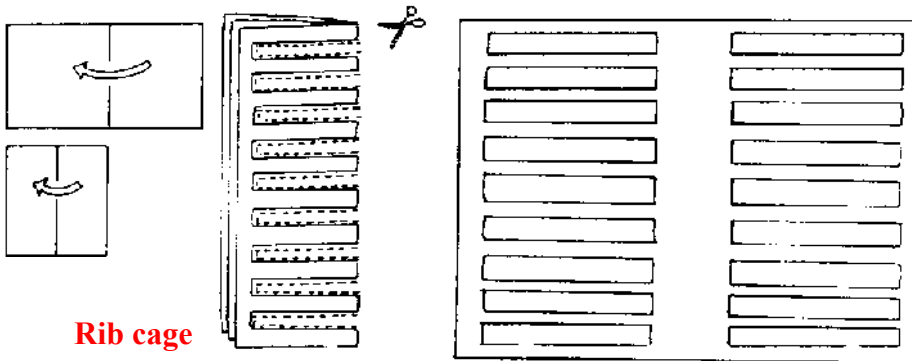


**Hands and Feet**



Draw half the pelvis and cut out the basic shape when the paper is folded. Cut out shoulder blades in the same way using an extra piece of paper. Cut out two strips for the backbone to give strength. Stick one piece to each side of the skeleton.

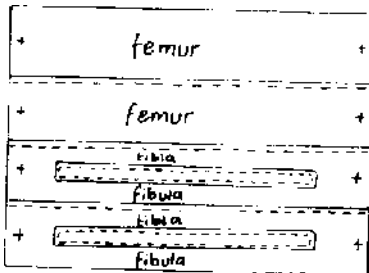
**Pelvis, Shoulder Blades and Backbone**



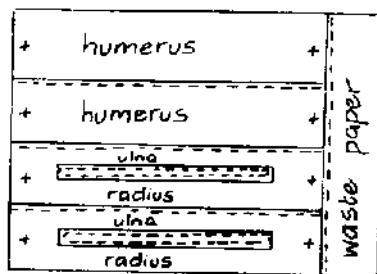
**Rib cage**

Fold the paper twice and then cut along alternate lines. Use a ruler to measure accurately if you want to have the exact number of ribs.

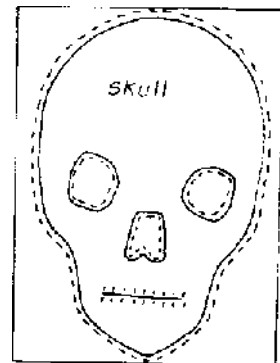
**Lower Limbs**



**Upper Limbs**



**Skull**



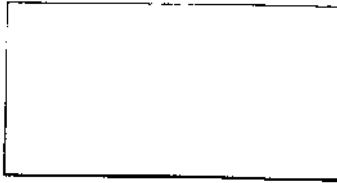
The lower limbs are cut out from one piece of paper. The upper limbs all fit into another piece.

Cut around the dotted line after drawing. The teeth and mouth can be cut without removing any paper.

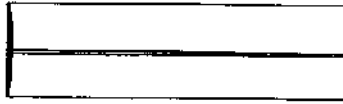
(Courtesy: VSO Science Teacher's Handbook)

## FANTASTIC FLEXAGONS

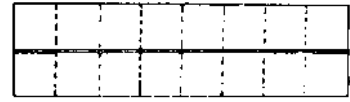
The flexagon is an amazing model. As you flex it on its centre, each time a different picture comes into view. It can be used to depict any four stage cycle or sequence. It is simply unbelievable that paper can rotate like this without tearing. You can make a flexagon using an old xerox paper.



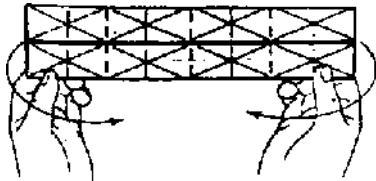
1. Take a 20-cm x 10-cm sheet of bond paper. This rectangle should be made up of two exact squares.



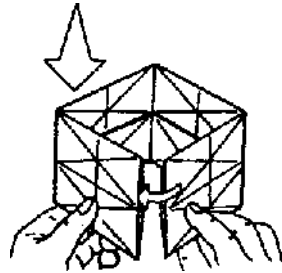
2. Crease the middle line along the length and fold the long edges to this midline.



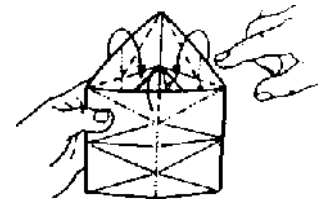
3. Fold eight equal segments along the width.



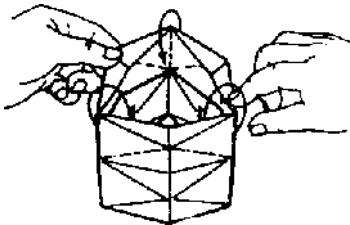
4. With the help of a pencil and scale, first draw the diagonal lines as shown and then crease them well.



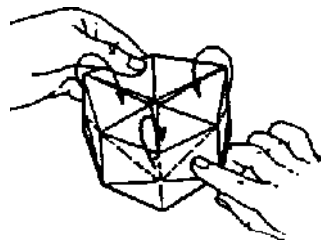
5. Bring the paper's left and right sides together and insert one side inside the other, thereby. Making a three dimensional prism.



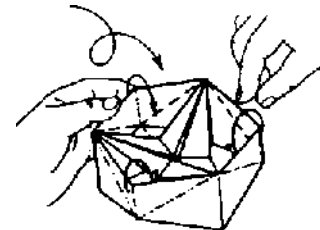
6. Push in the three triangular areas at the top of each other.



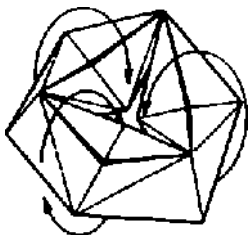
7. Press all the three top points down and through the centre. The next row of triangles will assume a similar shape.



8. Once again, press all three top points down and through the centre.



9. Turn the model over and push in the three triangular areas at the top of each other.



10. This will complete the flexagon. To make it rotate hold it on either side or twist the outer edges in towards the centre, so that the inner surfaces appear.

11. Every time you rotate the flexagon a different facet is exposed. You can depict a cycle or a sequence by drawing a different picture on each of the facets.

For instance, you can depict the **FOOD CHAIN** as **INSECTS** are eaten by the **FROGS**, who are eaten by the **SNAKES** - who in turn are eaten by the **EAGLES**.

Similarly, you could depict the **RAIN CYCLE**, **LIFE CYCLE OF A FROG** OR A **BUTTERFLY**, **A CYCLE OF SEASONS** etc on the Flexagon. The Flexagon is a very powerful model for depicting any cycle.

## LEAF ZOO

There are many kinds of trees  
With lots and lots of different leaves  
Some are broad some are thin  
Some have faces with a chin.

Have you seen leaves on trees  
Dancing in the summer breeze  
But have you ever seen how  
Leaves pretend to be a cow

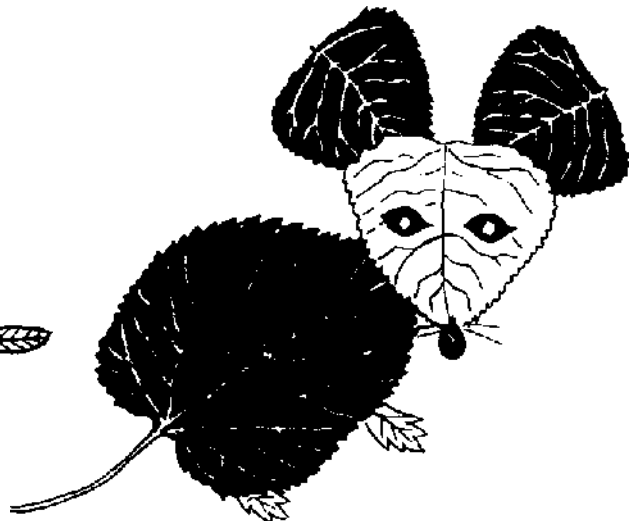
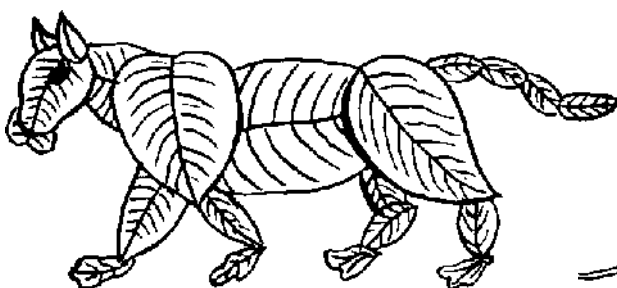
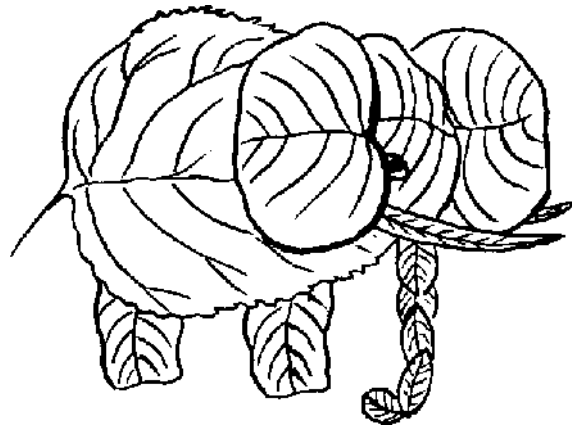
Stroke a leaf, feel its hair  
Watch it turn into a bear  
Hold it softly against your cheek  
Don't be frightened if it squeaks

Press few leaves in a book  
Once in a while sneak a look  
See the green turn ochre to rust  
Touch them gently if you must

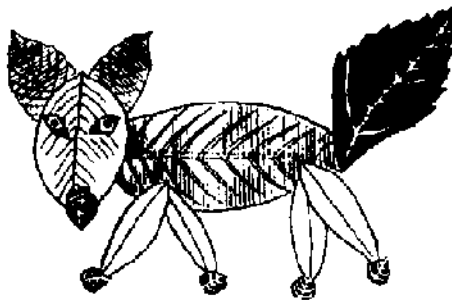
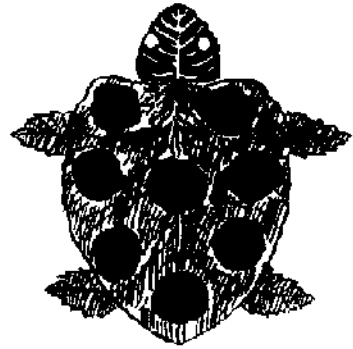
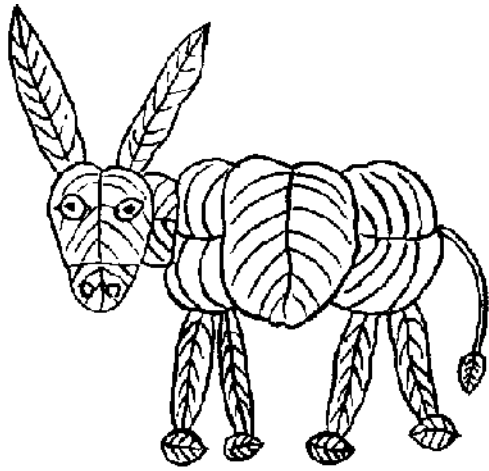
Peepal, Banyan, Mango, Rose  
Each has a distinctive pose  
One's a beak, another a claw  
This a stomach, that a paw

Stick them neatly with some glue  
And after you have made a few  
Go ahead, discover some more  
How about trying a dinosaur?

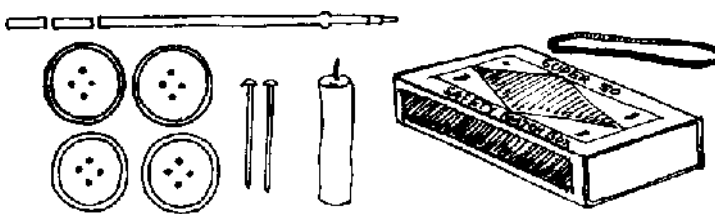
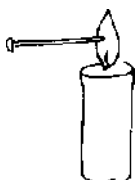
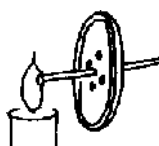
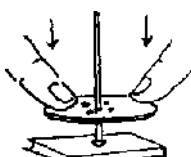
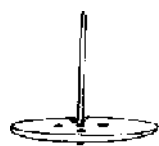
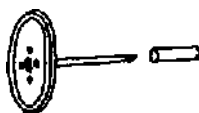
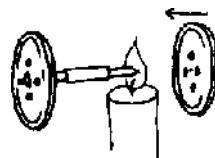
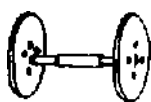
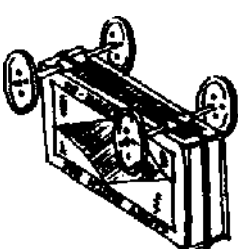
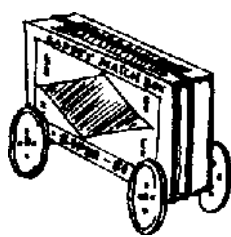
— Poem by Farida Mehta



LEAF ZOO



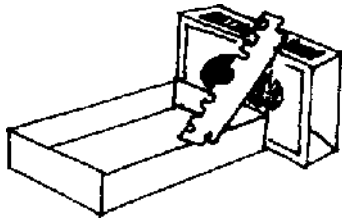
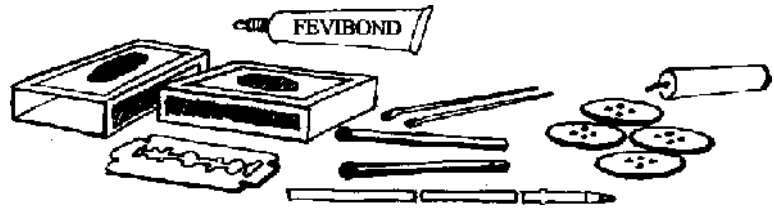
## MATCHBOX TROLLEY

	<p>1. To make the Matchbox Trolley you will need an old ball pen refill, a new matchbox, rubber band, two pins, candle, and four plastic buttons. The plastic identical round buttons are used because these melt when a hot pin is inserted in them.</p>	
 <p>2. Heat the tip of a paper pin and pierce it through the centre of a cheap quality plastic coat button.</p>	 <p>3. Now heat the head of the pin.</p>	 <p>4. Apply pressure on the rim of the button with your thumbs and press the hot pinhead against the ground.</p>
 <p>5. The pinhead will go and firmly embed itself in the centre of the plastic button. If however, the pin comes out at an angle, it can be made 'square' (at right angles to the button) while it is still hot and pliable.</p>	 <p>6. The pinhead firmly anchored in the centre of the button makes a good drawing pin. Cut and insert a small piece of ball pen refill. The refill will act as a 'bearing' or a bush.</p>	 <p>7. Heat the 'drawing pin' tips at the other end in the candle flame once again and embed it in the centre of another plastic button.</p>
 <p>8. This assembly consists of two button wheels, one paper pin axle and a ball pen refill bearing. Make two such wheel assemblies.</p>	 <p>9. Place a new matchbox on the refill bearings of two wheel assemblies. Put a rubber band around to keep the wheels in place.</p>	 <p>10. With the help of the matchbox trolley you can do a number of scientific experiments - like roll and drag friction, the inclined plane experiment etc. The trolley is a lovely toy for all times.</p>

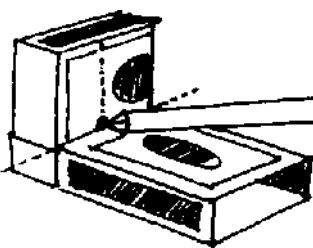
## MATCHBOX TIPPER TRUCK

You must have seen tipper trucks unloading sand, stones or coal. You can readily make a working model of a tipper truck - incorporating several simple elements of machines like lever, fulcrum and wheels.

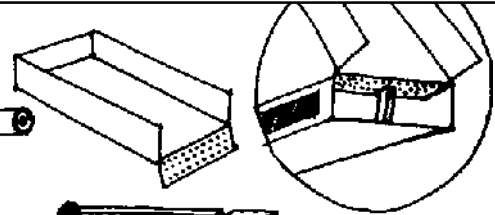
1. You will need two empty matchboxes, an old refill 2 long needles, 4 buttons, one eraser, blade, matchsticks, candle and some rubber adhesive like Fevibond or cycle puncture solution.



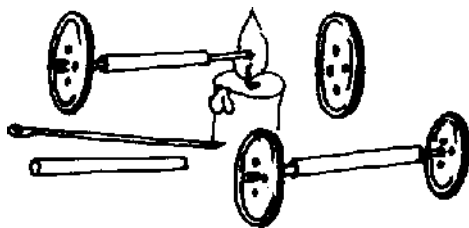
2. Take a matchbox and separate its drawer from the outer shell. Cut the outer shell so that it fits into the drawer. The cut shell becomes the **DRIVER'S CABIN**.



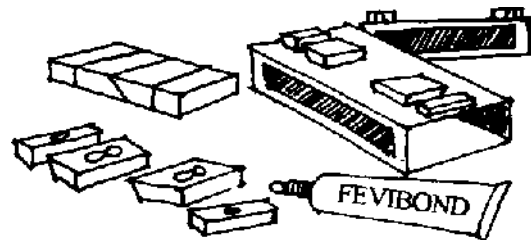
3. Make a hole in the Driver's Cabin. Slip another matchbox shell on the drawer. This will be the **BODY** of the tipper.



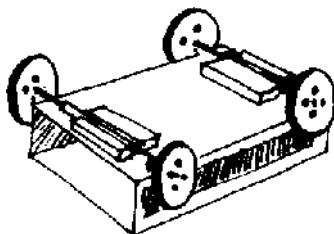
4. Take another drawer. Cut and bend its tongue into the body of the truck. You can either stick this tongue inside this body, or else you can wedge it with a piece of matchstick. This swivelling drawer makes the **LOADING PLATFORM** of the dumper truck.



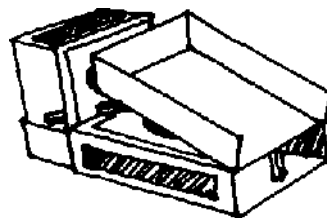
5. Make two pairs of **WHEELS** using cheap quality show-buttons, 2-cm long pieces of ball pen refills as bearings and long needles as axles. You need buttons, which melt with a hot needle.



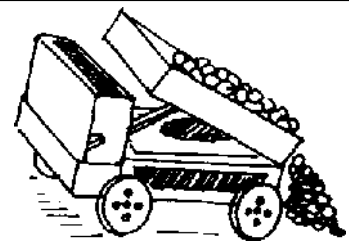
6. Cut a rubber eraser into 4 pieces. Stick these pieces in two pairs below the body. The distance between each pair should be equal to the thickness of a ball pen refill.



7. Insert the two pair of wheels between the rubber pieces.



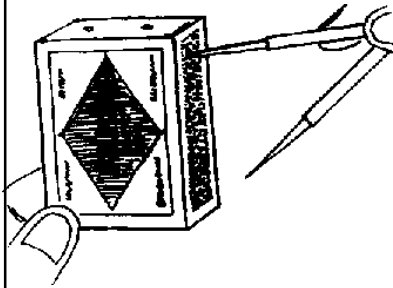
8. Insert a matchstick from the hole in the driver's cabin. The matchstick lever will act like a lever.



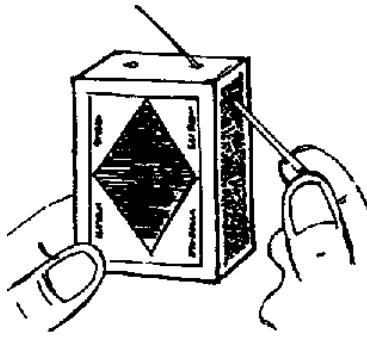
9. Load some pebbles as cargo in the truck. On pressing the matchstick lever from inside the driver's cabin, the loading platform will be raised to unload the cargo. The tipper truck will run very smoothly on being pushed.

## MATCHBOX RIDER

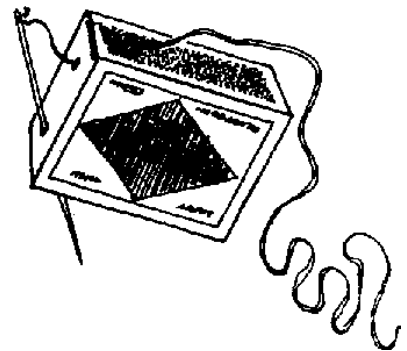
All it takes to make this matchbox train is an old cardboard matchbox and some thread.  
As you move your hand the toy matchbox moves on the thread rail track.



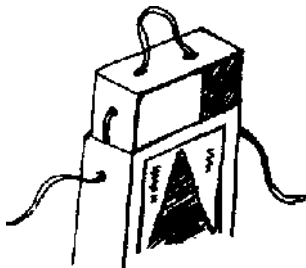
1. Make four holes on the matchbox- two on the drawer and two on the strike surfaces.



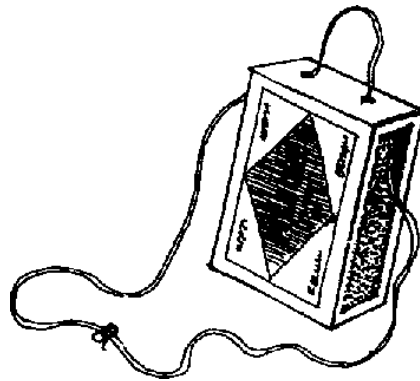
2. Take a needle with a 1.5-meter long string. Poke the needle from the strike surface hole into the drawer hole.



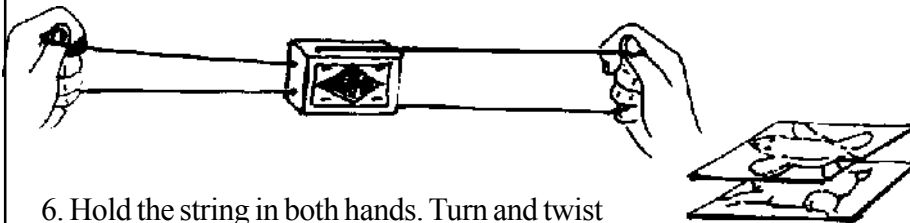
3. Thread the needle through the other holes too.



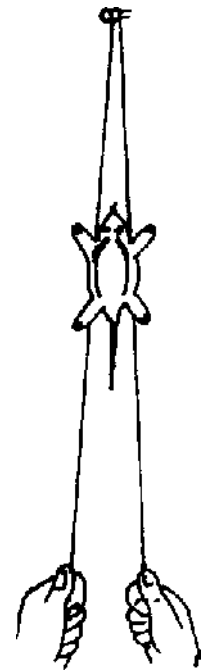
4. This is the threaded matchbox.



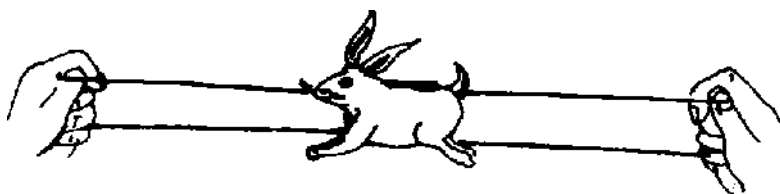
5. Now tie the two ends of the thread to complete the mechanism.



6. Hold the string in both hands. Turn and twist the left hand. The matchbox will travel on the string track towards your left hand.



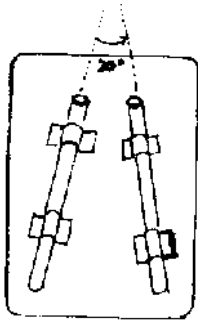
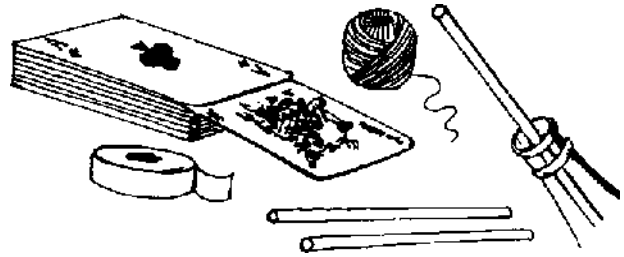
8. Hang the left string loop of the mechanism by a nail and stick a cut out of a lizard on it. On pulling the left and right strings alternately, the lizard will slowly climb up. This toy is based on friction.



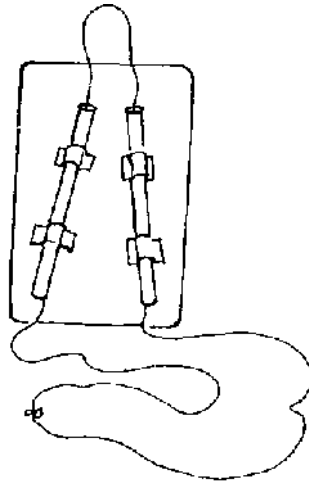
7. You can stick the picture of a rabbit on the matchbox and enjoy the rabbit hop at your fingertips. The mechanism moves only in one direction and you will have to bring it back once it reaches the left-hand end.

## CLIMBING JOKER

1. To make this Climbing Joker you need a joker from an old pack of playing cards or a stiff greeting card. You also need a stiff soda straw (Frooti straws are ideal) or an old plastic ball pen refill. You will also need sticky tape, two metres of thin and strong string and a pair of scissors.



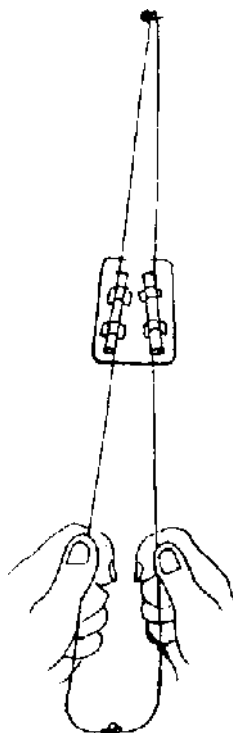
2. Remove the joker from an old pack of playing cards or else, cut a stiff greeting card the size of a playing card. Cut two pieces of stiff soda straw, or old refills each 6-cm long. Stick these soda-straw pieces at an angle of about 20 degrees, on the back-side of the joker card.



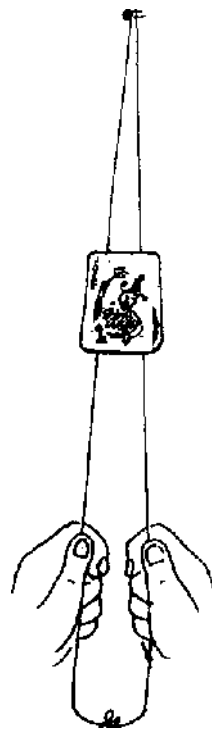
3. Thread a 2-metre long string through the straws. Tie both the ends of the string into a knot.



4. This is the complete model of the Climbing Joker.



5. Hang the string by a nail and hold both ends of the string taut. Pull each end of the string alternately and the joker will climb the string. Once the joker reaches the top, release the tension in the string and the joker will slide down. This toy is based on the principle of friction and gravity.



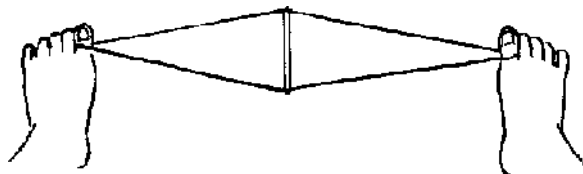
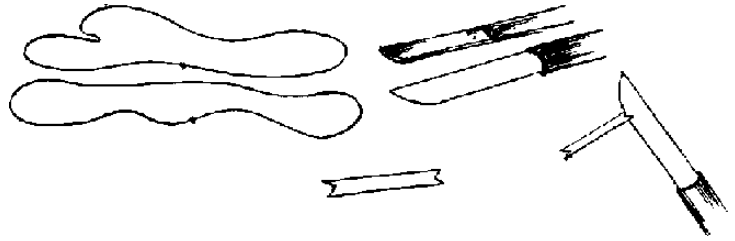
6. Before the joker begins to climb, the string should have a minimum of tension. Try to increase and decrease the angle between the straws and see the changes in the tension required to get the joker climbing. There is one good thing about the string-straw mechanism. Unlike the Matchbox Climber the Climbing Joker does not have to be brought back to its initial position. The Joker simply slides down as soon as the tension in the string is released.



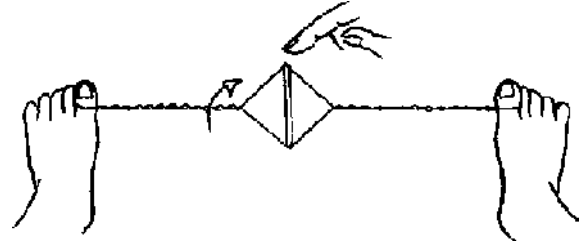
## SIMPLE SPINDLE

This is one of the most creative Indian toys.  
All it requires is a bit of string and an old ice-cream stick.

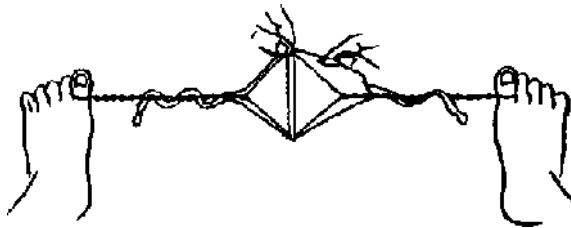
1. Take two strings each 80-cm long. Tie knots in their ends to make them into loops. Take a piece of ice-cream stick about 6-cm long. With a knife or a blade cut 'V' notches on both its ends. The notches are to hold the threads in place.



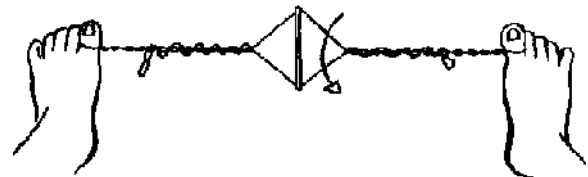
2. Take one loop of thread. Hold the two ends of the loop between the thumbs of your feet. Insert the stick. The thread will be in tension while the stick will be in compression.



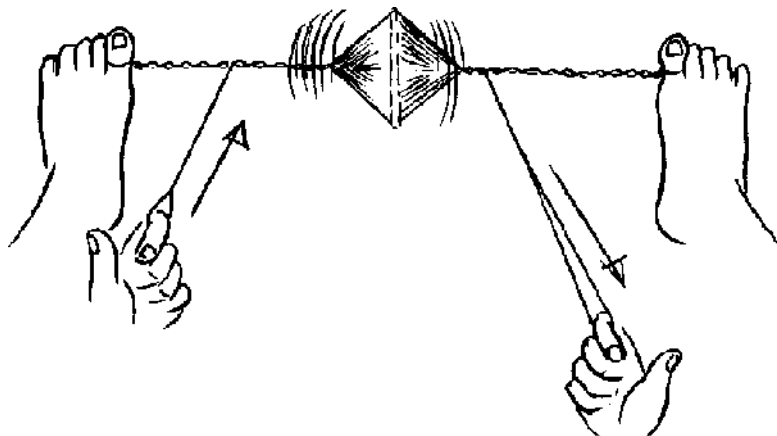
3. As in a spring toy wind the stick. The thread will wind too, and there will be twists in the thread. Hold the stick otherwise the thread will unwind in the reverse direction.



4. Now, hold on to the stick and place the other loop. Each thread of this loop will go into one 'V' notch.

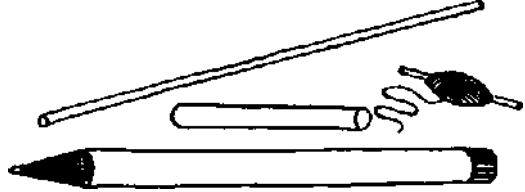
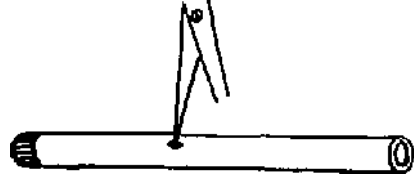
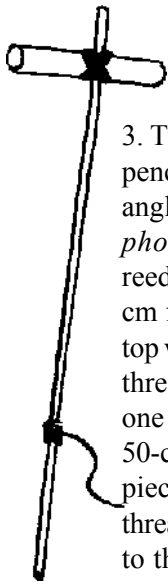
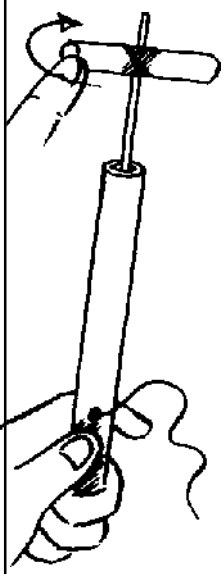
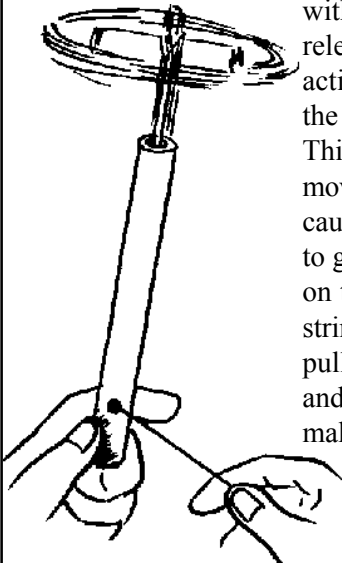


5. Make the stick unwind a little. Do this slowly, in such a way that some of the twists of the first loop get transferred to the second loop. The ends of the second loop must remain free.

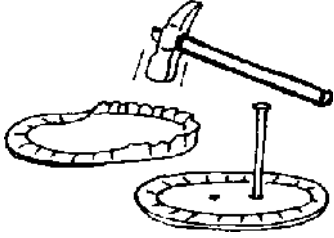
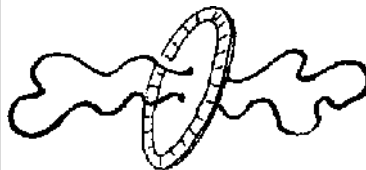
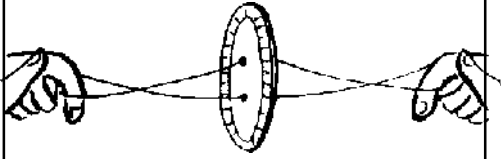
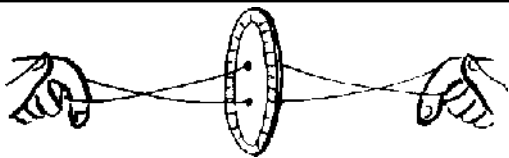
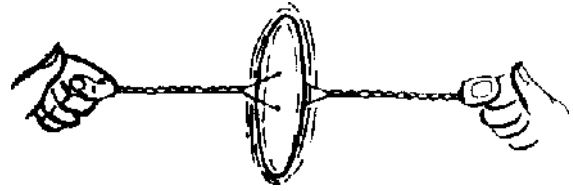


6. Now hold the two free ends of the second loop and pull them gently. Watch the stick rotate. It will remind of the old lathe machine in operation. The pulling of the second loop and then its gentle release results in a rhythmic motion. The Simple Spindle is like a solid of revolution. When the two thread triangles rotate they make cones. You can make pretty patterns in the thread triangles. When in motion they look amazing. You can also change these patterns at will.

## ROTATING FAN

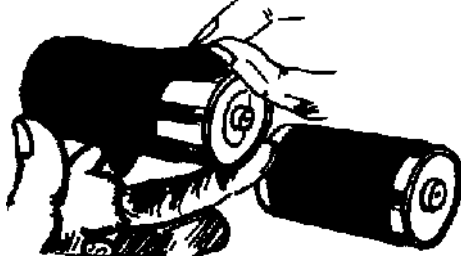
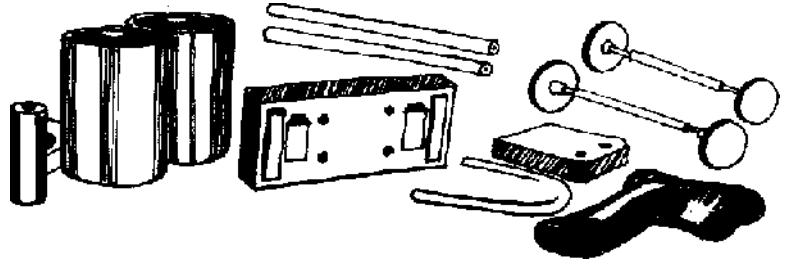
 <p>1. You need the body of a dried up sketch pen, a thin reed from an old <i>phool jhadu</i> or an empty ball pen refill, a 5-cm long pencil, some thread and ordinary tools.</p>	 <p>2. Take the outer body of the sketch pen and cut off its tapered end. With the help of a scissors make a 6-mm hole in the middle.</p>	
 <p>3. Tie a small pencil at right angles to the <i>phool jhadu</i> reed about 1 cm from the top with thread. Tie one end of a 50-cm long piece of thread tightly to the reed.</p>	 <p>4. Place the <i>phooljhadu</i> reed in the sketch pen body. Remove the other end of the <i>phooljhadu</i> thread from the hole of the sketch pen. Turn the pencil round and round so that the thread is wound on the reed.</p>	 <p>5. Pull the string with a jerk and release it. This action will cause the reed to rotate. This rotary movement will cause the string to get rewound on the reed. The string should be pulled with a jerk and re-leased to make it rotate.</p>

## SPINNING SODA-CAP

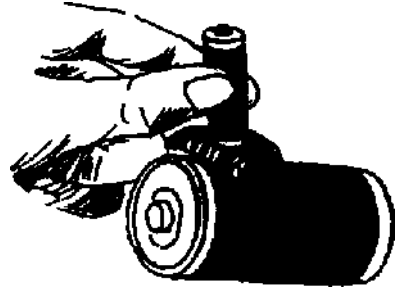
 <p>1. Hammer a soda bottle metal cap to make it flat. Hammer two holes with a nail in this disc. The hole should be at the same distance from the centre.</p>	 <p>2. Take 1-metre of string. Weave the string through the two holes of the disc and tie the ends into a knot.</p>	 <p>3. To wind the toy first hold the two loop ends of the string in your fingers and give it a few twists.</p>
 <p>4. Once there are several twists on either side of the disc, quickly pull the string by moving both your hands apart. Bring your hands close again to release the tension in the string. The toy will get rewound in this process.</p>	 <p>5. Bringing the hands close and taking them apart will keep the disc in motion. A bit of practice will make you a skilled player of this toy. You can also make this toy with a big button or a cardboard disc.</p>	

## BATTERY ENGINE

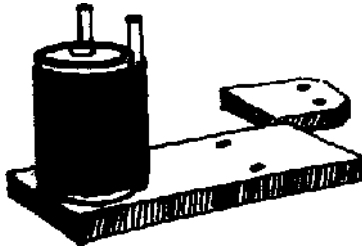
1. Collect two torch batteries and a pencil cell. An old cycle tube, old rubber slipper, wooden reeds from a broom (*phool jhadu*), cheap quality plastic show buttons, needles, old ball pen refills, rubber adhesive, simple home tools is all you will need to make this lovely coal engine.



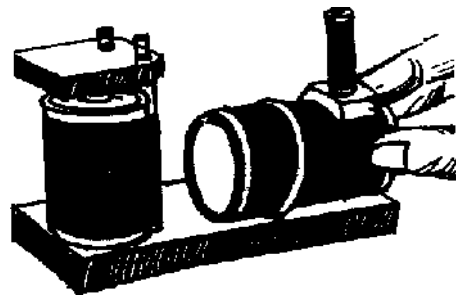
2. Cut two pieces from an old cycle tube and slide them on the batteries. One battery becomes the boiler of the coal engine and the pencil cell becomes the smokestack or the chimney.



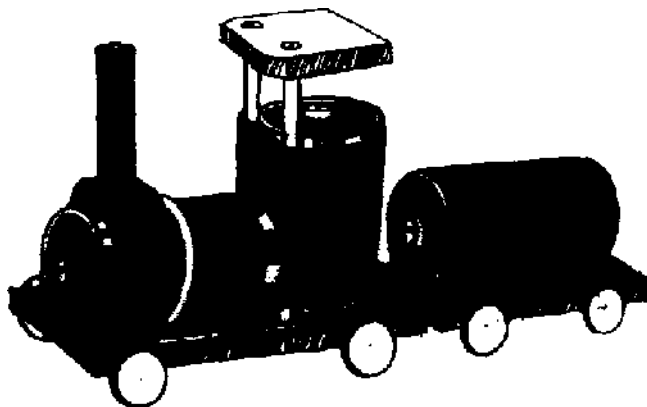
3. Cut a 2.5-cm square from an old *hawai* slipper. Make a hole in this piece so as to fit the pencil cell. Stick this rubber piece on top of the cycle tube of one battery using cycle puncture solution.



4. Cut a 5cms x 12-cm piece of shoe sole rubber for the base of the engine. Insert two *phool jhadu* sticks in between the battery and the tube. Make two more holes in the engine base to fix these sticks.

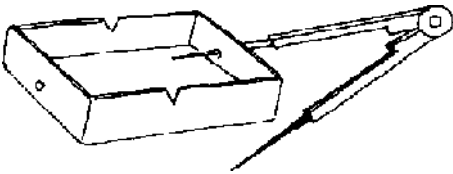

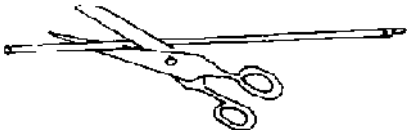
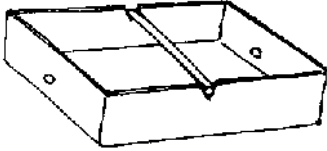
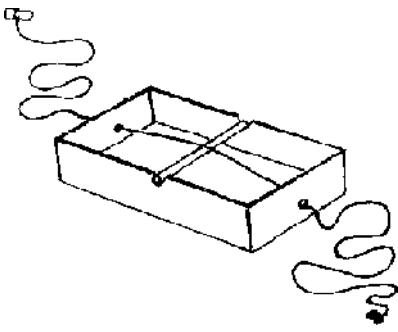
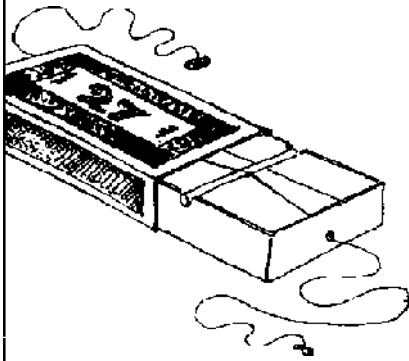


5. Make two holes in the engine rubber base and tie the boiler and the chimney assembly to it. Also fix a rubber canopy on top of the driver's cabin.


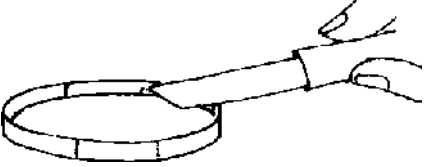

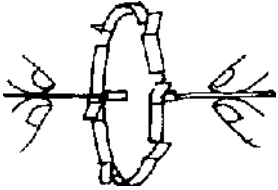
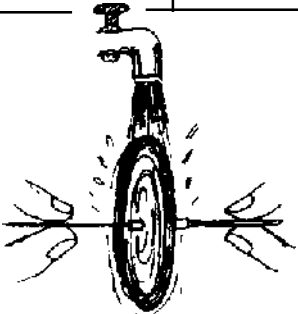


6. Make two pairs of wheels using cheap quality plastic show- buttons. Heat the tip of a long sewing needle and fix it in the centre of one button. Then slip in a 3-cm long piece of used plastic refill in the needle. Now heat the other end of the needle and fix it in the centre of the second button. Stick two pairs of rubber pieces on the bottom of the engine base. The refill bush/bearings of the wheels will snap and lock into them. The tanker wagon can be made using a single torch battery. Assemble the engine and the tanker into a train.

## GO - NO GO MATCHBOX

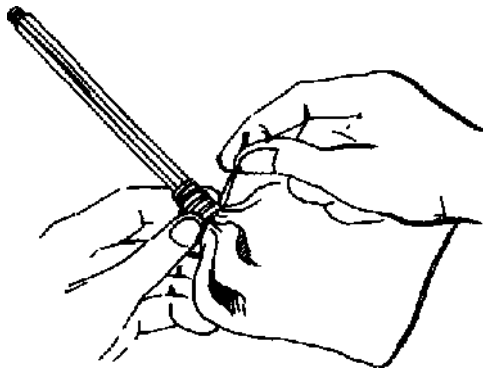
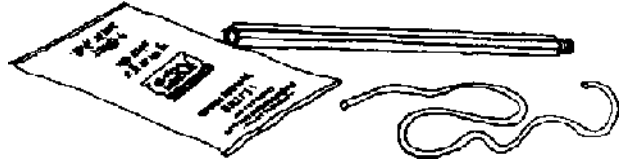
	<p>1. Take a cardboard matchbox drawer and cut two V notches in the middle of its two long edges. Make a clear hole in the centre of both ends of the drawer.</p>	 <p>6. Hold the two ends of the string up-right. If the string is kept loose then the match-box slides down. But if you tighten the string it rubs against the refill and brakes the matchbox to a stop. This obedient match-box is based on the principle of friction and gravity.</p>
 <p>2. Cut an old ball pen refill equal in size to the width of the drawer.</p>	 <p>3. Fix the refill in the V notches of the drawer with a dab of glue.</p>	
 <p>4. Weave a 70-cm. long string through the two holes of the drawer. The thread should go over the refill. Tie two pieces of folded paper at the two ends for a good grip</p>	 <p>5. Cover the drawer with the outer shell of the matchbox.</p>	

## TURNING TURBINE

 <p>1 Take the plastic lid of a <i>Paan Masala</i> tin.</p>	 <p>2. Mark out six equally spaced lines on its rim. Cut these lines and about 1-cm of the rim.</p>	 <p>3. Offset the cut portions to make the blades of the turbine. Make a hole in the centre of the lid and press fit a 2-cm long piece of used ball pen refill in it.</p>
 <p>4. Put a long needle inside the refill bush to complete the turbine.</p>	 <p>5. Hold the turbine under a stream of water and see it spin.</p>	

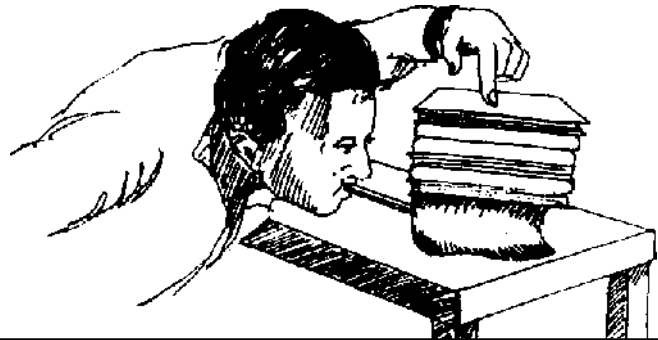
## AIR JACK

1. To make an air jack you will require empty plastic milk bags, a piece of thick string or cycle valve tube and an old pen body.

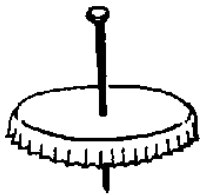


2. Tie an old pen body or a pipe to the mouth of the bag with a string.

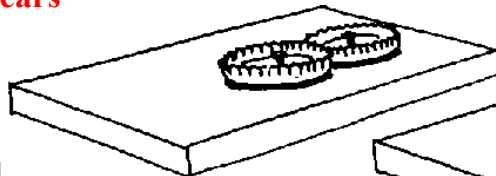
3. Place 5 or 6 thick books on the plastic bag and slowly blow air into it with your mouth. As the bag gets inflated the books get raised. How does the air jack work? The pressure that you exert with your mouth is limited. But the large area of the milk bag magnifies this pressure and enables you to lift the heavy books.



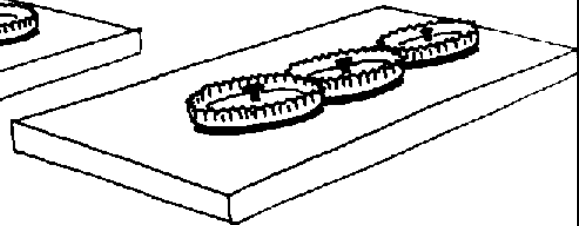
## Soda Water Cap Gears



1. Collect a few soda water bottle caps. Hammer a nail in their centre to make a small hole.

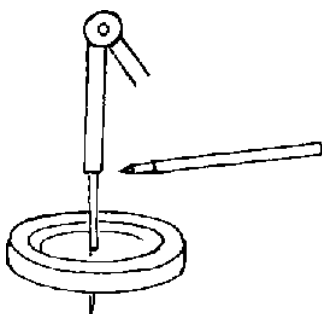


2. Place two caps on a wooden plank and mesh their teeth. Put a nail through their holes so that the caps can rotate freely. Rotate one cap and see the direction of rotation of the other cap.

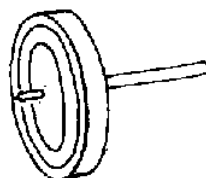


3. Now fix a third cap in mesh with one cap. Observe the direction of rotation of the three caps.

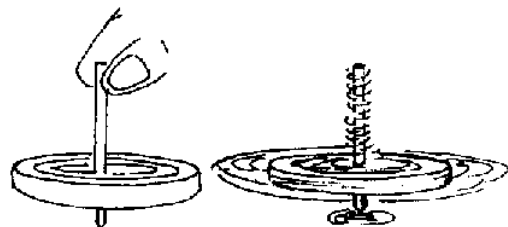
## Cap Top



1. Take a plastic cap of a white film reel bottle. Make a hole in its centre with a divider.

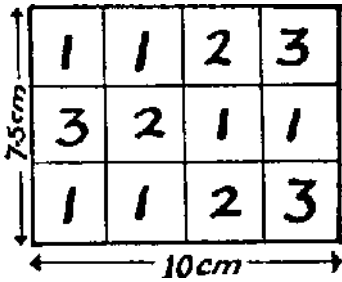


2. Tightly fit the metal part of a 5-cm long refill in this hole (refills with long brass tips are best).

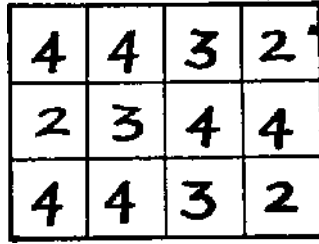


3. Now hold the plastic refill and spin this almost perfect top. This toy has got all the attributes of a great top - a low centre of gravity and a large moment of inertia.

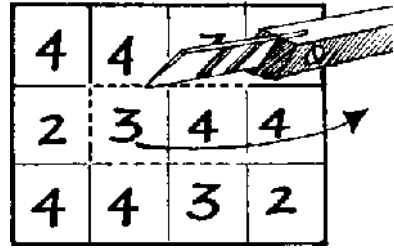
## MAGICAL NUMBERS



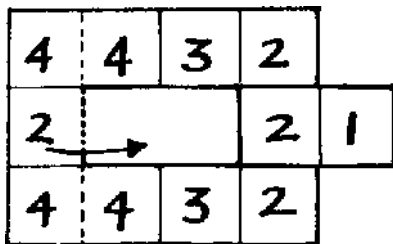
1. Make twelve 2.5-cm squares in a 7.5-cm x 10-cm sheet of bond paper. Mark each square with a number as shown. Turn the paper keeping it the same way up.



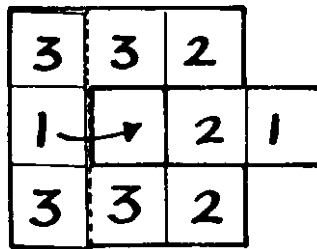
2. Divide the reverse side similarly into 12 squares and write the numbers as shown.



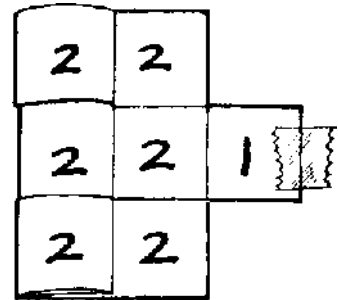
3. Now cut neatly along the dotted line to make a rectangular flap. Fold this to the right.



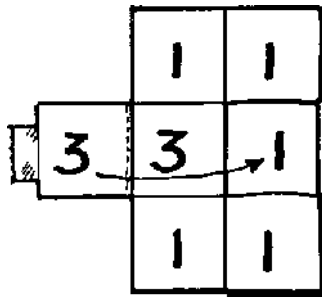
4. Fold the left edge of the paper to the centre once and then...



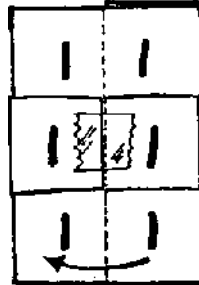
5.... fold it once again.



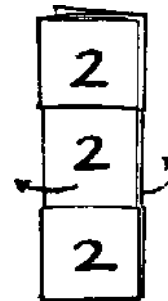
6. Stick a piece of sticky tape to the end of the projecting flap. Then turn over...



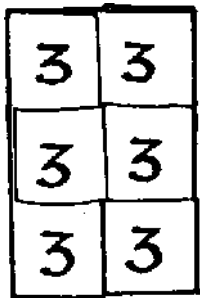
7... and fold the flap to the right fixing it firmly to the square behind the window.



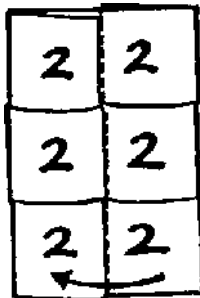
8. This completes the model. You will see that the front surface has six squares each marked with 'ones'. Fold it in half from right to left.



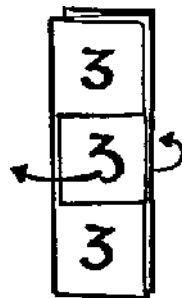
9. Separate the two layers at the right.



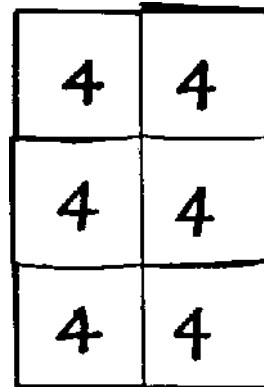
10. You will be surprised to see that the new surface is marked all with 'threes'. Turn the model over.



11. You will find that this surface is marked with 'twos'.



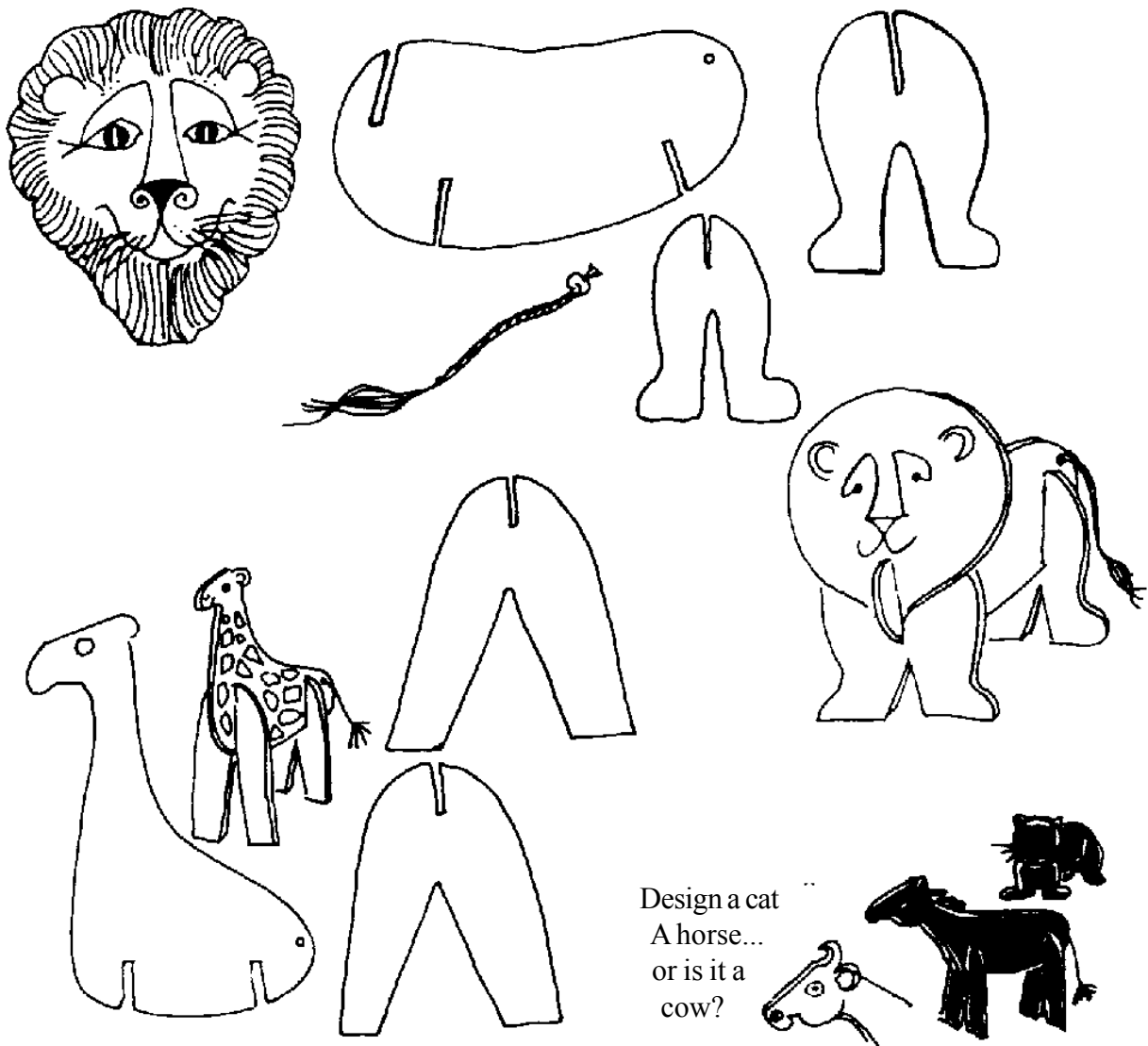
12. Separate the layers at the right again...



13. ...and now you will have a complete set of 'fours'. Instead of numbers you could cut 7.5-cm x 5-cm pictures into squares of 2.5-cm and stick them too.

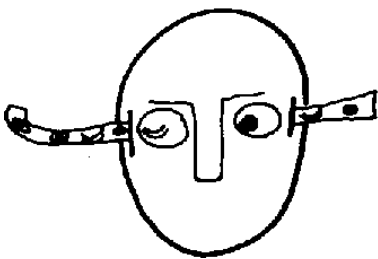
## SLOTTED ANIMALS

These slotted animals can be made out of the cardboard cover of exercise books. You do not require any glue or staples. These animals are collapsible and can be flattened when not in use. The body parts of the animals are interchangeable.

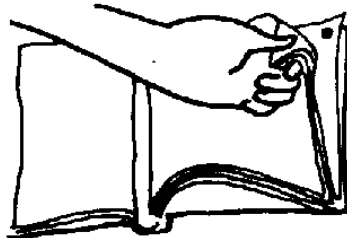


(From *Making Things* by Ann Sayre Wiseman)

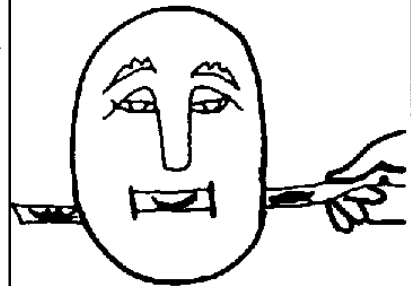
## ANIMATED MOTION



1. You can pull a filmstrip of eyeballs through a mask and animate a still face.




2. You can draw a red dot on every page of this book and you can see the dot dance by snapping the corners.

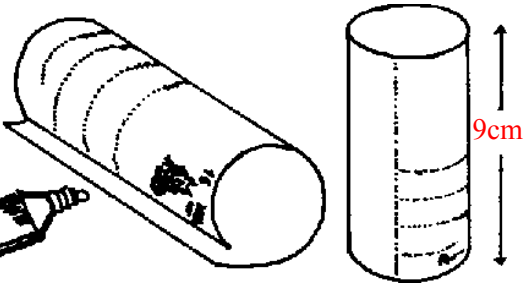


3. You can open and close a conversation and smile and frown.

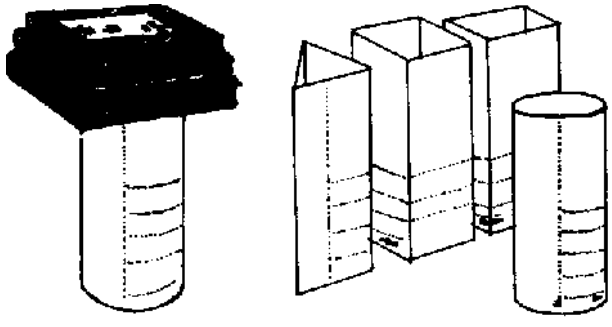
## POSTCARD STRUCTURES



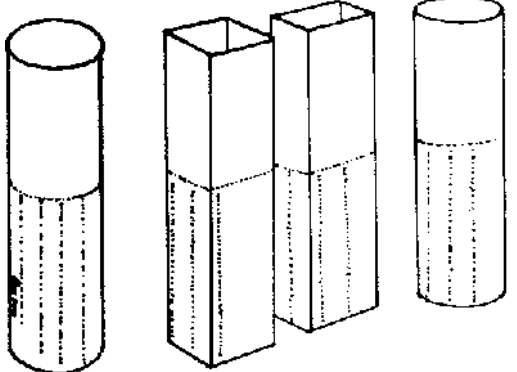
1. Everything has a structure. The human body, buildings, bridges all have a skeletal frame which bears the load. Using old postcards we will explore a few structures. All postcards are 14-cms. long and 9-cms wide.



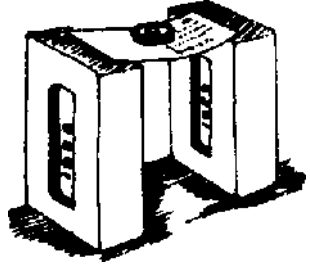
2. Roll a postcard into a cylinder and glue its edge to make a 9-cm tall cylinder. It does not look very strong. How many loads can it support? Make a guess?



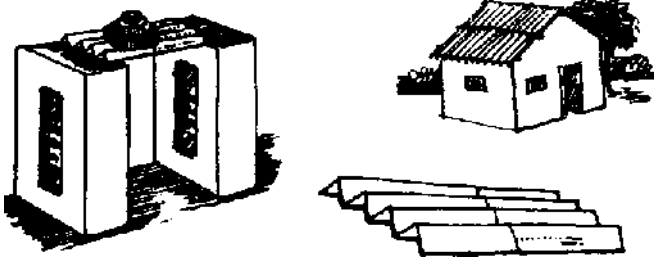
3. Slowly place books on the cylinder so that they do not tip off. Keep piling books until the cylinder gets crushed. The 9-cm tall postcard cylinder will be able to support almost 4- kgs of books. Are you surprised? Make square, triangular and oval cylinders. Which cylinder can bear more load?



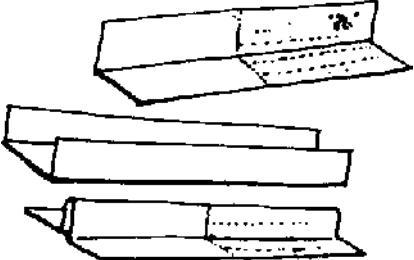
4. Now fold postcards in various cross-sections to make 14-cm high columns. Which cylinder can bear the most load? Why? Have you wondered why tree trunks are circular and not triangular or square? For a fixed perimeter the circle encloses the maximum area.



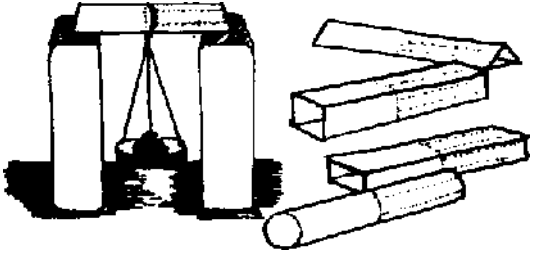
5. Stand two bricks 12-cm apart. Place a postcard on top so that 1-cm. of the card sits on each brick. Place a 50-paise coin (5gms) on the card. The postcard sags. When the load is 40-gm the postcard caves and falls down.



6. Fold zigzag, fan shaped pleats in the postcard. It can almost support 1-Kg. Are you surprised? It is no more a material, but has become a structure. The shape of the material gives it strength. Corrugated tin roof sheets are an example of increased strength.



7. Crease postcards to make a right-angle section, a U channel and a T beam. Do different sections bear different loads?

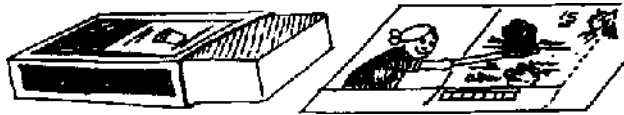


8. Place the 14-cm long column as beams between two bricks. Hang a shoe tin pan and place weights in it. Which cross-section of beam supports the maximum load?

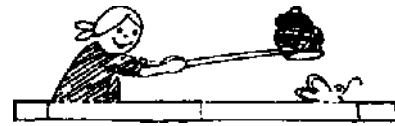


## SOME INTERESTING TOYS

### Catch a Butterfly



1. To make this dynamic toy you will need an old postcard, empty matchbox, scissors, pencil and glue. First draw the picture of the girl and the butterfly on a postcard and then cut it.



2. Fold the picture along the dotted lines.

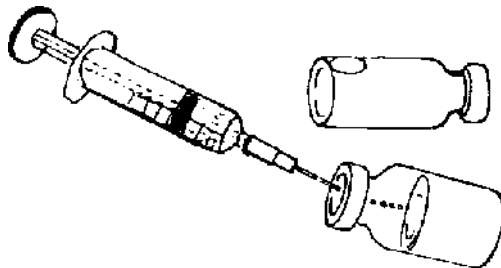


3. Stick one end of the postcard strip to the matchbox base and the other end to the match-box drawer. In this position the girl's hand will be in an upward position and the net will be far removed from the butterfly.

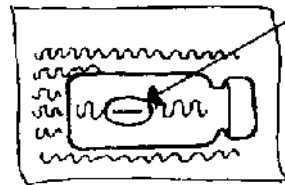


4. On pulling the matchbox drawer outwards, the girl catches the butterfly in the net.

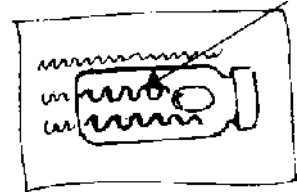
### Bubble bottle lens



REDUCED

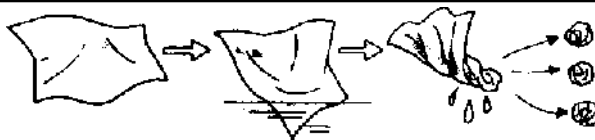


ENLARGED

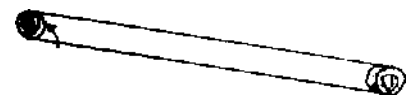


Take a 2 ml used injection bottle. Do not remove its aluminium cover. With a clean plastic syringe inject some water into the bottle. Suck the contents with the syringe. This way the bottle will be flushed. Now inject clean water in the bottle until only one air bubble remains. Roll this bottle on a newspaper. If you look through the bubble then you will see the newsprint size reduced. The bottle - a bi-convex lens, however, enlarges the size of the newsprint.

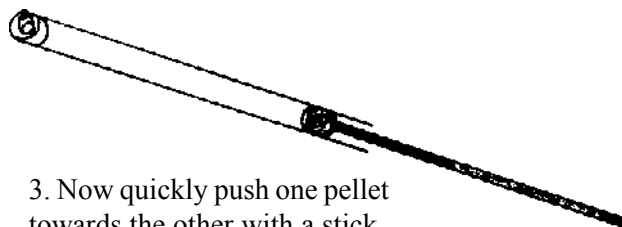
### Pop gun



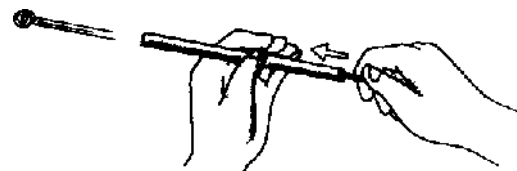
1. Dip a piece of newspaper in water. Tear out a piece of this soggy newspaper and make little round balls or pellets out of it. These pellets must tightly fit the bore of a thin bamboo or plastic pipe.



2. Take a 1-cm bore, 30-cm long plastic pipe or bamboo and tightly push a paper pellet on each end.

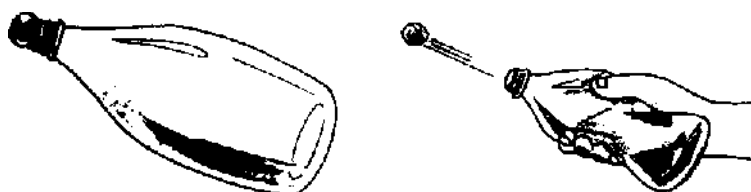


3. Now quickly push one pellet towards the other with a stick.



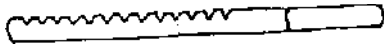
4. You will be surprised to see the end pellet come out with a loud bang. When you push the pellet in, the air between the two pellets gets compressed and pushes the first pellet to come out with a bang.

### Pop bottle



Take a mineral water plastic bottle and tightly fit a soggy newspaper pellet in its mouth. On pressing the bottle the pellet will come out with a loud POP!

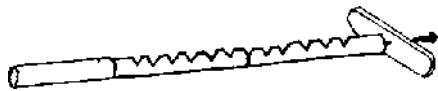
### Magic Windmill



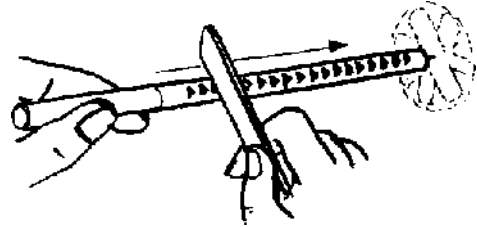
1. Take a pencil with an eraser on one end, or else take a 25-cm long fat reed from an old *Phool Jharu*. Cut 8-10 notches on it. The notches should be 1-cm apart.



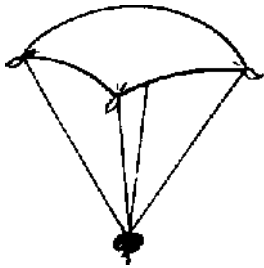
2. Cut a 1-cm x 4-cm propeller from a thick greeting card. Make a hole in the centre of this fan. Make the hole loose so that the fan can rotate freely on a pin or a thin nail.



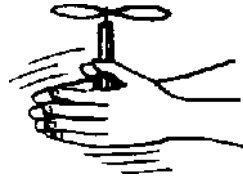
3. Put a pin or thin nail through the fan hole and fix it in the eraser of the pencil or at the end of the notched stick.



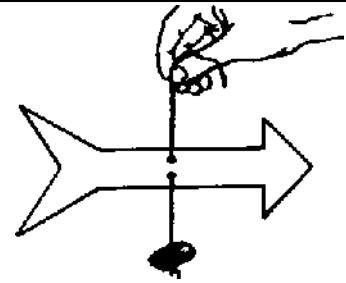
4. Hold the notched stick with one hand and stroke an ice-cream stick or a ball pen refill on the notches, back and forth. This sets up vibrations in the stick / pencil and the fan rotates.



Make a small parachute from thin plastic or cloth. Roll up the parachute and throw it into the air. Increased drag caused by its wide surface slows down the rate of fall.



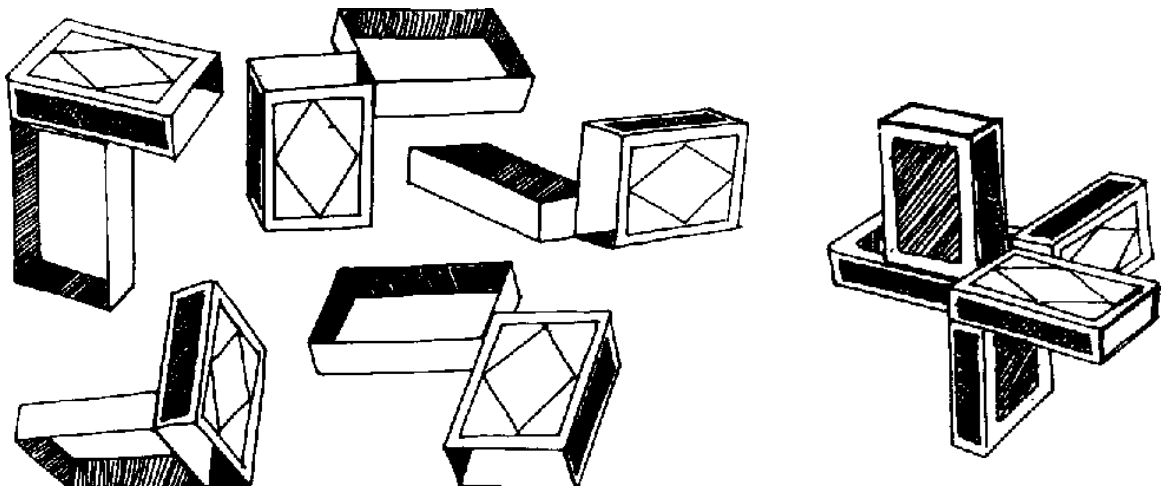
Make a toy helicopter by gluing a small round stick to a propeller made by twisting a card sheet. Twirl the stick in your hands and make it rise into the air.



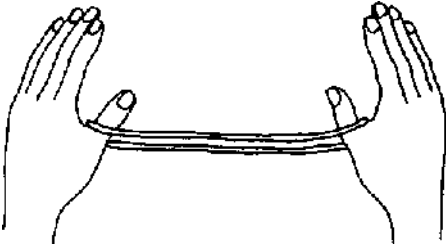
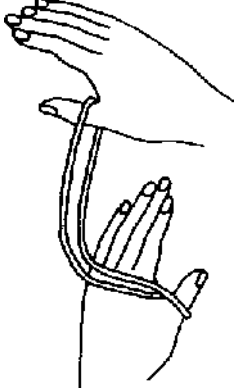

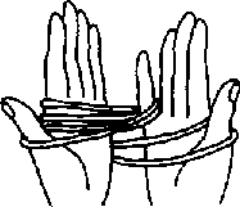
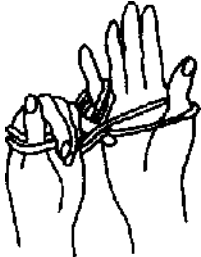
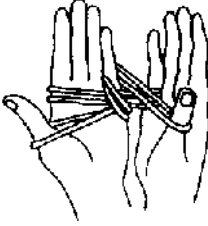
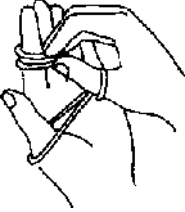
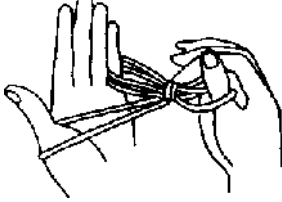
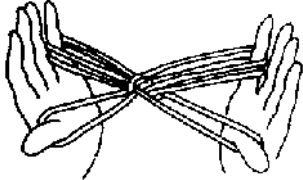

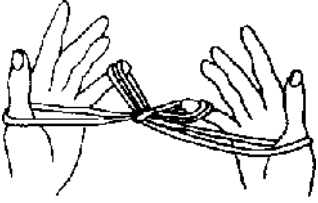
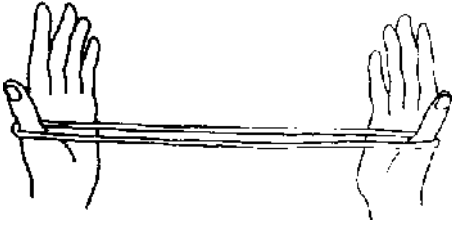
Make a simple weather vane out of a cardboard and string. Place it in the wind. The larger drag of the tail forces it back and makes the arrow point into the wind.

### Matchbox Maze

This unusual puzzle designed by a scientist named Van Deventer, has five inside drawers of the matchboxes stuck to their outer cases in different positions. The ideal matchbox size for the puzzle should be such that its three dimensions are in the ratio of 1:2:3. However, the ordinary Ship brand matchboxes available in our country will serve our purpose reasonably. Glue the five drawers to their respective cases. Now you have to figure out how the drawer of one case slides into the shell of the other. If you are on the right track then the entire assembly will simply fall into place with no need to push or pull. One such assembly is shown. There are two other ways. Can you figure them out?

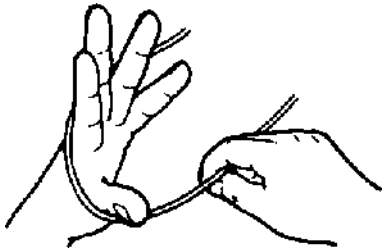


## MOSQUITO OR FLY

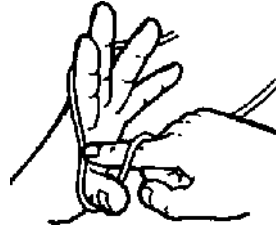
 <p>1. Take a 1.5 metre long loop of string. Loop it around the two thumbs.</p>	 <p>2. Wrap both the strings around the back of the left hand.</p>	 <p>3. Hook the little finger of the right hand under the two strands between left thumb and index finger.</p>
 <p>4. Pull right little finger (with strings) back as far as it will go. Keep strings tight. Move them as far down on the fingers and thumb as possible.</p>	 <p>5. Bring left little finger toward right palm and from the top, curl it under the two strands running from right thumb across the palm.</p>	 <p>6. Move the left little finger, with string, back into position, so the hands are side by side, and the palms are facing you.</p>
 <p>7. With the right thumb and index finger, pick up the two strands of string running from the left palm to the back of the left hand.</p>	 <p>8. Move both hands back and forth until the knot in the middle tightens and the figure looks like a big mosquito or a fly.</p>	 <p>9. Make buzzing sound of a mosquito and move it around.</p>
 <p>10. Clap your hands together to kill the mosquito.</p>	 <p>11. Take your hands apart, point little fingers downwards, releasing the strings from the little fingers quickly.</p>	 <p>12. Pull your thumbs apart. The mosquito will disappear.</p>

## A STRING STORY

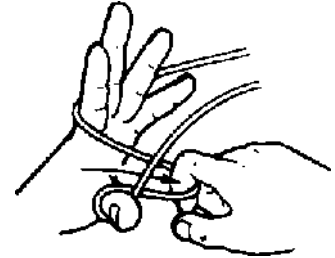
This story is known throughout the world. The Indian version is as follows: A farmer first ploughs the field, then he sows the seeds, next he waters the crop, finally he applies manure. The crop is now ready to be harvested. Then a fat rat comes and eats up the entire crop. Take a 2-metre long thick string (*Sutli* - jute twine would do). Make a long loop by tying its two ends.



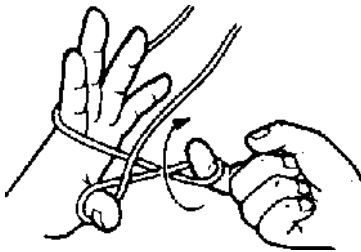
1. Place the loop of string over your left hand (farmer selects the field).



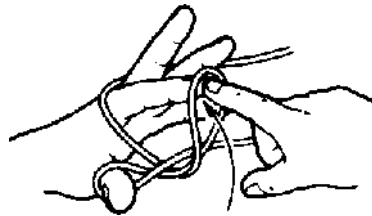
2. Put your right index finger under the front string and hook the string that is between the left thumb and index finger.



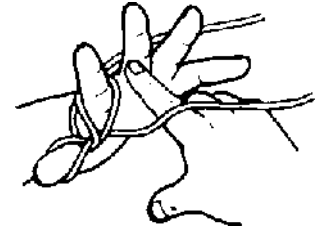
3. Pull it back a little under the front string.



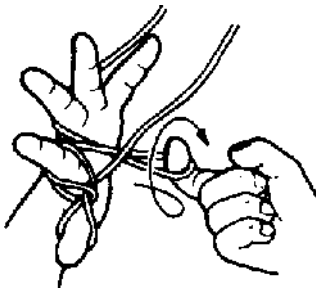
4. Give it half a turn clockwise, making a small loop.



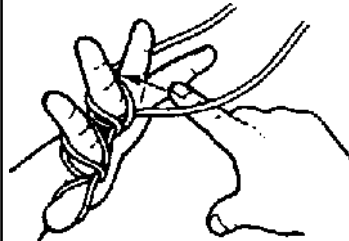
5. Place this small loop over your left index finger (farmer ploughs the field).



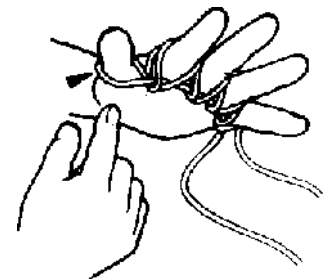
6. With your right index finger again hook the string between the left index and middle finger.



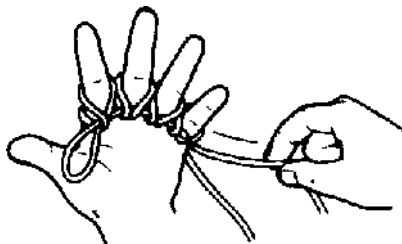
7. Pull it under the front string. Give it half a clockwise turn to make another loop and place it in the middle finger (farmer sows the seeds).



8. Again hook the string, make a loop and put it in the next left-hand finger (farmer waters the crop). Put another loop in the little finger (farmer applies manure).



9. This should be the finished result (the crop is all ready). Release the left thumb loop (a fat rat comes, the loop is the rat).



10. Pull the front string away from your left hand.



11. The loops will unwind from all the fingers (the fat rat eats up the entire crop). That is the end of the story.

## THE WEB OF LIFE

Nearly 150 years ago, Chief Seattle, a wise and widely respected native Red Indian Chief delivered this compelling message to the government in Washington, which wanted to buy his people's land. This is perhaps the most eloquent statement ever made on the environment.

How can you buy the sky? Chief Seattle began.  
How can you own the rain and the wind?

My mother told me,  
Every part of this earth is sacred to our people.  
Every pine needle. Every sandy shore.  
Every mist in the dark woods.  
Every meadow and humming insect.  
All are holy in the memory of our people.

My father said to me,  
I know the sap that courses through the trees  
as I know the blood that flows in my veins.

We are part of the earth and it is part of us.  
The perfumed flowers are our sisters.

The bear, the deer, the great eagle, these are our brothers.  
The rocky crests, the meadows,  
the ponies - all belong to the same family.

The voice of my ancestors said to me?  
The shining water that moves in the streams and rivers is  
not simply water, but the blood of your grandfather's  
grandfather.  
Each ghostly reflection in the clear waters of the lakes tell  
of memories in the life of our people.

The water's murmur is the voice of your great -  
great grandmother.  
The rivers are our brothers. They quench our thirst.  
They carry our canoes and feed our children.  
You must give to the rivers the kindness you would give  
to any brother.

The voice of my grandfather said to me,  
The air is precious. It shares its spirit with all  
the life it supports. The wind that gives me my first  
breath also receives my last sigh.  
You must keep the land and air apart and sacred,  
as a place where one can go to taste the wind that  
is sweetened by the meadow flowers.



When the last Red Man and Woman have vanished with their wilderness,  
and their memory is only the shadow of a cloud moving across  
the prairie, will the shores and forest still be there?  
Will there be any of the spirit of my people left?  
My ancestors said to me, This we know:  
The earth does not belong to us.  
We belong to the earth.

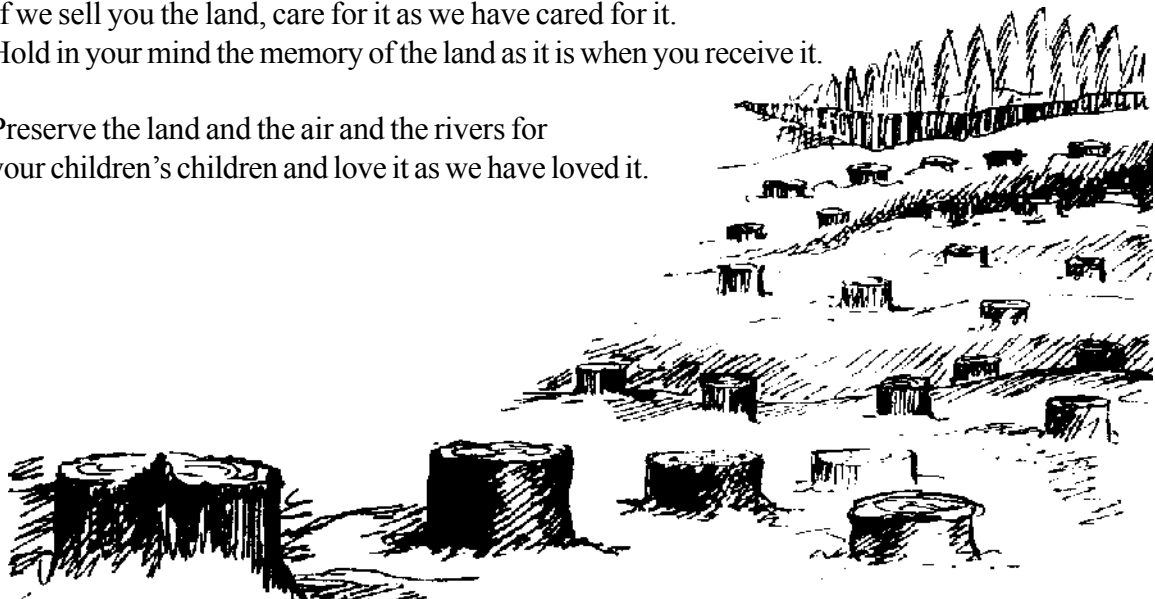
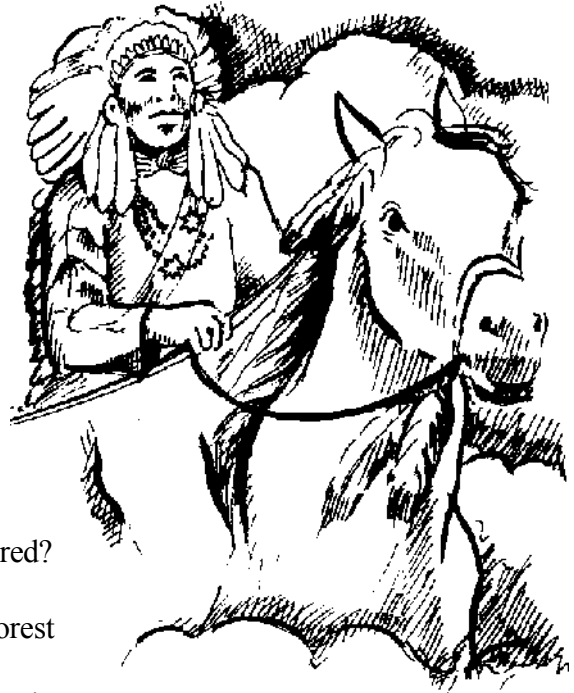
The voice of my grandmother said to me,  
Teach your children what you have been taught.  
The earth is our mother.  
What befalls the earth befalls all the sons  
and daughters of the earth.

Hear my voice and the voice of my ancestors,  
Chief Seattle said.  
The destiny of your people is a mystery to us.  
What will happen when the buffalo are all slaughtered?  
The wild horses tamed?  
What will happen when the secret corners of the forest  
are heavy with the scent of many men?  
When the view of the ripe hills is blotted by talking wires?  
Where will the thicket be? Gone.  
Where will the eagle be? Gone!  
And what will happen when we say good - bye to the swift pony and the hunt?  
It will be the end of living and the beginning of survival.

This we all know: All things are connected like the blood that unites us.  
We did not weave the web of life,  
We are merely a strand in it.  
Whatever we do to the web, we do to ourselves.

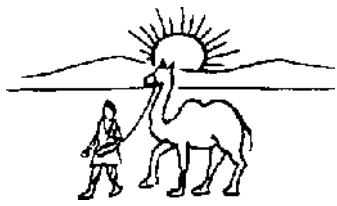
We love this earth as a new-born loves its mother's heartbeat.  
If we sell you the land, care for it as we have cared for it.  
Hold in your mind the memory of the land as it is when you receive it.

Preserve the land and the air and the rivers for  
your children's children and love it as we have loved it.

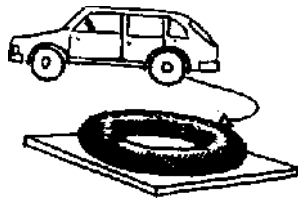


## SIMPLEST SOLAR COOKER

This solar cooker has been designed by Suresh Vaidyarajan - an architect, who has found a simple solution for a tough problem. For the last one year he has been cooking his food in this solar cooker. This is the simplest solar cooker that I have ever seen.



1. There is a tremendous shortage of wood, kerosene and fuel for cooking. But can we not use the tremendous heat of the sun to cook food?



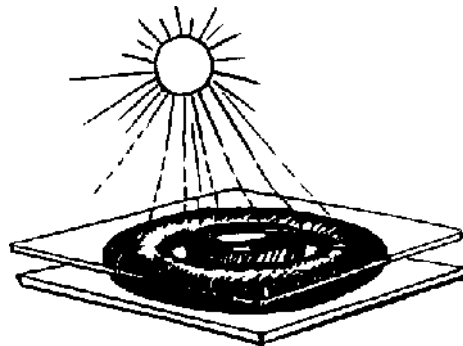
2. Take an old car tube. If the tube is punctured get it patched. Inflate the tube and keep it on a wooden board.



3. Take an aluminium-cooking vessel with a lid. Paint it black from the outside. Put all the ingredients for cooking *Khichdi* - rice, daal, salt, water etc. in the cooking pot.



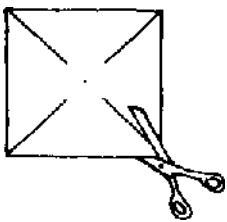
4. Place the cooking vessel inside the tube. Cover the tube with a piece of plain glass. Within three hours the *Khichdi* will get cooked.



5. What happens ? The space in the well of the tube is like a closed cavity. Air can neither go out nor come in. The rays of the sun enter the glass and get trapped. Slowly, the temperature of the cooking vessel rises and the *Khichdi* gets cooked.

### SOLAR PINWHEEL

This simple device uses the sun's energy to rotate a pinwheel.



1. Fold a square paper to make a windmill. Cut along the diagonals as shown.



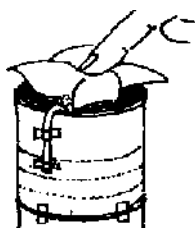
2. Glue the corners to the centre. Make a dent (not a hole) with a pencil at the centre of the windmill



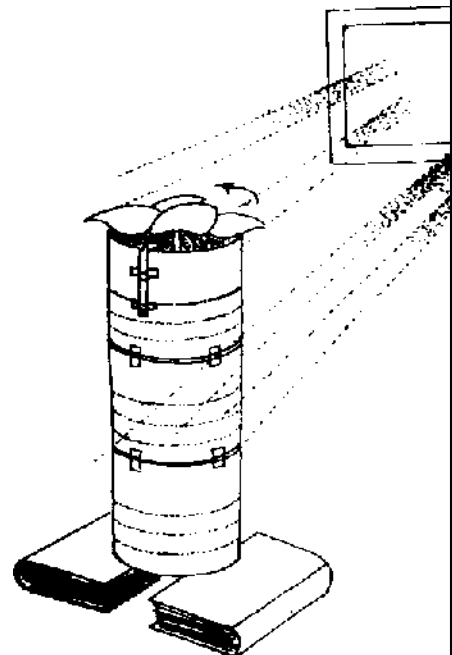
3. Bend a piece of thin wire as shown.



4. Cut the bottom out of three old tin cans. Paint the outside of the cans black. Join the three cans together with some tape to make a tall metal cylinder.



5. Tape the wire on the top of the can and balance the windmill on its tip.



6. Stand the cans on two books on a sunny windowsill. Watch what happens as the sun warms the cans. The hot air inside the can rises up, sucking cold air from below. This continuous convectional current keeps the pinwheel rotating.

## A TOUCHING SLATE

This slate can help blind children in recognising shapes. But it is great fun for normal children too. Dr. Dilip Bhatt designed it for his blind son. Dr. Bhatt works for the Indian Space Research Center (ISRO) in Ahmedabad. As you write on this slate, wool comes out of a pen and sticks to the Velcro on the slate.

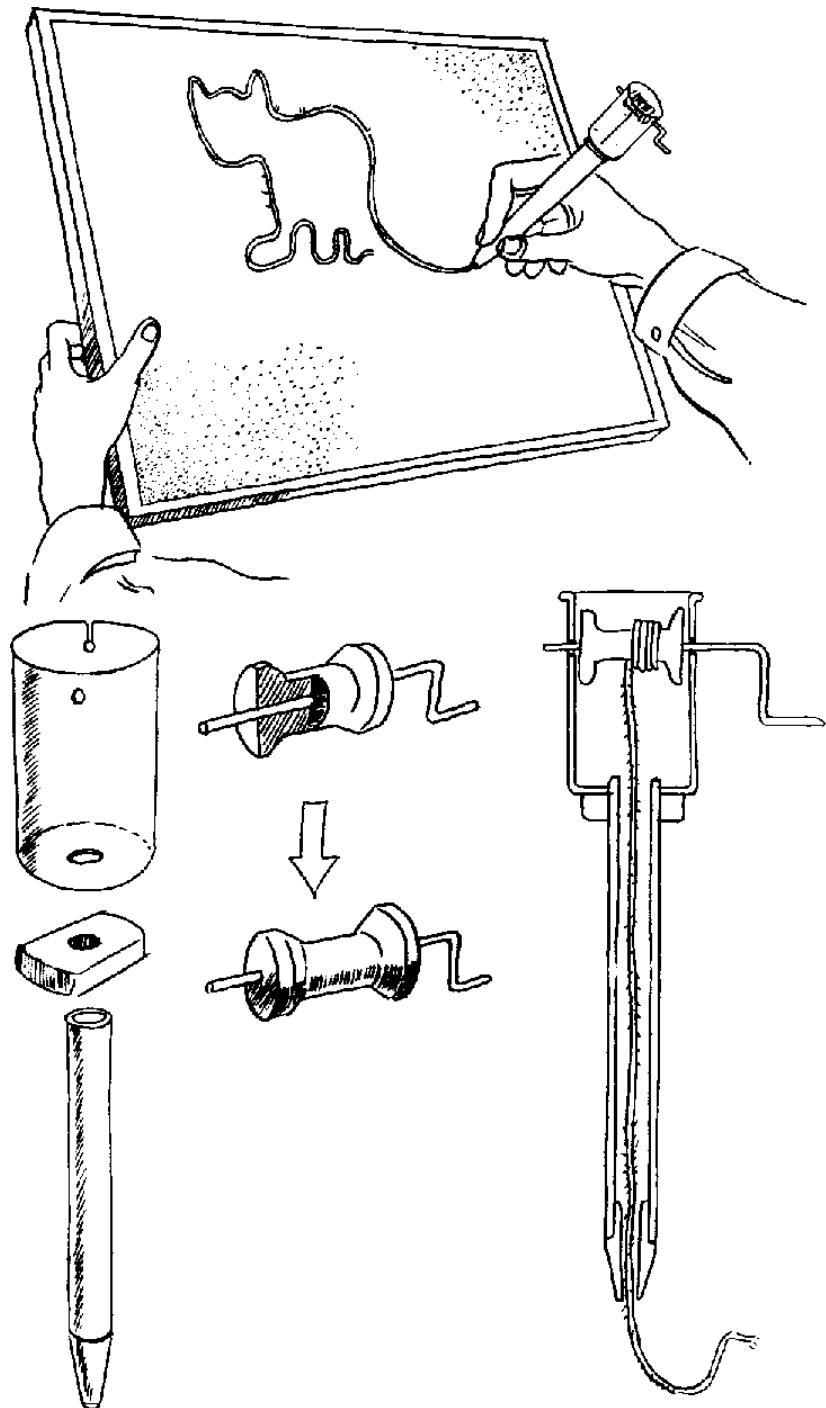
### The Slate

The actual writing is done on the Velcro, which is supported underneath by plywood. Stick Velcro strips on a rectangular piece of plywood to make this slate. Velcro comes as a strip. It has got thousands of minute nylon hooks on its surface. The fibres of the wool stick to these hooks.

### The Pen

The special pen is made from a film roll bottle and the outer plastic casing of an ordinary ball pen. A hole is made in the base of the bottle. The pen is fixed in this hole with a piece of shoe rubber and some Fevibond (rubber adhesive). A small wire (cycle spoke piece) is bent into a 'Z' shape to make the crank. A small pulley - made from a piece of shoe rubber is attached to the crank. Two holes are made near the mouth of the bottle to fix the crank. One hole is slit for easy fixing and removal of the crank from the bottle.

Take 1.5 meters of thin wool. Tie one of its ends to the pulley and then wrap it around the pulley. Weave the other end of the wool through the bottle and the pen body. Tie a thick knot at the writing end of the wool. Now place the crank with the wool in the bottle. Hold the pen and start drawing a cat on the slate. The wool will come out of the pen and stick to the Velcro. To erase the picture simply rotates the handle. The wool will get wrapped around the pulley and the picture will disappear.



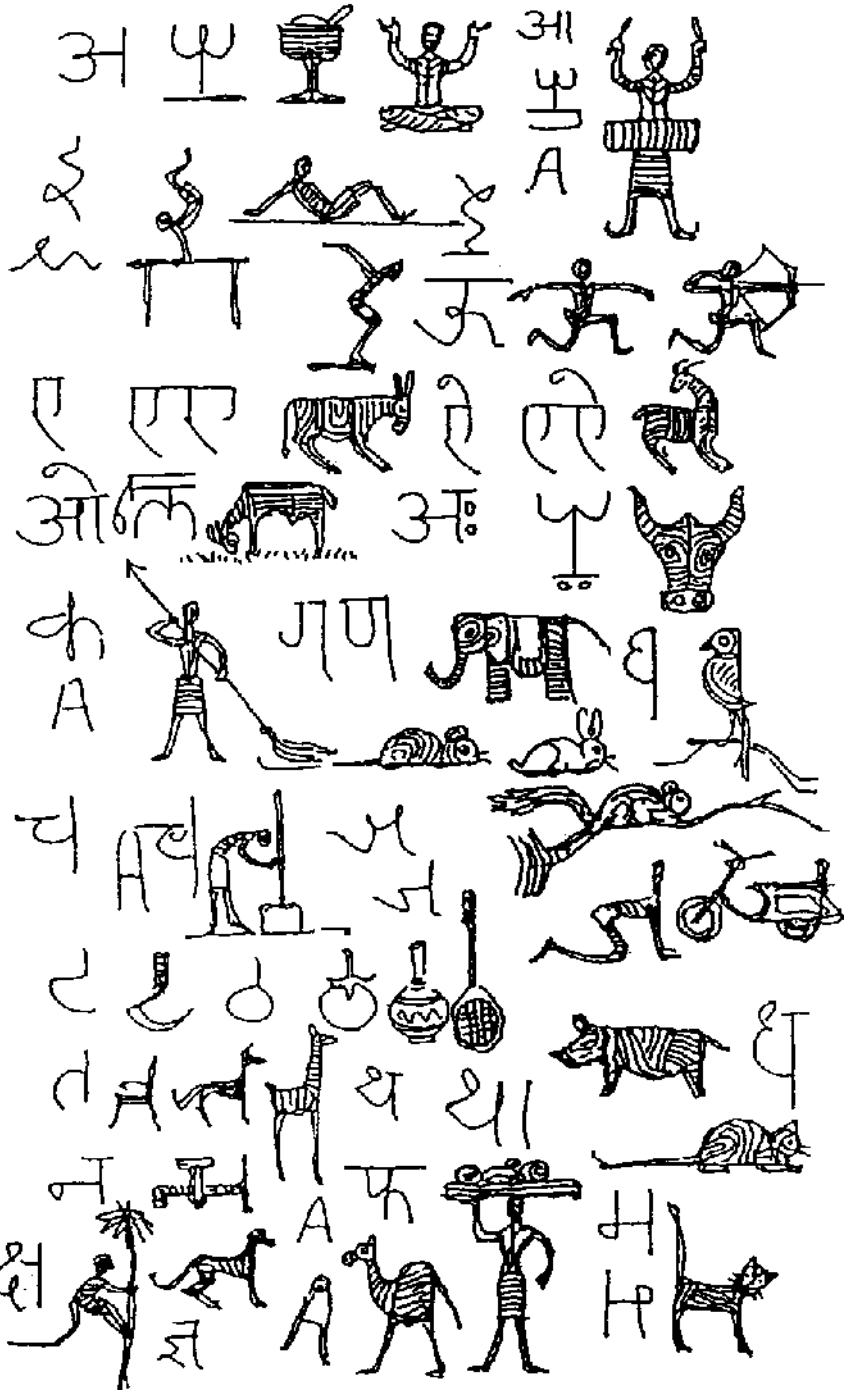
(Illustration by Henrik Johansson)



## ACROBATIC ALPHABETS

If something is done in the spirit of play, it is much more fun. If things are learnt by rote, without understanding, then they soon become boring. The letters of the alphabet are a good example. Children have to write down their A, B, C's again and again, to learn them well. The shapes of these alphabets are very abstract. But after repeated efforts all children learn them. But if children see some real life shapes in these letters, then learning them will become great fun - it will no more be a chore. It will also put a spark to their imagination.

All these Alphabet Pictures have been created by Vishnu Chinchalkar. Guruji - as he is popularly known has worked for over 60 years with children. Guruji has shown a few possibilities using Hindi and English letters. There are numerous animals, objects and people hidden inside them. If children will turn the letters and view them from different angles, they will see new shapes and objects in them. Soon these lifeless letters will become their dear friends.



३ ३ ३ ३ ३

३ ३ ३ ३ ३



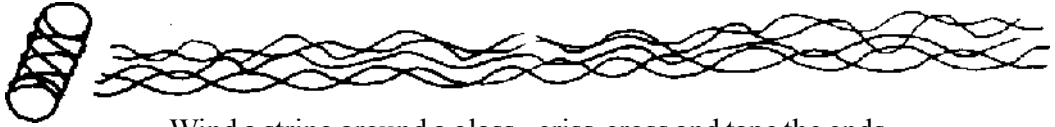
ACROBATIC ALPHABETS



## ROLLER PRINTING

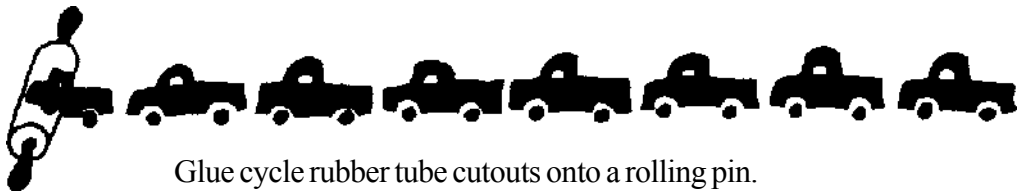
Any symbol, or icon, when repeated becomes a pattern. Several interesting patterns can be made using rollers. The roller itself can be any simple cylindrical object - a glass, a pencil, a rolling pin (*belan*) or a wooden thread spool. Roller printing can be done with any cylinder that has been inked or painted or pressed on a wet stamp pad and rolled out on paper.

**Drinking  
Glass or  
Jar**



Wind a string around a glass - criss-cross and tape the ends.

**Rolling  
Pin**



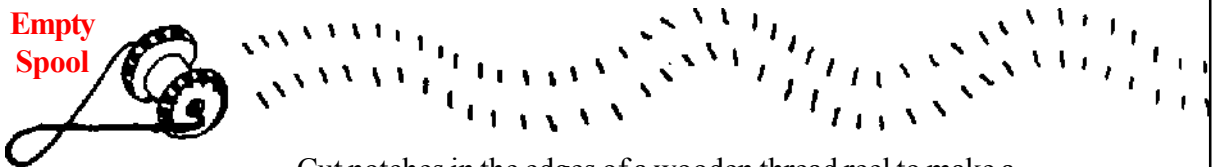
Glue cycle rubber tube cutouts onto a rolling pin.

**Roller**



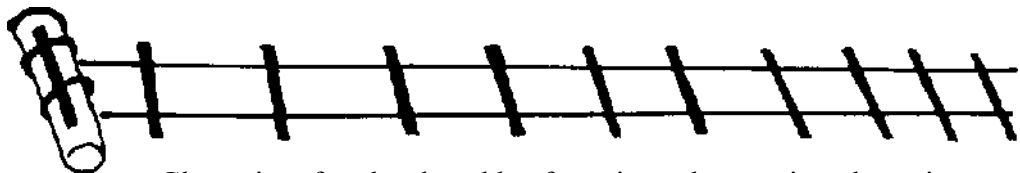
Stick cycle rubber tube cutouts on an old tin. Punch holes on its ends and put a handle for the roller.

**Empty  
Spool**



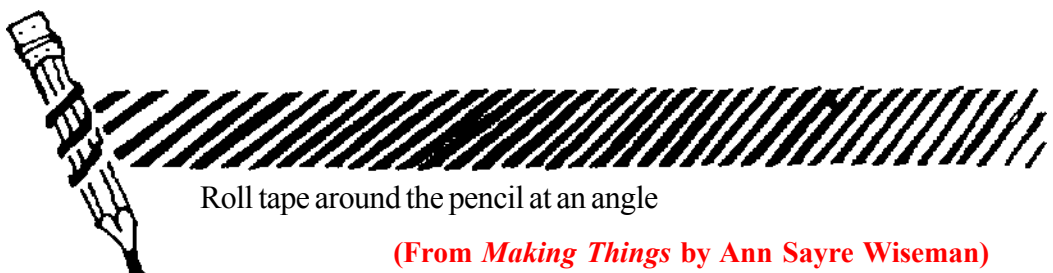
Cut notches in the edges of a wooden thread reel to make a continuous road for cars to go on.

**Broom  
Stick  
Handle**



Glue strips of cycle tube rubber for train track cross ties, glue string for the rail track.

**Pencil  
or Pen**

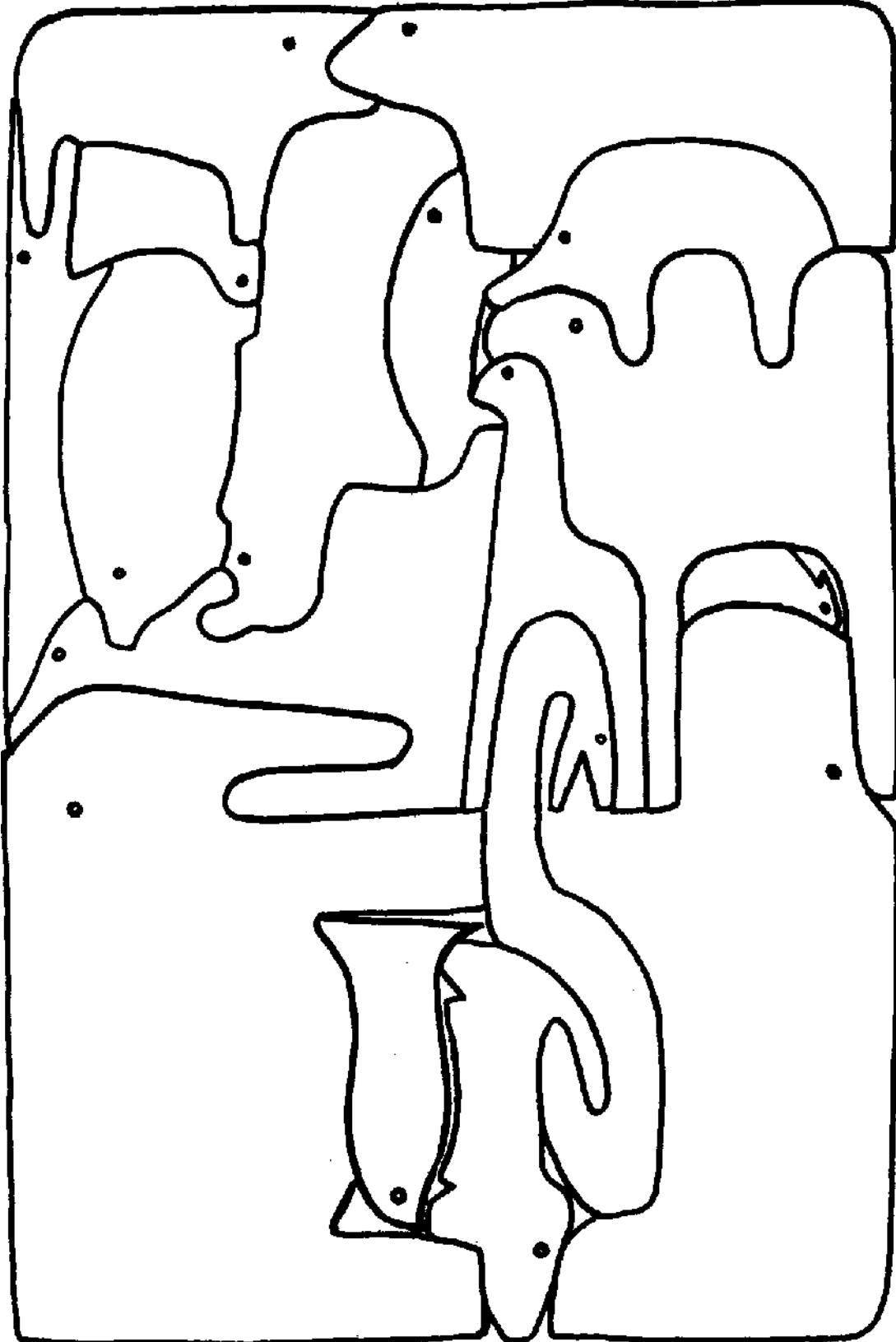


Roll tape around the pencil at an angle

(From *Making Things* by Ann Sayre Wiseman)

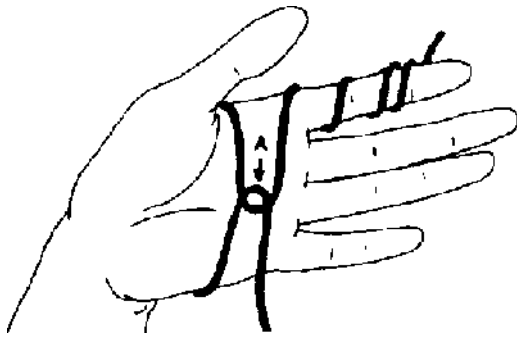
## ANIMAL KINGDOM JIG-SAW

This is a very creative jigsaw puzzle. Trace this rectangular pattern on a piece of shoe sole rubber sheet, plywood or cardboard, and cut it neatly using a fret-saw or a cutter. You will have 17 different animals, which will collectively make a lovely zoo. Now try arranging the animal's back into a rectangle.



## SOME AMUSING EXPERIMENTS

### How to break a strong string?



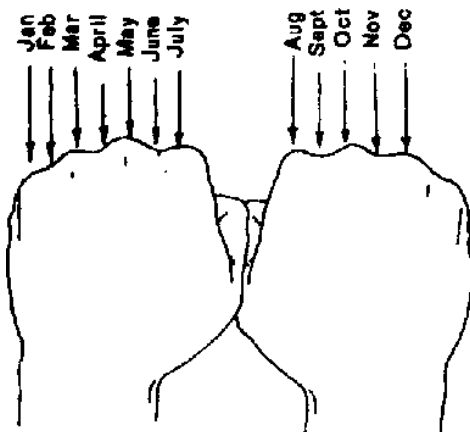
Tie one end of the string to your left forefinger, and then put it around the hand as shown. Now take the string half a metre lower with your right hand and turn it 4 or 5 times round the right hand. Close your hands into fists. Now quickly move your right fist down and your left fist up. The string will break at point A.

### Can you tie a knot?



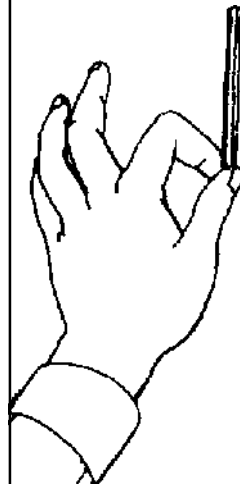
Put a piece of rope on the table. Ask a friend to take one end in each hand and tie a knot. Your friend must not let go any of the ends. It seems impossible, but you can do it easily. The trick is to fold your arms first and then pick up the rope as shown in the picture. When you unfold your arms, you will find your knot in the centre of the rope.

### Days in a month



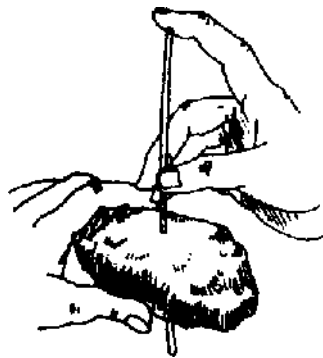
This picture will help you to remember the days in each month. You imagine the names of the months on your knuckles and the places between them (from left to right). All the months, which are on the knuckles, have 31 days; the others have 30 days, except February. February as you know has 28 days, but once every four years, that is in a leap year it has 29 days.

### Illusion with a pencil



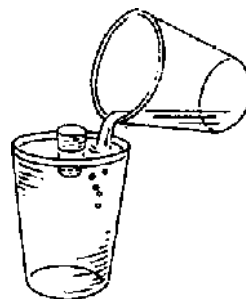
Take a pencil and hold it with your fingers near one end. Then you move your hand up and down no more than 5 centimetres. Hold the pencil easily so that it moves as your hand goes up and down. If you do it the right way, it will seem as if you are holding a rubber pencil which bends all the time.

### Plastic Straw through a potato



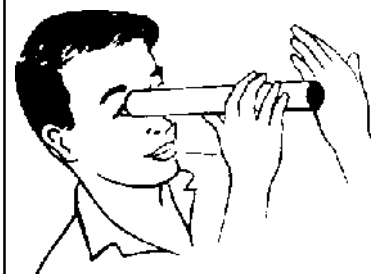
Hold a raw potato and a straw as shown. Your finger must cover the top opening of the straw. Strike the potato quickly with as much force as you can, but be sure that the straw is perpendicular to the potato. After some practice you will be able to put the straw through the potato.

### Put the cork in the Centre



Fill a drinking glass with water and float a small cork in it. Ask your friends to make the cork stay in the centre of the water - it must not touch the sides of the glass. They will find that the cork always moves to the side of the glass. Now you add more water so that it is slightly bulging up. The cork now moves to the centre, where the water is highest.

### Hole in your hand



Roll up a piece of paper to make a long tube. Sight through the tube at an object. Now place your hand as shown. You will see a big clean hole in the middle of your hand!

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