

# HANDS ON- IDEAS AND ACTIVITIES

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## SCIENCE SENSE

Children learn a great deal without being taught. To be able to “speak” is a great life skill. Children learn to “speak” not in the school, but at home. One educationist candidly remarked, “It is nice that children spend just a few hours at school. If they spend all 24 hours in school, they will all turn out dumb!” In most schools - teacher’s talk, children listen. The same is true for other skills too. Children learn a great deal by tinkering and pottering on their own. In their free moments they are always doing and making things.

Learning by experience is profound knowledge. It is more deeply imprinted in memory than words or formulas. Children need enriching experiences with different materials and in diverse situations.

Burettes, pipettes, test tubes – and other fancy laboratory apparatus often threaten children. Science principles are best understood if children can see them in a toy – something they can play with. For children the whole world is a laboratory and life itself is a series of experiments. They have an innate ability to see patterns in “little” things around them. All children love making “action” toys that spin, fly, whistle, jump, and hop.

This book is a collation of some interesting activities - geometry by paper folding, toys, tangrams, pumps, caps, experiments, and simple science models. These activities are interspersed with inspiring stories on education, peace, environment and mathematics. More than one thousand line drawings illustrate the text. This book follows no strict order or hierarchy. It is not meant for any specific age group, nor does it supplement or complement textbooks. This book shows possibilities of doing science with simple things. The ability to improvise experiments with almost zero-cost, holds great promise in this resource-starved country. The message is loud and clear -school kids can do great science with little money and resources. Newspapers make great caps. Origami – paper folding is a wonderful way to learn practical geometry. Film-roll cans, mineral water bottles, rubber slippers, crown caps make lovely action toys. Making patterns out of seeds, stones, leaves, and thumbprints, apart from being fun are deeply creative and satisfying activities.

We buy more than we need and generate enormous amounts of “junk” burdening the earth. To heal the earth we need to reduce, recycle and reuse. Sustainability demands that we do more with less. Often creativity blossoms in conditions of scarcity – when there is a paucity of resources.

In collating this book I have relied heavily on old books – most of them out of print. Some of them are my own inventions but the majority of them are drawn from other sources, which have been acknowledged in the reference at the end. Several of these books like the *VSO Science Teacher’s Handbook*, UNESCO’s *700 Science Experiments for Everyone* and *Helping Health Worker’s Learn* by David Werner have always been in the public domain and have enriched many. Some of the modern books on science experiments, despite their gloss and colour are less interesting, because they all copy experiments from their predecessors!

This collation has stories interspersed with activities. Some of these stories have deeply inspired me, stirred me. I have retold them to share their joys with others. I hope stories like *The Man Who Planted Trees*, *The Generous Tree*, *School of Barbiana*, *The Man Who Loved Numbers*, *Danger School!* *The Bull Who Loved the Smell of Flowers* and Dalai Lama’s words of wisdom will have their magical effect on you. We are a billion people. Still, many old science classics are not available to teacher’s in our country. **Vigyan Prasar** has endeavoured to reprint low-cost editions of these. They have been listed at the end of the book. For the last several years we have struggled hard to translate and make available some of the world’s most inspiring books on education *Divasvapna*, *Tottochan*, *Summerhill*, *Teacher*, *Duishen*, *How Children Fail*, *Letter to a Teacher*, *Bahuroope Gandhi* etc. into Indian languages. Hope someday all the good books in the world will be digitised and will be available to every child - rich or poor, at the click of the mouse. Only then will the dream of “**A Million Books for a Billion People**” come true.

The great pioneers of science did their work with simple equipment. It is possible to follow their footsteps and do scientific thinking without much expensive and elaborate apparatus. After all, the student’s mind is the most precious piece of equipment involved!

## THE HEIGHT OF IT!

Clever students seldom do things the intended way!

The graduate class was asked the following question as part of the final exam paper in Copenhagen University: "How will you find the height of a skyscraper using a barometer?"

One student answered: "I will hang the barometer with a long rope from the top of the building. Once the barometer touches the ground then I will measure the length of the rope. I will add the height of the barometer to the length of the rope to determine the height of the skyscraper."

The examiner felt almost offended after reading this very original solution. He got very angry and failed the student. The aggrieved student appealed to the University and pleaded that his answer was correct and if any proof was required it could be tested. The University was in a fix. It appointed an external, neutral examiner to objectively and dispassionately unravel the truth. After a deep probe the external examiner gave his verdict: "Though the student's answer is correct it does not reflect any deep understand of physics." So it was decided to call the student for a six-minute interview to test his understanding and grasp of the basic principles of physics.

During the interview, the student sat absolutely silent with his head hung low for the first five minutes. When the examiner reminded him of the time limit the student replied, "Sir, I know of several elegant solutions. But I am unable to decide on the most appropriate one!"

On being coaxed by the examiner the boy gave a quick reply:

"Well, you can drop the barometer from the top of the skyscraper.

Measure the period 't' of fall. Then using the equation  $H = 0.5 g \times t \times t$  calculate the height of the building. In this experiment the barometer, of course, will get smashed to pieces.

Or else, if it is a sunny day, then you can first measure the actual height of the barometer and the length of its shadow. Next you measure the length of the shadow cast by the skyscraper. Later, using simple arithmetic and the principle of similar triangles you can find the height of the skyscraper.

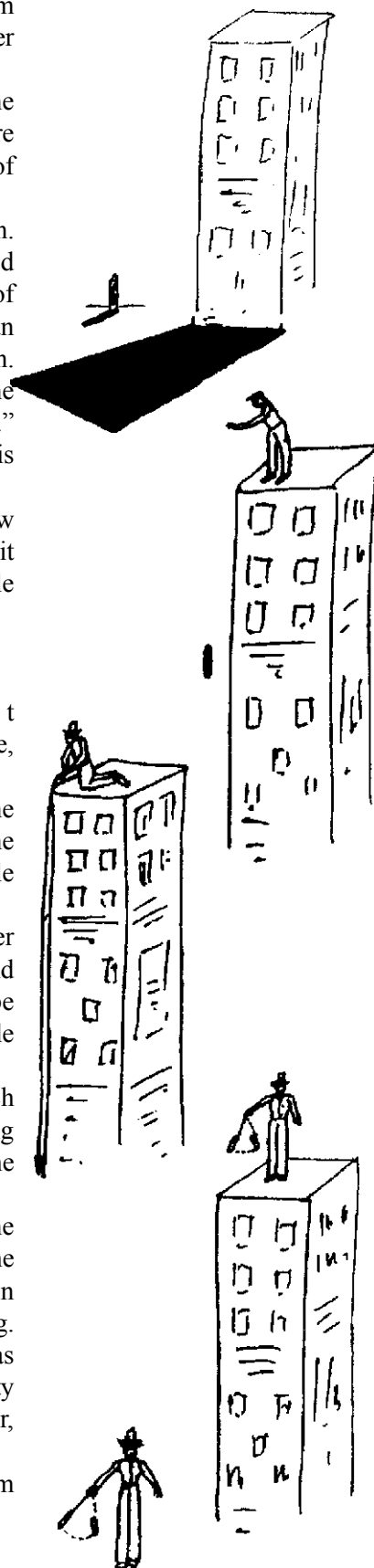
But if you wish to use a very precise scientific method then tie the barometer to the end of a short string and swing it like a pendulum - first on ground and then on roof of the building. The height of the skyscraper can then be determined by using the simple equation for finding the time period of a simple pendulum.

But if the skyscraper has an emergency staircase then the task will be much easier. While climbing up the stairs keep measuring the height of the building using the barometer like a scale. Later you can add them up to calculate the height of the skyscraper.

But if you wish to adopt a very conventional and boring way then using the barometer you can measure the difference in the atmospheric pressure on the ground and the top of the building. This difference in air pressure given in "milli-bars" can later be converted into feet to give the height of the building. But students are always asked to use their own original and independent ideas to learn science, so the best solution would undoubtedly be to go to the security guard of the building and tell him, 'Here, you can have this brand new barometer, but first you will have to tell me the height of the building!'"

The name of this student was Neils Bohr - the first and only person from Denmark to win a Noble Prize in Physics.

(Pix: Abha Mehrotra)



## THE PARADOX OF OUR TIMES

Is that we have taller buildings, but shorter tempers  
Wider freeways, but narrower viewpoints  
We spend more, but we have less  
We have bigger houses, but smaller families  
More conveniences, but less time  
We have more degrees, but less sense  
More knowledge, but less judgement  
More experts, but more problems  
More medicines, but less wellness  
We have multiplied our possessions, but reduced our values  
We talk too much, love too seldom, and hate too often  
We have learnt how to make a living, but not a life  
We have added years to life, but not life to years  
We've been all the way to the moon and back  
But have trouble crossing the street to meet the new neighbour  
We have conquered outer space, but not inner space  
We've cleaned up the air, but polluted our soul  
We've split the atom, but not our prejudice  
We've higher incomes, but lower morals  
We've become long on quantity but short on quality  
These are the times of tall men, and short character  
Steep profits, and shallow relationships  
These are the times of world peace, but domestic warfare  
More leisure, but less fun; more kinds of food, but less nutrition  
These are the days of two incomes, but more divorces  
Of fancier houses, but broken homes  
It is a time when there is much in the show window  
And nothing in the stockroom  
A time when technology can bring this letter to you  
And a time when you can choose  
Either to make a difference.... or just hit, delete.

*- His Holiness the Dalai Lama*



## THUMBPRINTS

Thumbprints can be amazing fun. Try some!

Of all the little  
things we seek  
Our thumb appears,  
to be unique.

Have you seen  
your own thumbprint?  
It has a  
unique imprint.

No two thumbprints,  
look the same.  
But they make  
a very good game.

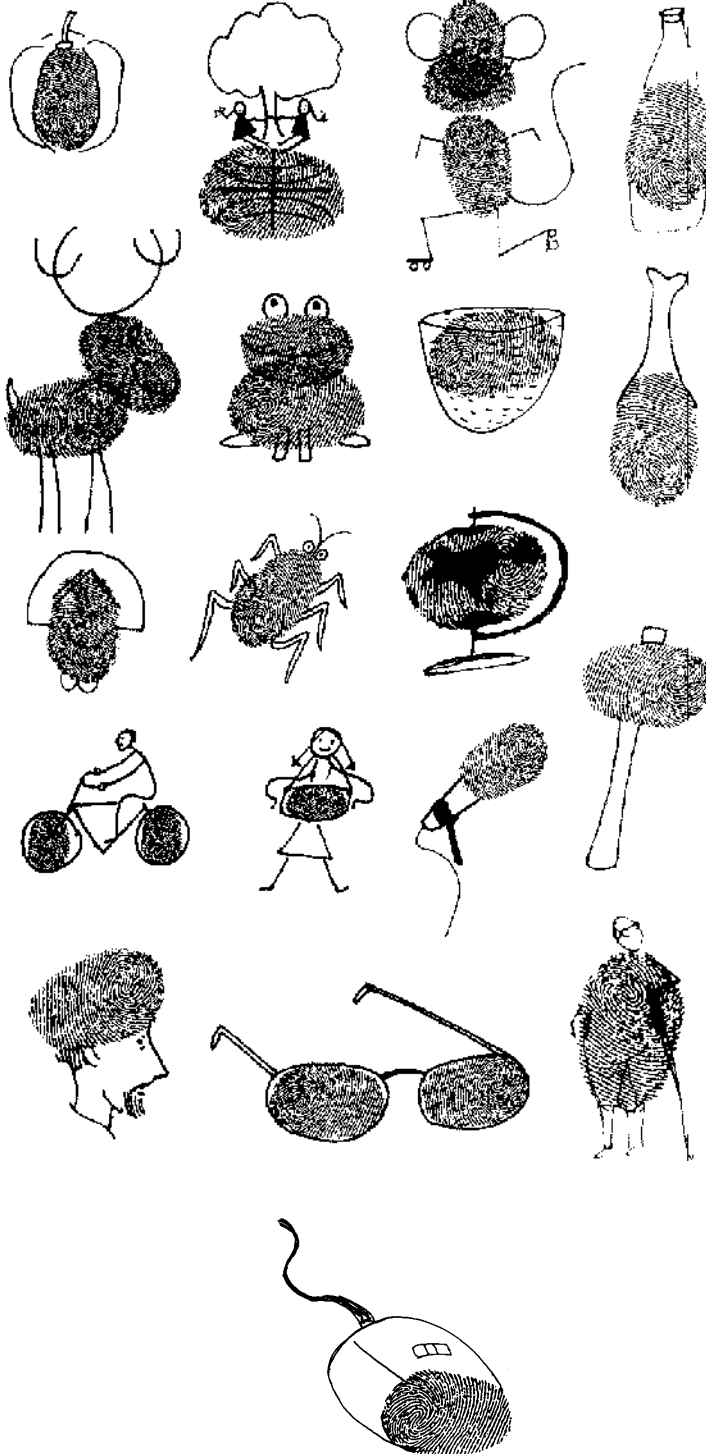
Six billion people,  
through the globe.  
Each with a  
unique thumb lobe.

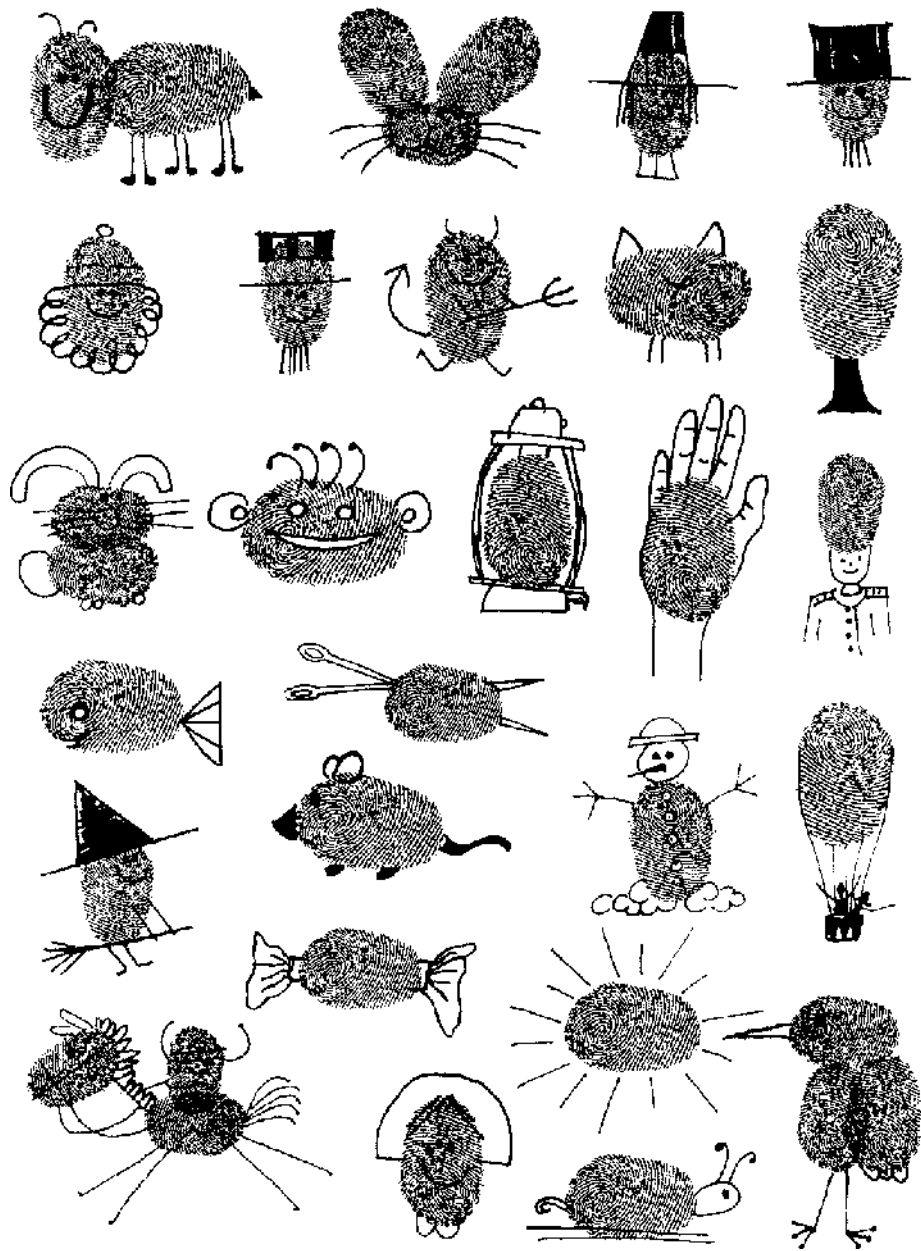
Every thumbprint,  
in the world,  
Has different lines,  
different whorls.

Print your thumb,  
look up or down.  
You might find,  
in it a clown.

A bird, a lion,  
a crawling snail.  
A fish, a peacock,  
snorting whale.

In your thumbprint,  
you will find.  
Lots of things,  
to open the mind.





## THE GENEROUS TREE

The most inspiring “green” tale ever. Adaptation of Shel Silverstein’s classic *The Giving Tree*.

Once there was a tree and a little boy. The tree loved the boy very much. Everyday the boy played under the tree. He picked up flowers and made them into a garland. He climbed the tree trunk and swung from its branches. He played hide and seek with the squirrels and talked to the birds. By afternoon he got very tired. Then he slept under the shade of the tree. Whenever he felt hungry he ate the fruits of the tree. The boy loved the tree too. But time flew by. And the boy grew up. Then he stopped coming to the tree. The tree felt very sad and lonely.

After many years one day the boy came to the tree. The tree was overjoyed to see him. He said, “Come boy, come play and have fun. Climb on my trunk and swing from my branches.” The boy said, “I don’t have time for that anymore. I want some money. I want to go to the bazaar and buy something. Can you give me some money?” The tree replied, “I don’t have any money to give you. But you can pluck my fruits and sell them in the market. Then you will have the money to buy what you want.” So the boy took all the fruits. The tree was happy. The boy disappeared. Years passed.

One day the boy came and said, “I need a house. Soon I will be married and I will need a house for my wife and children.”

“You can chop my branches and make a log house”, said the tree. And this is what the boy did. The tree was still happy. Now all that remained of the tree was its tall trunk.

Several years passed and the boy did not come back. The tree remembered him and felt sad. So, one day when the boy came the tree actually shook its leaves with joy. The boy was carrying a kind of executive briefcase.

“What can I do for you my child?” asked the tree.

“Well, I have to go on a business trip for which I need to cross the sea. I urgently need a boat. Can you give me one?”

The tree thought for a while and said, “All I have left is a trunk. You can make a boat out of it.” So the tree lost its trunk too.

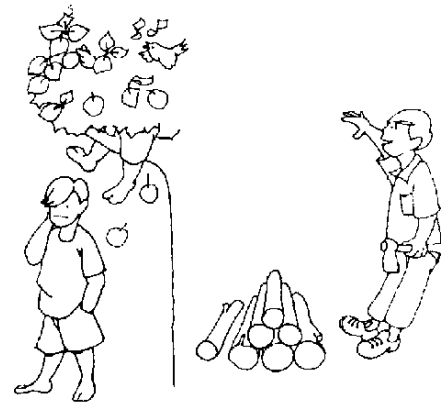
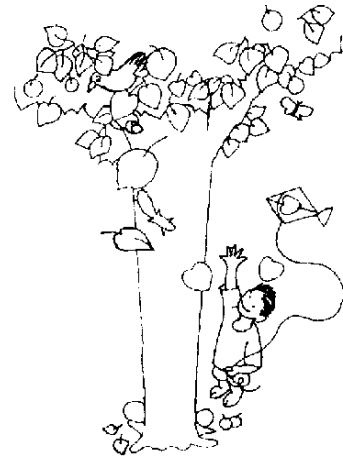
All that was left of the tree was a stump.

Many-many years passed. One-day one doddering old man came up to the stump. The tree immediately recognised him to be its childhood friend. The tree was very apologetic. It said,

“Sorry, my friend I have nothing left to give you. My fruits are gone. My branches and trunk are gone. All that is left of me is a lowly stump.”

The old man sighed and said, “You see, I have no teeth left to eat your fruit. Nor do I have energy left to climb up your trunk and swing from your branches. I am too old and tired. All I want is a place to rest and relax.”

“Then sit on me,” said the tree. The tree was still happy.

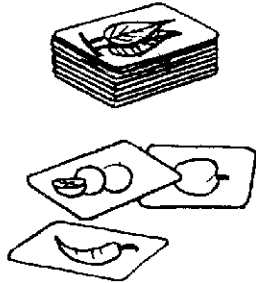
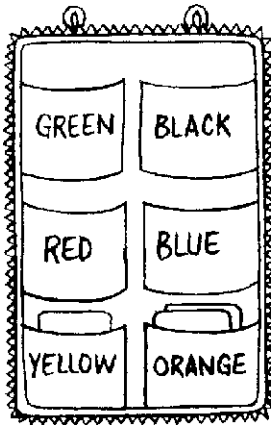


(Pix: Dilip Chinchalkar)



## COLOUR MATCHING

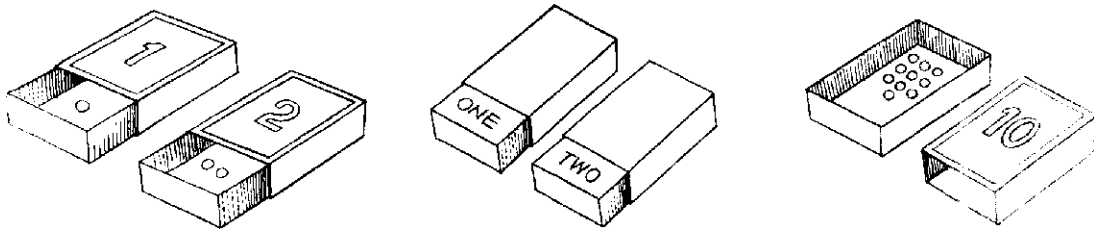
This is a simple and popular activity for little children.



Make a cloth bag with several small pockets. Stitch the pockets with colour cloth. For instance, the 'GREEN' pocket should be made from green coloured cloth. Draw common things on a pack of plain cards with black sketch pen. These things could include leaves, vegetables, fruits and other common objects. Children take turns in playing the game. They remove one card from the pack, and place it in the right colour pocket. For instance a "brick" might go into the red pocket. There might be instances when it might be possible to put the card in more than one pocket. For instance, chillies could be green or red. This could lead to an animated discussion.

## NUMBER MATCHING

This activity gives children an opportunity to match numerals to actual number of things.

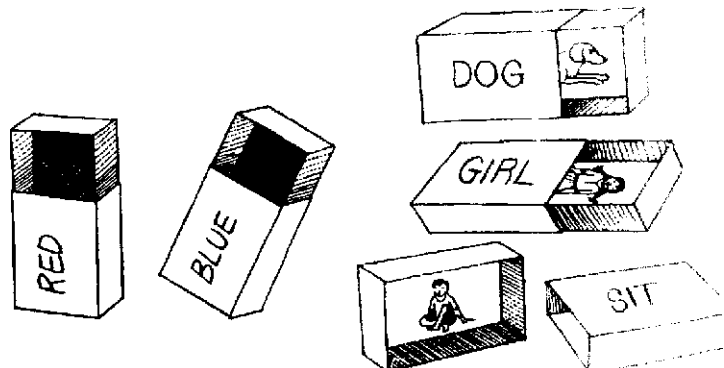


Ask children to bring empty matchboxes from their home. Stick white paper on the outer shells and inside drawers. Now write the number "1" on the outer shell. Draw one little circle inside the drawer. Write "one" on the back of the drawer. Do this for numerals 1 to 20. Remove the drawers from the matchboxes and make a pile of the matchbox cases and their drawers. Children can now put the drawers in their right shells. They can arrange the matchboxes in an ascending or descending order. Many number patterns can be discovered through these activities.

## WORD MATCHING

This activity gives children an opportunity to match words to their pictures.

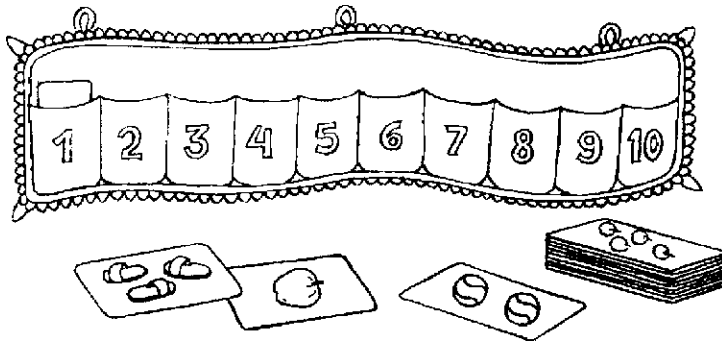
This activity is quite similar to the number matching activity. On top of the matchbox shell you write the name of a common object. Inside the drawer you draw a picture of that thing. Then make a pile of matchbox word shells and picture drawers and ask children to match them.



(Pix: Avinash Deshpande)

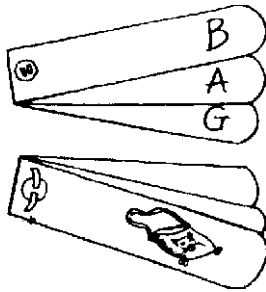
## NUMBER POCKETS

Little children find this activity great fun.

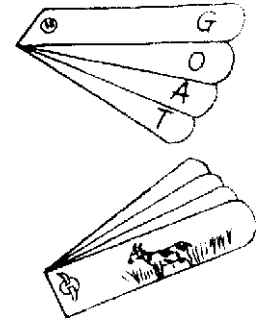


Make a cloth bag with ten pockets each numbered from 1 to 10. Make a pack of cards with different number of objects on them. Children pick up a card, count the number of things on it and place the card in the right “number” pocket.

## SPELLING FAN



These mini fans can help children remember the correct spelling of words. Take 2-cm x 8-cm rectangles of thick paper. Make a pile of three cards. Align them and then punch a hole near the centre of the left edge. Secure the cards together with the help of a split pin or a press button. Now write the letters **B**, **A** and **G** on the cards. Draw the picture of the bag on the back of the mini-book. These are self-correcting cards. Children can open up the fan, read the word and then invert the fan to see the picture.

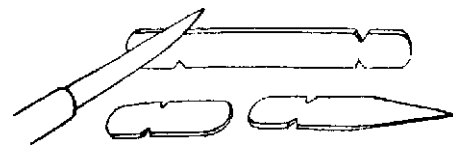


## FLICK KNIFE

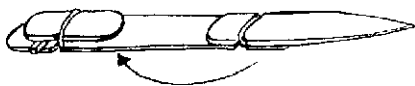
This automatic mechanical knife - a *Rampuri Chaku*, is fun to make and a sheer delight to play with.



1. To make the Flick Knife you will need two wooden ice-cream sticks, two small rubber bands, a matchstick and a paper knife or blade. Cut one ice-cream stick about 3-cm from one end.



2. Cut notches in the pieces as shown. Taper the long piece so that it looks like a knife blade. Cut notches on the other ice-cream stick too, as shown.

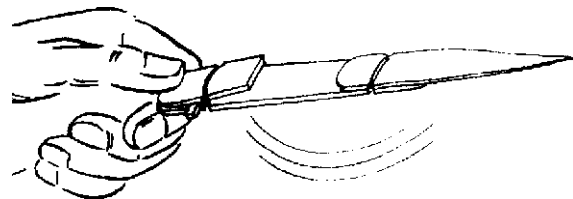


3. Join the cut pieces on the big ice-cream stick by putting a rubber band in each pair of notches. Slip in a piece of matchstick between the small piece and the big ice-cream stick. This is the fulcrum and is part of the locking system. You can open and close it by pressing it.

(Pix: Avinash Deshpande)



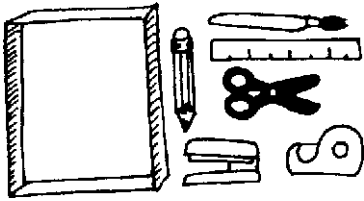
4. Now swing the blade and lock it under the small piece.



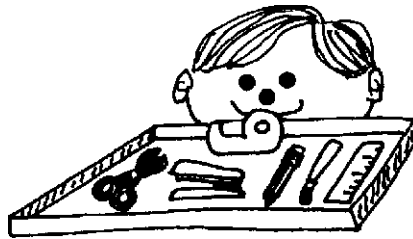
5. Now, if you press the left button, the blade will flick open in a fraction of a second.



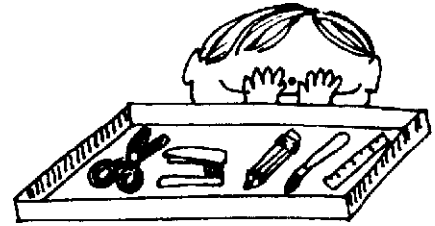
## WHAT IS MISSING?



1. You need a tray or a big *thali*, and lots and lots of different things.

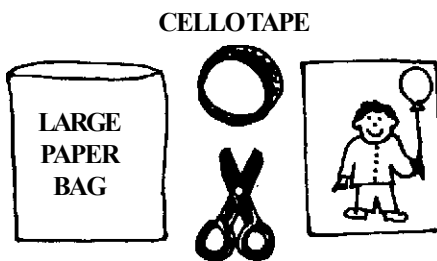


2. Lay different things on the tray. Let a friend have a good look at them.

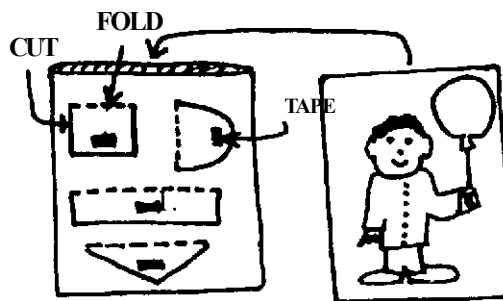


3. Then ask a friend to cover his eyes, while you remove one item from the tray. Ask your friend to open his eyes and find the missing item.

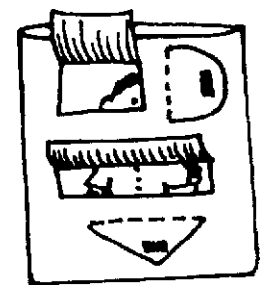
## PART AND WHOLE



1. Make a picture on a sheet with markers. You could also use a picture from an old magazine.

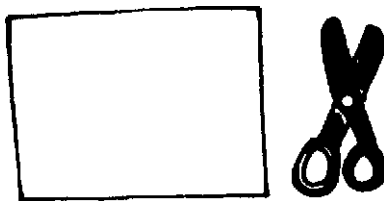


2. Now cut windows in a big brown envelope. Make hinged-window shutters with tape. Then slide the picture into the envelope.

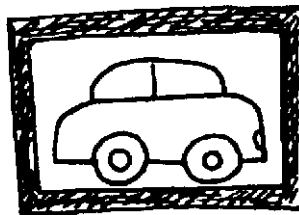


3. Let a friend peek at the picture through the windows and guess what it is.

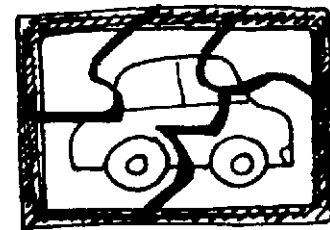
## SIMPLE JIGSAW



1. For making a jigsaw you will need an old file cover, sketch-pens and a scissors.



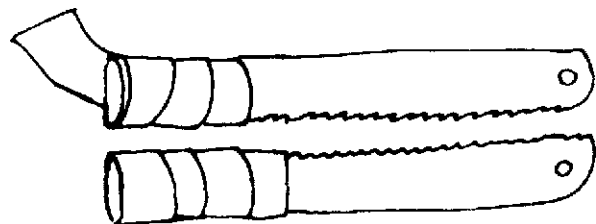
2. Draw a border around the cardboard. Then draw a picture on the cardboard.



3. Cut the picture into a few pieces. Ask a friend to assemble the jigsaw.

## BROKEN HACKSAW BLADES

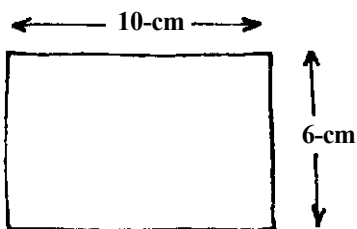
Do not throw away broken hacksaw blades. Wrap the raw ends with tape or an old cloth to make a handle. Cost of tools is often a reason why schools and homes have no workshops. In India broken hacksaw blades are often sharpened and made into very efficient cutting knives.



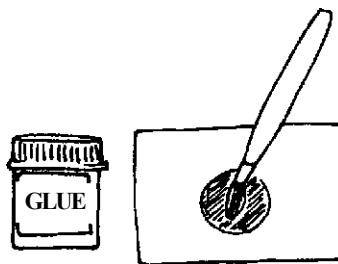
(Pix: MAKING THINGS by Ann Wiseman)

## SMELL WELL!

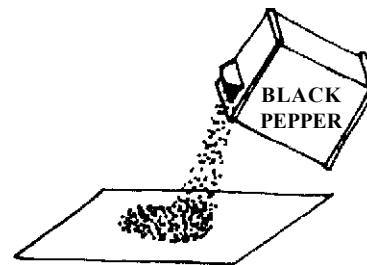
This is a nice game of smells. Use strong smelly stuff like pickles, *heeng*, peppermint, *pan masala*, *odomas*, *amrutanjan* etc. to make the experience interesting.



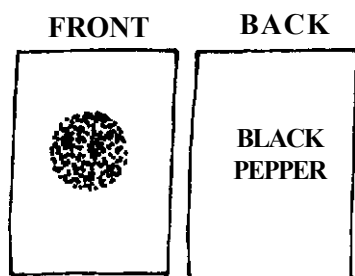
1. Take several thick 6-cm x 10-cm cards.



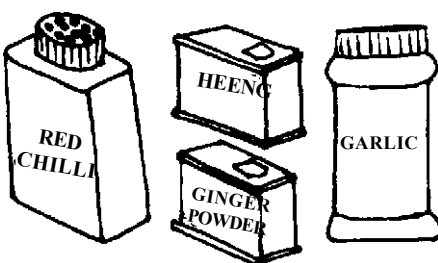
2. Paint a 3-cm circle of glue on the card.



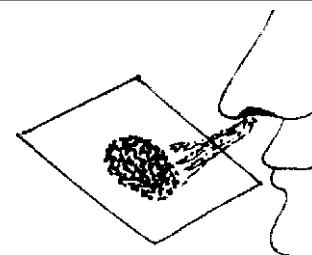
3. Sprinkle some black-pepper powder on the wet glue.



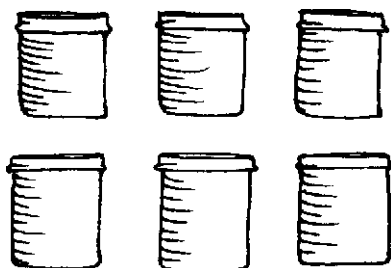
4. On the backside of the card write BLACK PEPPER.



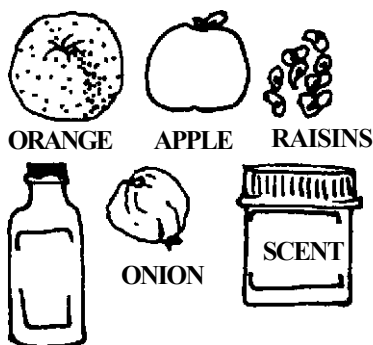
5. Make several cards with different powders having different smells.



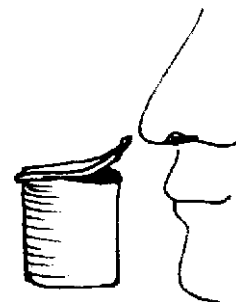
6. Let your friend smell each powder and guess its name. Cross check your guess by reading the name on the back.



7. Collect several black empty film roll bottles.



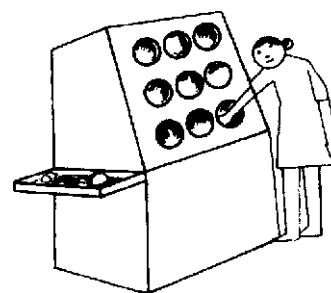
8. Put little bits of different foods into each case. Cover the lids tightly shut for several hours.



9. Ask your friends to guess the food by only smelling it. Carefully open the lid only a little so that the food inside cannot be seen.

## TOUCH AND TELL

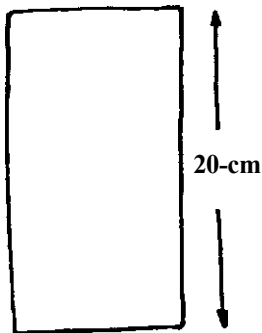
Hide things in drawers, so that children can't see them but they can put their hands inside the drawer and feel them. Children should be able to name things without seeing by "feel" alone. They should also be able to connect this experience with things they can spot in their surroundings.



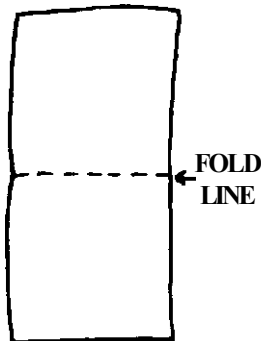
(Pix: Vikram Sarabhai Community Science Centre, Ahmedabad)

## MINI MOVIES

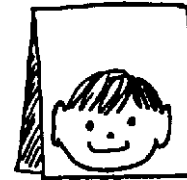
When a picture is removed from in front of your eyes, its image still lingers in the mind for a fraction of a second. A normal cinema reel uses a lot of frames to depict "action". But even two frames can give you a feel for simple animation.



1. Take a piece of paper 8-cm x 20-cm.



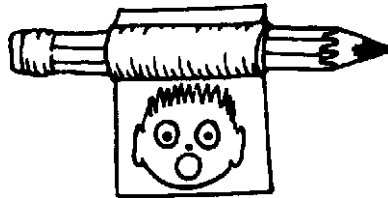
2. Fold the paper in half.



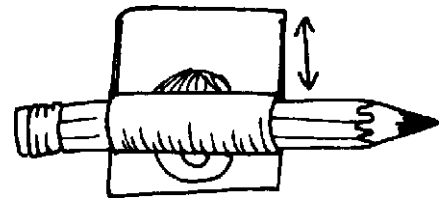
3. Think of an action which can be shown in two simple pictures. Draw one picture on the top sheet.



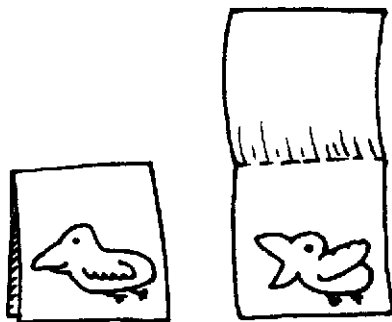
4. Draw the other picture directly below on the bottom sheet. Only change the part of the picture you want to see move.



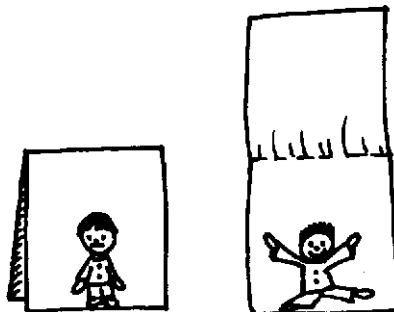
5. Roll the top sheet tightly around a pencil.



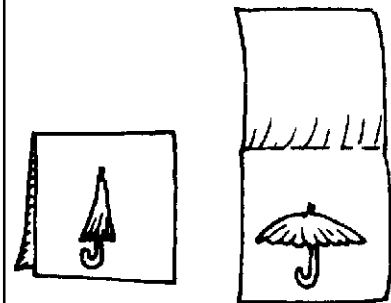
6. Move the pencil up and down quickly so that the top sheet rolls up and unrolls.



7. Make many more mini movies for example, make a bird fly...



8. ...or a boy jump....

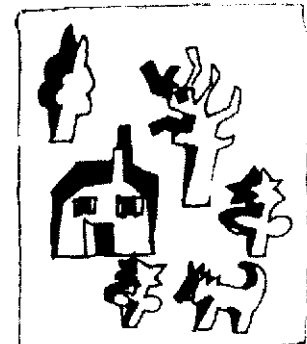
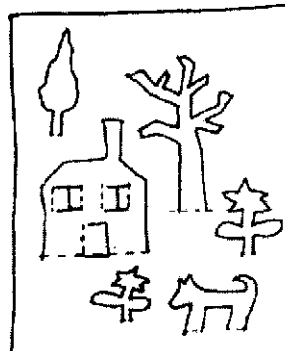


9. ...or open and close an umbrella.

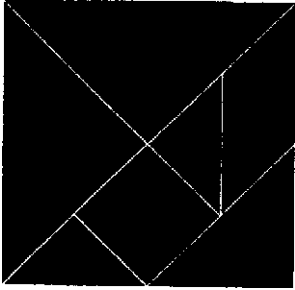
## 3-DIMENSIONAL PICTURES

Use thick paper to make these 3-D pictures. Draw houses, trees, animals etc. Cut along the drawn lines except where things bend (dotted lines). Use a paper knife to cut. Finally bend shapes to make things stand. This is a good technique for making dioramas and cards. It is a good way to learn about perspective.

*(Pix: MAKING THINGS by Ann Wiseman)*

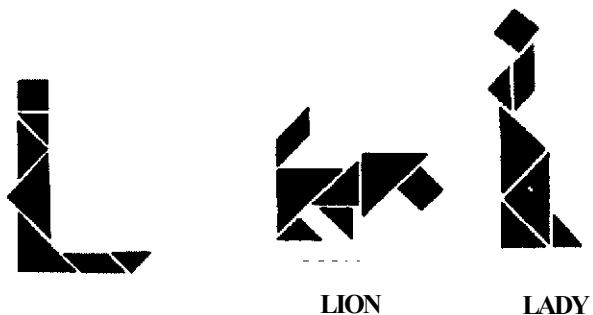
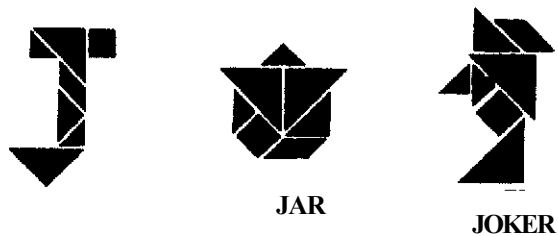
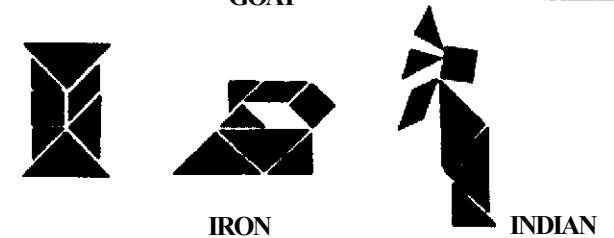
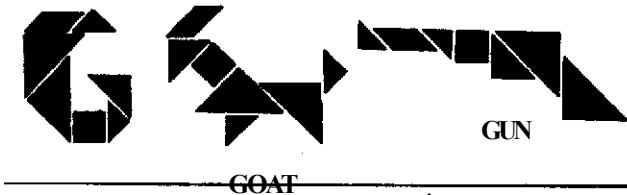
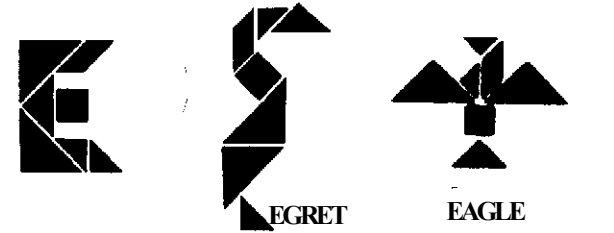
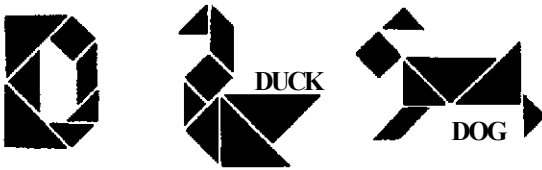
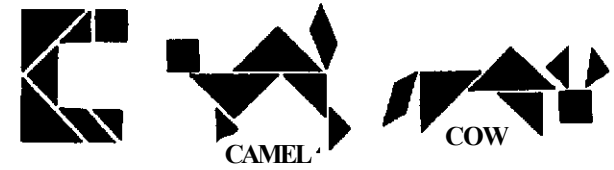
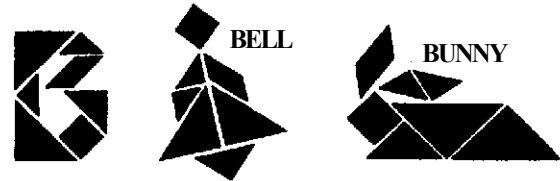


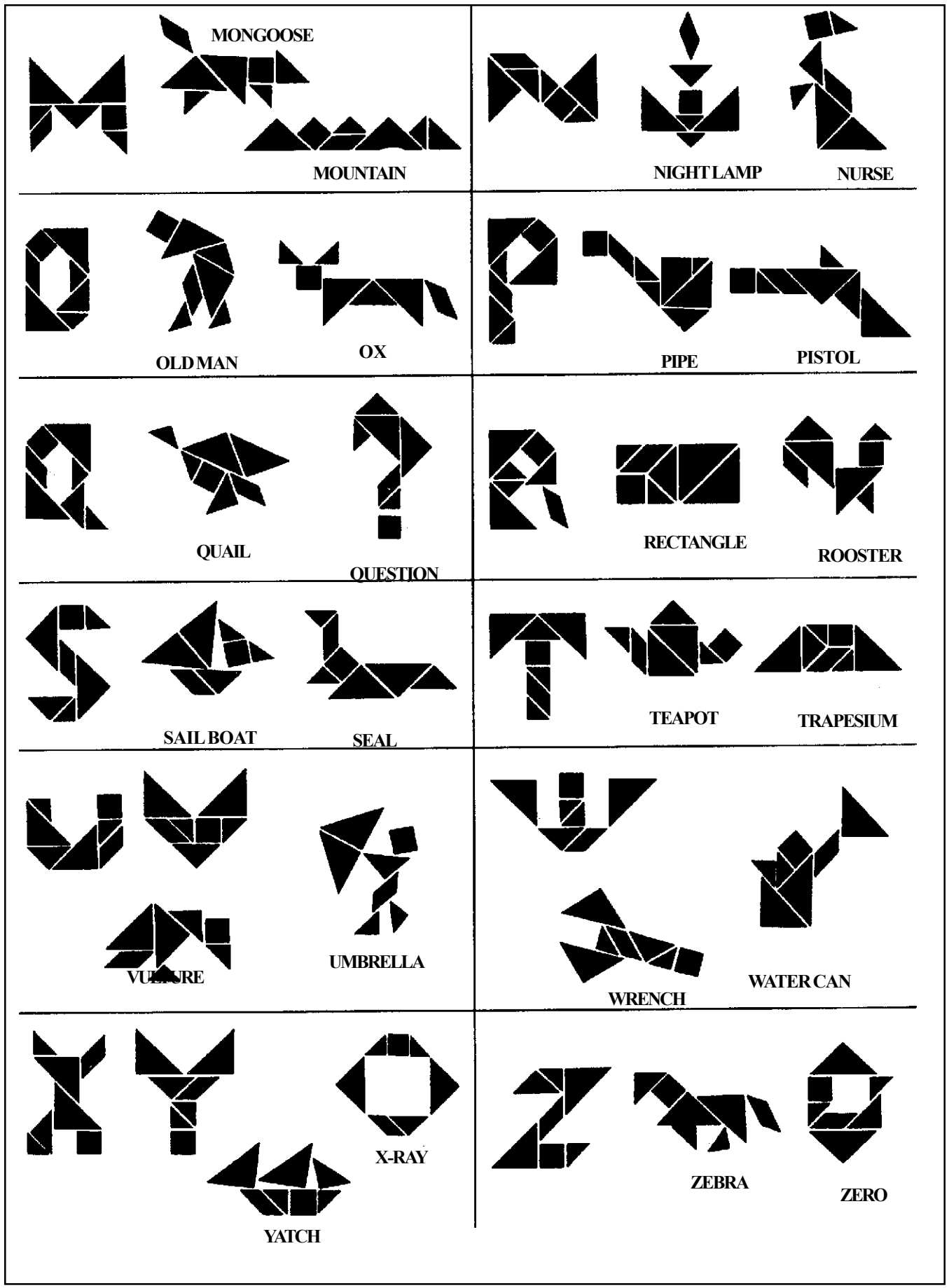
## ABC OF TANGRAMS



Tangrams come from China. They are thousands of years old. The Tangram is made by cutting a square into seven pieces. The puzzle lies in using *all seven* pieces of the Tangram to make birds, houses, boats, people and geometric shapes. In each case you have to use all the seven pieces - no more, no less.

Tangrams have fascinated mathematicians and lay people for years. You might be wondering why only the solutions are given. Well, you could just blacken the white lines to create the problems! Watch out, as Tangrams are known to be addictive. With these **Seven Little Wonders** the whole family can have hours of fun!





## MODELLING MATERIALS

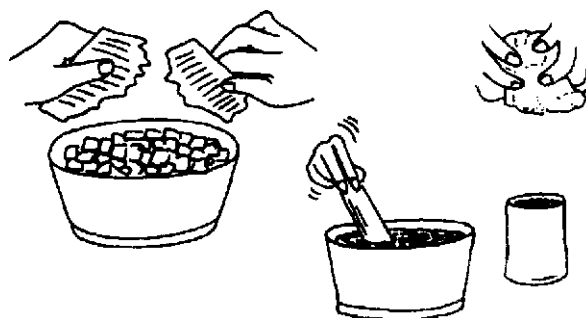
### FLOUR GLUE

Glue from wheat flour (*atta*). Sift flour to remove lumps. Maize or wheat flour is suitable. Mix the flour with water a little at a time to avoid lumps. It should be the consistency of thin cream. Cook the mixture gently until it thickens. Keep stirring to ensure the paste remains smooth and of even texture. Allow the paste to cool. Store in a closed container in a cool place for future use.



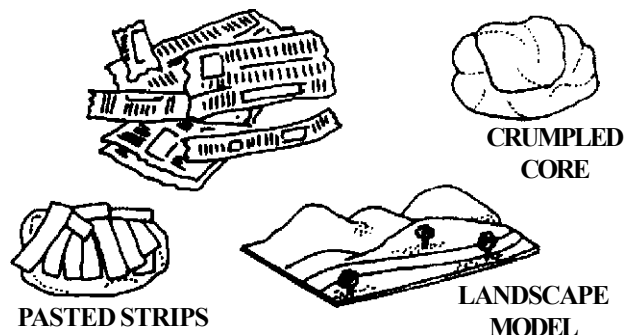
### PAPIER MACHE

Soak pieces of paper or card in water for half a day. Mash, grind, stir or pound the mix to a smooth fine pulp. Squeeze or press out excess water. Mix in a little glue (*fevicol*) or glue made from wheat flour, and work the material to a sticky modelling consistency.



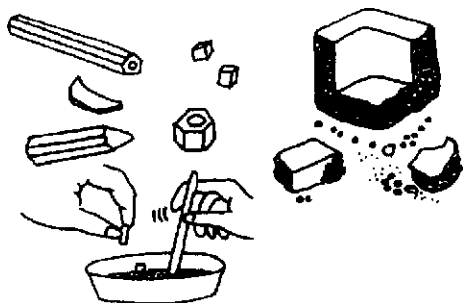
### PAPIER MACHE LAYERING

Soak small pieces, or narrow strips, of newspaper in paste. Use crumpled newspaper as a core or skeleton for the model. Build up the model in layers of strips and pieces. After drying, sandpaper smooth and paint and varnish.



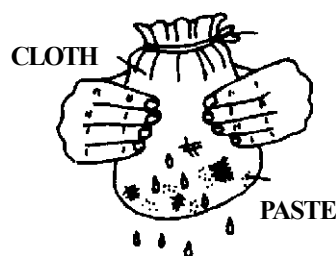
### POLYSTYRENE CEMENT

Dissolve polystyrene ball pen casings, or Styrofoam (thermocole) packing material in a little petrol. Natural rubber dissolved in petrol will make 'rubber' solution – another glue.



(VSO Science Teacher's Handbook)

### RICE GLUE



Cook one-part rice with 3-parts of water. Strain off excess water. Rice thickens as it cools. Squeeze the wet rice through open-weave cloth. Squeezing breaks down the rice grains and makes it into a paste. On cooling the rice paste forms a good glue.



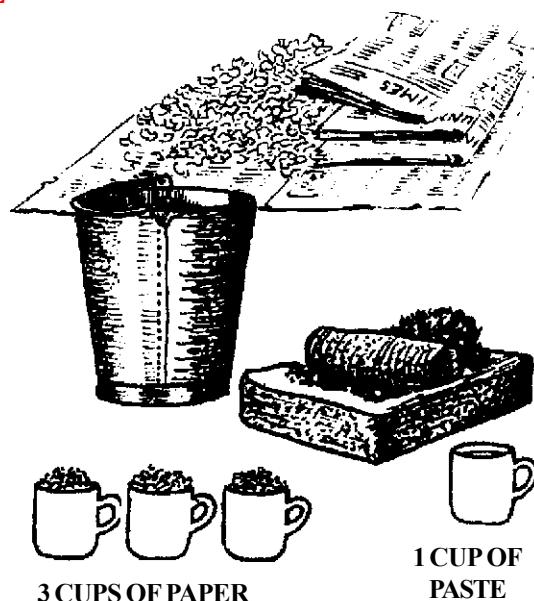
## PAPIER MACHE

Papier mache (pronounced as *Papeeay-mashay*) comes from the French, and means chewed paper. It is useful for making all sorts of models.

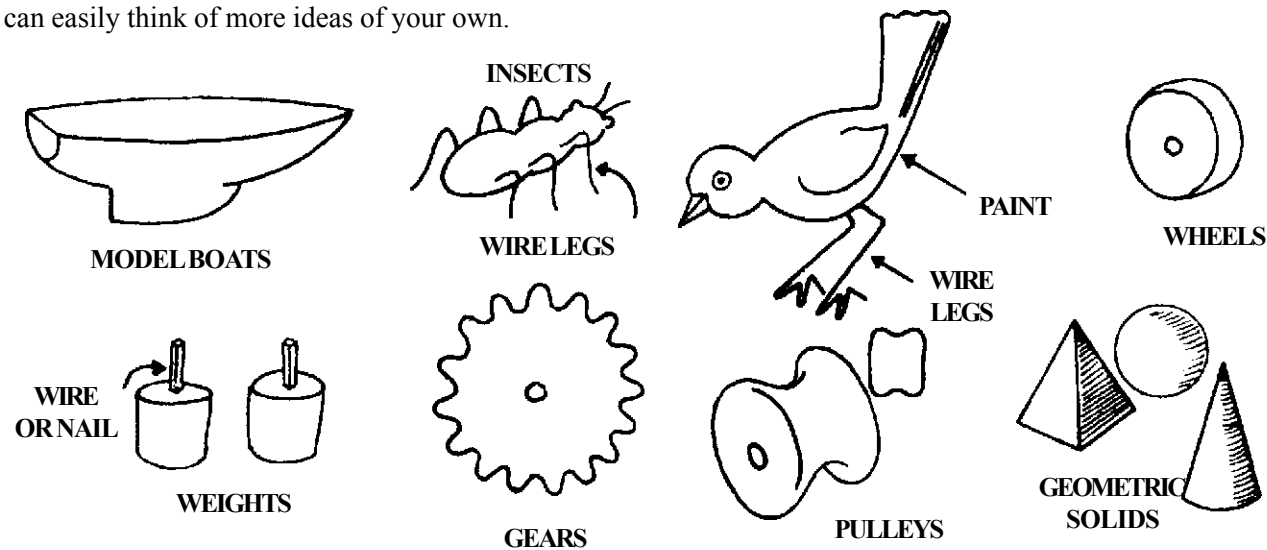
This is how you make it. You need paper and flour (*atta*) paste. Make the flour paste by mixing white flour or *maida* with water, put in enough flour to make it like thin curds. Cook it slowly until it boils, stirring well all the time.

Now tear up newspapers into pieces as big as postage stamps, and soak them in water for 24 hours. Then squeeze out the water and mash them on a grinding-stone. Mix the mashed paper with paste as shown:

1. Tear six newspapers into small pieces.
2. Soak them in a bucket for twenty-four hours.
3. Grind them on a grinding-stone.
4. Squeeze out all the moisture and mix with flour paste.



Many useful things for studying science can be made with papier mache. When it is dry it becomes very hard and does not break easily. Here are some ideas of making simple science models. You can easily think of more ideas of your own.



### FRICTION TOY

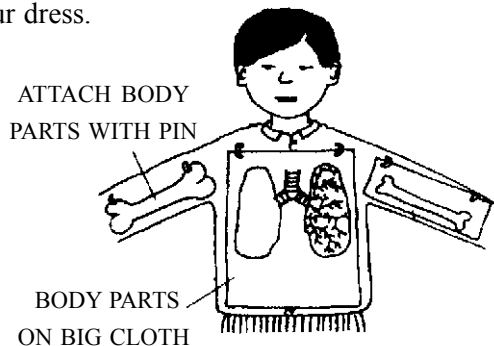
This toy is easy to make. It works on friction. Make some clay with mud and water. Make a lump of about 10-cm x 5-cm x 3-cm. When the clay is fairly dry, take a pencil and push it top at an angle, as shown in the picture. Poke from the bottom, again at an angle, so that the holes meet. Put a piece of string through the hole. When you hold the string tight the block won't move. When you hold the string loosely it slides down the string.



(Pix: David Horsburgh)

### DISPLAY DRESS

A nice way to learn about the human body - draw body parts on cloth and pin them up on your dress.



## PARROT'S TRAINING

This classic story - written by Indian Nobel Laureate Rabindranath Tagore in 1924, says it all.

Once upon a time there was a bird. It was ignorant. It sang all right, but never recited scriptures. It hopped pretty frequently, but lacked manners.

Said the Raja to himself: "Ignorance is costly in the long run. For fools consume as much food as their betters, and yet give nothing in return."

He called his nephews to his presence and told them that the bird must have a sound schooling.

The pundits were summoned, and at once went to the root of the matter. They decided that the ignorance of birds was due to their natural habit of living in poor nests. Therefore, according to the pundits, the first thing necessary for this bird's education was a suitable cage.



The pundits had their rewards and went home happy.

A golden cage was built with gorgeous decorations. Crowds came to see it from all parts of the world.

"Culture, captured and caged!" exclaimed some, in a rapture of ecstasy, and burst into tears.

Others remarked: "Even if culture be missed, the cage will remain, to the end, a substantial fact. How fortunate for the bird!"

The goldsmith filled his bag with money and lost no time in sailing homewards.

The pundit sat down to educate the bird. With proper deliberation-he took his pinch of snuff, as he said: "Textbooks can never be too many for our purpose!"

The nephews brought together an enormous crowd of scribes. They copied from books, and copied from copies, till the manuscripts were piled up to an unreachable height.

Men murmured in amazement: "Oh, the tower of culture, egregiously high! The end of it lost in the clouds!"

The scribes, with light hearts, hurried home, their pockets heavily laden.

The nephews were furiously busy keeping the cage in proper trim.

As their constant scrubbing and polishing went on, the people said with satisfaction: "This is progress indeed!"

Men were employed in large numbers, and supervisors were still more numerous. These, with their cousins of all different degrees of distance, built a palace for themselves and lived there happily ever after.

Whatever may be its other deficiencies, the world is never in want of fault-finders; and they went about saying that every creature remotely connected with the cage flourished beyond words, excepting only the bird.

When this remark reached the Raja's ears, he summoned his nephews before him and said: "My dear nephews, what is this that we hear?"

The nephews said in answer: "Sire, let the testimony of the goldsmiths and the pundits, the scribes and the supervisors, be taken, if the truth is to be known. Food is scarce with the fault-finders, and that is why their tongues have gained in sharpness."

The explanation was so luminously satisfactory that the Raja decorated each one of his nephews with his own rare jewels.

The Raja at length, being desirous of seeing with his own eyes how his Education Department busied itself with the little-bird, made his appearance one day at the great Hall of Learning.

From the gate rose the sounds of conch-shells and gongs, horns, bugles and trumpets, cymbals, drums and, kettle drums, tom-toms, tambourines, flutes, fifes, barrel organs and bagpipes.

The pundits began chanting mantras with their topmost voices, while the goldsmiths, scribes, supervisors, and their numberless cousins of all different degrees of distance, loudly raised a round of cheers.

The nephews smiled and said: "Sire, what-do you think of it all?"

The Raja said: "It does seem so fearfully like a sound principle of Education!"

Mightily pleased, the Raja was about to remount his elephant, when the fault-finder, from behind some bush, cried out: "Maharaja, have you seen the bird?"

"Indeed, I have not!" exclaimed the Raja. "I completely forgot about the bird."



Turning back, he asked the pundits about the method they followed in instructing the bird.

It was shown to him. He was immensely impressed. The method was so stupendous that the bird looked ridiculously unimportant in comparison. The Raja was satisfied that there was no flaw in the arrangements. As for any complaint from the bird itself, that simply could not be expected. Its throat was so completely choked with the leaves from the books that it could neither whistle nor whisper. It sent a thrill through one's body to watch the process.

This time, while remounting his elephant, the Raja ordered his State Ear puller to give a thorough good pull at both the ears of the fault-finder.

The bird thus crawled on, duly and properly, to the safest verge of insanity. In fact, its progress was satisfactory in the extreme. Nevertheless, nature occasionally triumphed over training, and when the morning light peeped into the bird's cage it sometimes fluttered its wings in a reprehensible manner. And, though it is hard to believe, it pitifully pecked at its bars with its feeble beak.

"What impertinence!" growled the kotwal.

The blacksmith, with his forge and hammer, took his place in the Raja's Department of Education. Oh, what resounding blows! The iron chain was soon completed, and the bird's wings were clipped.

The Raja's brothers-in-law looked back, and shook their heads, saying: "These birds not only lack good sense, but also gratitude!"

With textbook in one hand and the baton in the other, the pundits gave the poor bird what may fitly be called lessons! The kotwal was honoured with a title for his watchfulness and the blacksmith for his skill in forging chains. The bird died. Nobody had the least notion how long ago this had happened. The fault-finder was the first man to spread the rumour.

The Raja called his nephews and asked them: "My dear nephews, what is this that we hear?"

The nephews said: "Sire, the bird's education has been completed."

"Does it hop?" the Raja enquired.

"Never!" said the nephews.

"Does it fly?" "No."

"Bring me the bird," said the Raja.

The bird was brought to him, guarded by the kotwal and the sepoy. The Raja poked its body with his finger. Only its inner stuffing of book-leaves rustled.

Outside the window, the murmur of the spring breeze amongst the newly budded Asoka leaves made the April morning wistful.

(Pix: Kamiriithu)

## THE MAN WHO LOVED NUMBERS

An unusual story of a great mathematician.

Paul Erdős was the most prolific mathematician of all time. “The first sign of senility,” Erdős often said, “is when a man forgets his theorems. The second sign is when he forgets to zip up. The third sign is when he forgets to zip down.” Erdős never experienced the first sign. He managed to think about more problems than any other mathematician in history and could recite the details of all 1,475 of the papers he had written or co-authored. Fortified by coffee and amphetamines, Erdős did mathematics 19 hours a day, seven days a week. “A mathematician,” Erdős was fond of saying, “is a machine for turning coffee into theorems.” When friends urged him to slow down, he always had the same response: “There’ll be plenty of time to rest in the grave.” Erdős, to be sure, always spoke in aphorisms.



*Life* magazine said of Paul Erdős that “he felt about numbers the way some people feel about their children: He loved them unreservedly, but he could not completely understand them, no matter how assiduously he applied his formidable intelligence to the task. And while he had no children—indeed, no wife, no job, no hobbies, not even a home of his own—numbers returned his love, revealing their secrets to him as they did to no other mathematician this century. For six decades, living out of a single ratty suitcase, he criss-crossed four continents at a frenzied pace, moving from one university or research centre to the next, in search of good mathematical problems and fresh mathematical talent. His modus operandi was to show up on the doorstep of an esteemed mathematician, declare, “My brain is open,” work with his host for a day or two, until he was bored or his host was run down, and then move on to another home. Erdős’s motto was not “Other cities, other maidens” but “Another roof, another proof.” Maidens, in fact, were rarely on Erdős’s mind: He was celibate his entire life. Mathematics was his only love.

Paul Erdős was born in Budapest on March 26, 1913, the son of two high school math teachers. While his mother, Anna, was giving birth to him, her two daughters, ages three and five, contracted septic scarlet fever and died within the day. Of the three children, the girls were considered to be the smart ones. When Erdős was one and a half, his father was captured in a Russian offensive and sent to Siberia for six years. Until he reached his teens, Erdős’s mother kept him out of school, fearing that it was the source of childhood contagion.

Home alone, with time on his hands, Erdős did mental arithmetic. At three he could multiply three-digit numbers in his head and amuse visitors by asking their ages and computing how many seconds they had lived. At four he started looking for patterns to the prime numbers, integers like 2, 3, 5, 7, 11, and 17, which are evenly divisible only by themselves and the number 1. From then on he was hooked on a life of the mind. He became a mathematical monk, renouncing physical pleasure and material possessions for an ascetic, contemplative life, a life devoted to a single narrow mission: uncovering mathematical truth.

It was also a life torn asunder by some of the major political crises of the twentieth century. “I remember an incident when I was six,” Erdős recalled. “Jews in Hungary had lots of problems after the Communist revolution in 1919. Being a Jew, my mother once said to me, ‘You know the Jews have such a difficult time, shouldn’t we get baptised?’ I told my mother, ‘Well, you can do what you please, but I remain what I was born.’” Erdős would leave Budapest before the Nazis moved in. Although his mother survived the war, the Nazis killed four of her five siblings and Erdős’s father died of a heart attack.

Erdős never felt at home in any country. Everywhere he went he had trouble with political authorities. During the McCarthy era the U.S. denied him a re-entry permit because they feared he was a Hungarian spy, Stalinist Hungary harassed him because of his long stays in the U.S. Mathematics was his escape from a hostile world.

## HOW TO REACH THE SUN... ON A PIECE OF PAPER

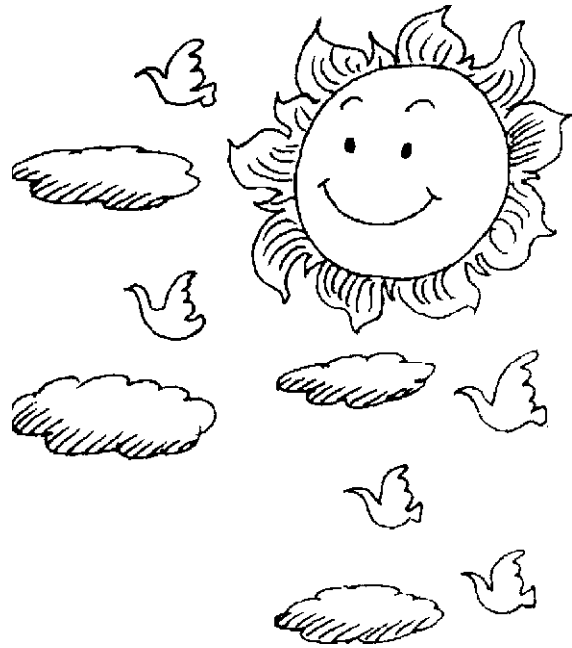
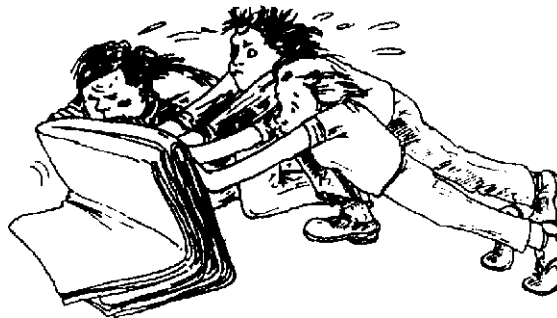
A poem by - Wes Magee

Take a sheet of paper and fold it,  
and fold it again,  
and again, and again.  
By the 6th fold it will be 1-centimeter thick.

By the 11th fold it will be  
32-centimeter thick,  
and by the 15th fold - 5-meters.

At the 20th fold it measures 160-meters.  
At the 24th fold - 2.5-kilometers,  
and by fold 30 it is 160-kilometers high.  
At the 35th fold it is 5000-kilometers.  
At the 43rd fold it will reach the moon.

And by the fold 52  
will stretch from here  
to the sun!  
Take a piece of paper.  
Go on.  
TRY IT!



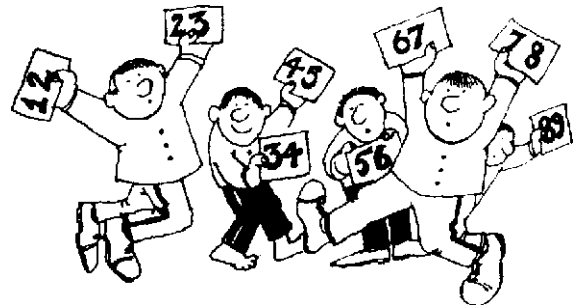
## UP TO 100

Here's an unusual game for just two players. It's called "Up to 100" and it's simple to learn but exciting. If you play the game with a friend, get him to start. He has to begin by writing down any number from 1 to 10 on a piece of paper. You then write down a second number, again it can be any number from 1 to 10, and add the two numbers together. He then writes down the third number, again any number from 1 to 10, and adds this to the first two. You can continue doing this, with each of you taking it in turns to add a number to the total. The player who adds the final number that makes the total add up to exactly 100 is the winner.

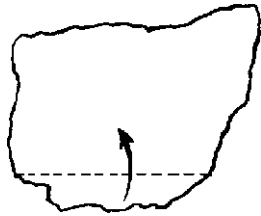
And if you like winning, you'll be pleased to know that you can win this game EVERY TIME!

All you have to do to win is this:

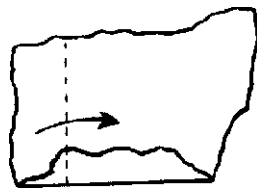
Make sure that at the end of one of your moves the total is either 12 or 23 or 34 or 45 or 56 or 67 or 78 or 89. Once you have reached one of these numbers, your worries are over, because all you have to do then is play numbers which, when added to your opponent's last number, makes 11. Once you reach 89 it doesn't matter what number he calls, you can always add whatever it takes to hit 100.



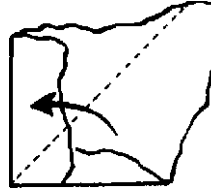
### SQUARE FROM ANY TORN PAPER



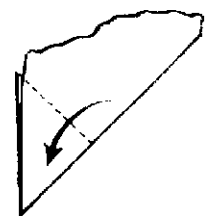
1. Make a fold in the paper.



2. You now have a straight folded edge. Fold part of this edge back on itself.



3. You now have a second folded edge at right angles to the first edge. Fold these two edges together.



4. Fold the diagonal edge back on itself ...



5. ... like this. Turn over.

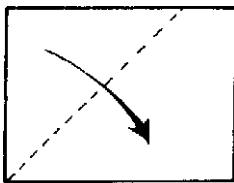


6. Cut parallel to the horizontal straight edge, just above it. Unfold the paper and discard the shaded portion.

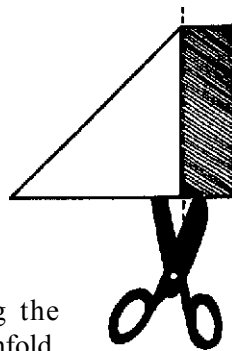


7. You now have a perfect square.

### SQUARE FROM A RECTANGLE



1. Fold the side of the rectangle to the bottom edge.

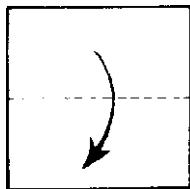


2. Cut along the dotted line. Unfold.

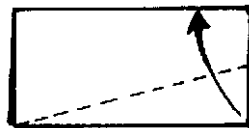


3. To get a square.

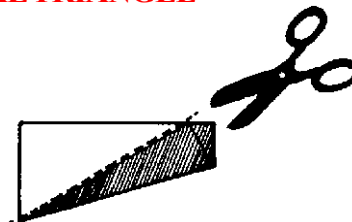
### EQUILATERAL TRIANGLE



1. Fold the top edge of the square to the bottom edge.



2. Fold the bottom right corner to the top, making sure that the crease line starts from the bottom left corner.



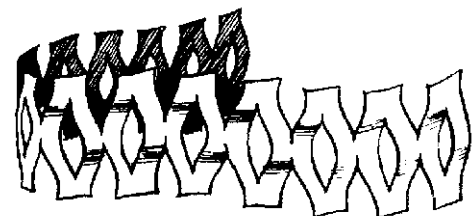
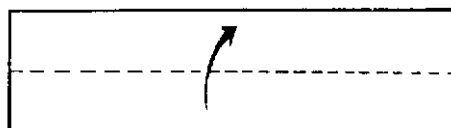
3. Cut along the dotted line. Discard the shaded area and unfold.



4. To get a regular equilateral triangle.

### PAPER CHAIN

Fold a long strip into half. Make alternative cuts in the top and bottom edges. Open it to see a chain.





### DIAMOND



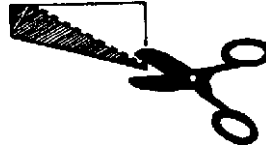
1. Fold a rectangle of paper (2 x 1) into half.



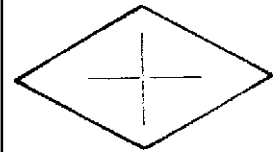
2. Fold top to bottom.



3. Fold the bottom left corner up to the top as shown.

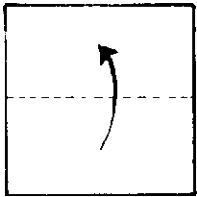


4. Cut. Discard the shaded area and unfold.

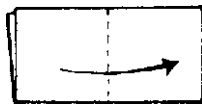


5. To get a lovely diamond shape.

### CROSS



1. Fold a paper square in half.



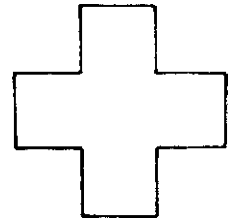
2. Fold in half from left to right.



3. Fold the upper layer diagonally in half. Turn over and do the same behind.

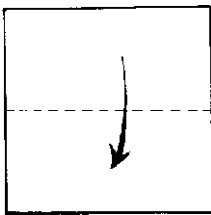


4. Cut at right angles to the top edge. Discard the shaded area and unfold.

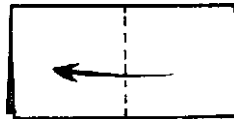


5. The cross.

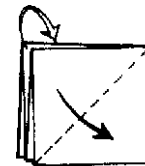
### OCTAGON



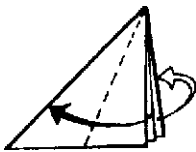
Fold a square in half from top to bottom.



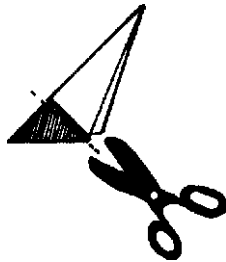
2. Fold in half from right to left.



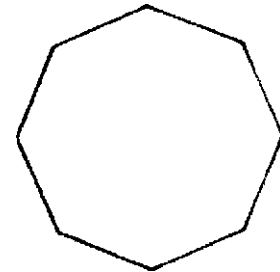
3. Fold the upper layer diagonally in half. Turn over and do the same behind.



4. Fold the vertical edges (two layers) to the diagonal edge at left. Turn over and fold the remaining vertical edge to the diagonal edge.

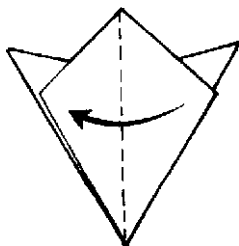


5. Cut along the edge. Discard the shaded area and unfold.

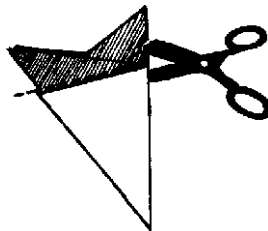


6. The octagon.

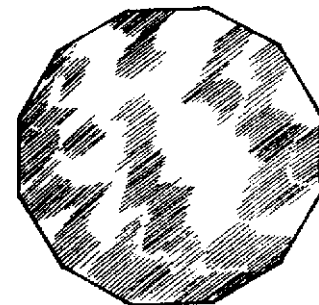
### TWELVE-SIDED FIGURE



Start by folding steps 1 - 4 of the hexagon (page 22).  
1. Fold in half from right to left.

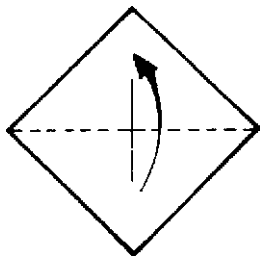


2. Cut along the edge. Discard the shaded area and open up.

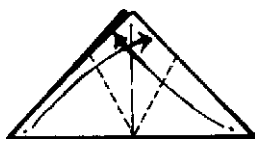


3. The twelve-sided figure.

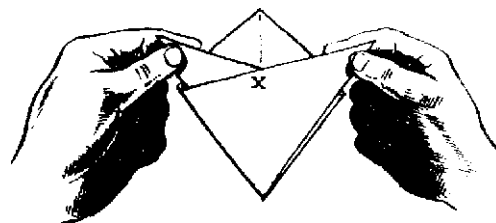
## HEXAGON



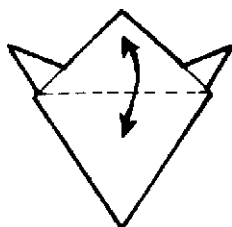
1. Fold the two opposite corners of a square.



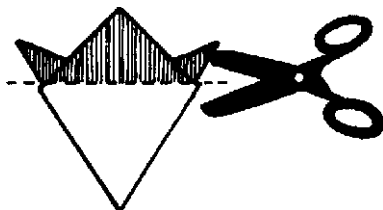
2. Making sure that the creases start from the centre of the folded edge, bring the two side points forward to lie across each other.



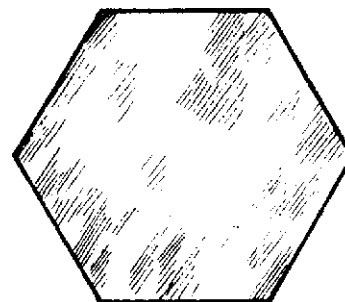
3. Carefully pull the points apart so that the angle where the edges of the two flaps meet (point X) is in line with the vertical centre crease. Now crease firmly and turn over.



4. Fold the top point as far as it will go, crease and return.



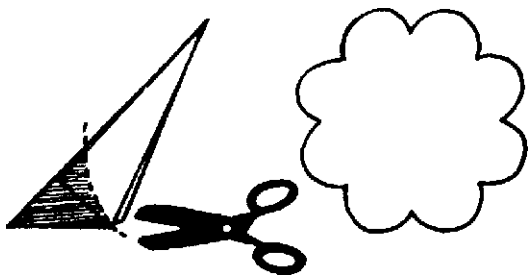
5. Cut along the crease line you have just made. Discard the shaded portion and open up.



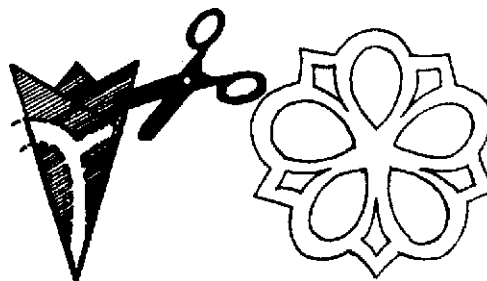
6. To get the six-sided Hexagon.

## PAPER PATTERNS

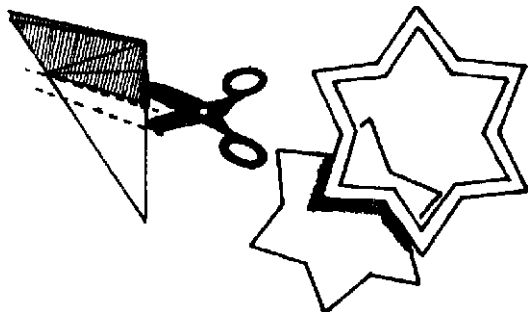
First fold a paper several times. Then by making some extra cuts or altering the direction of cuts you could prepare interesting paper patterns.



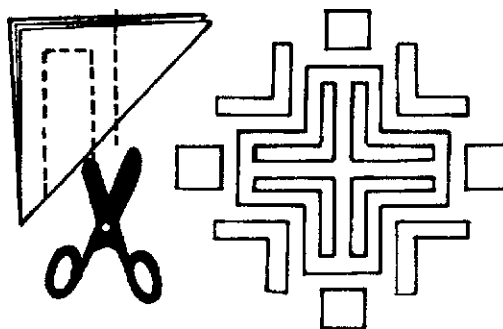
1. Instead of a straight line cut a curved cut on a 8-fold paper will make a flower with eight petals.



2. A few straight and curved cuts will make a flower and leaf design.

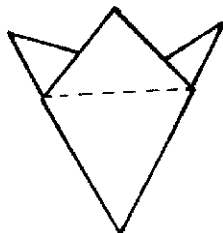


3. If the first cut is followed by a second parallel cut as shown, then the paper will unfold into two similar shapes - one "hollow" and the other "solid".

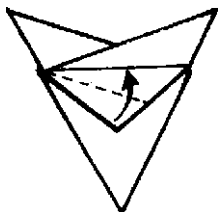


4. One straight cut followed by a few further cuts will generate a perforated shape as shown.

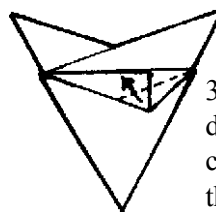
### SIX-POINTED STAR



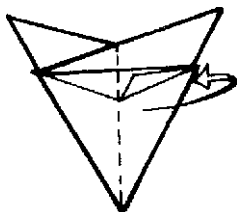
Start by folding steps 1-3 of the hexagon (p22).  
1. Fold the top point down as far as it will go.



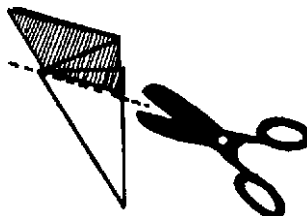
2. Fold one of the diagonal edges of the central triangle to the horizontal edge.



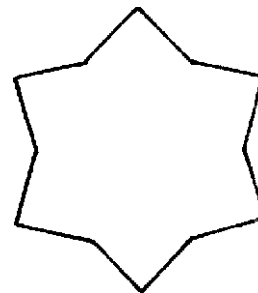
3. Fold the other diagonal edge of the central triangle to the horizontal edge.



4. Fold in half by taking the right side behind.

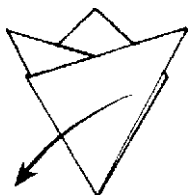


5. Cut along the edge. Discard the shaded area and unfold.

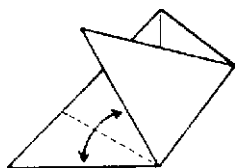


6. The six-pointed star.

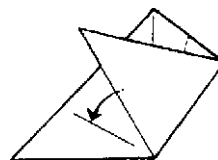
### FIVE-POINTED STAR



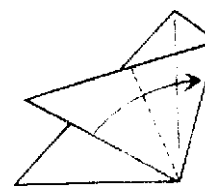
Start by folding steps 1-3 of the hexagon.  
1. Start by unfolding the uppermost flap.



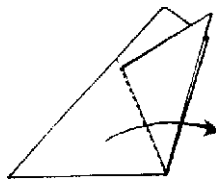
2. Fold the bottom edge to the diagonal edge. Make a crease and open flat again.



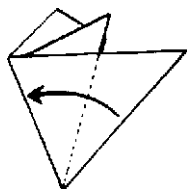
3. Now reposition the triangular flap so that its lower edge lies along the crease made in the previous step.



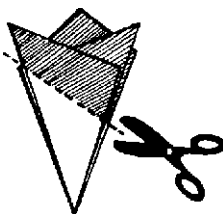
4. Then fold the flap in half.



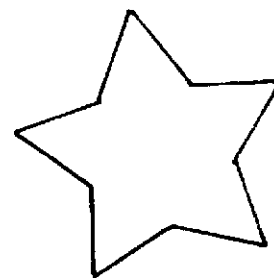
5. Fold the left point across the folded edge.



6. Bring the flap back to the left.

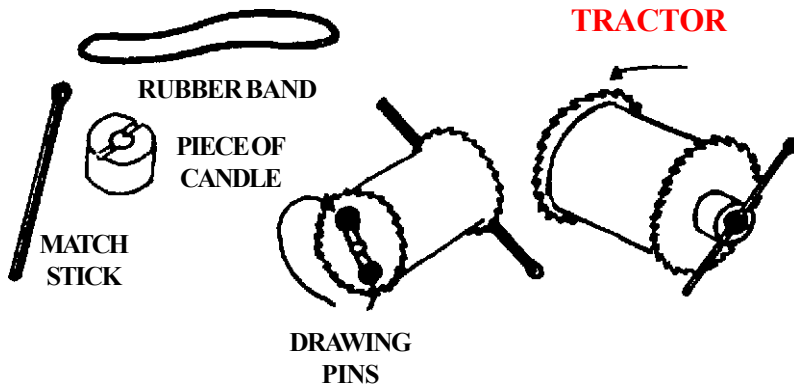


7. Cut from a point about halfway down the right edge to where several folded edges meet at left. Then discard the shaded area and open up.



8. The five-pointed star.

### TRACTOR



RUBBER BAND

PIECE OF CANDLE

MATCH STICK

DRAWING PINS

This simple tractor can move up a slope!

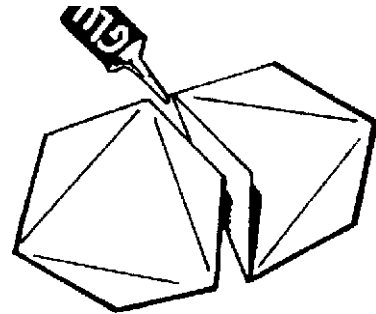
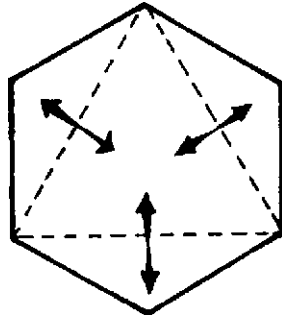
Weave the rubber band through the reel from matchstick to the drawing pins. Wind up the rubber band by rotation the matchstick, and then keep it on an inclined surface to climb.

(Pix: David Horsburgh)

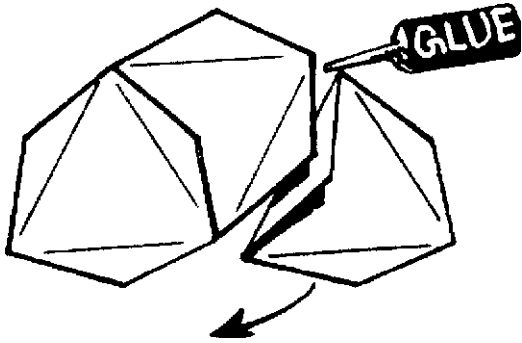
## PAPER BALL

You will need 20 hexagons (page 22) and glue, to make this Paper Ball.

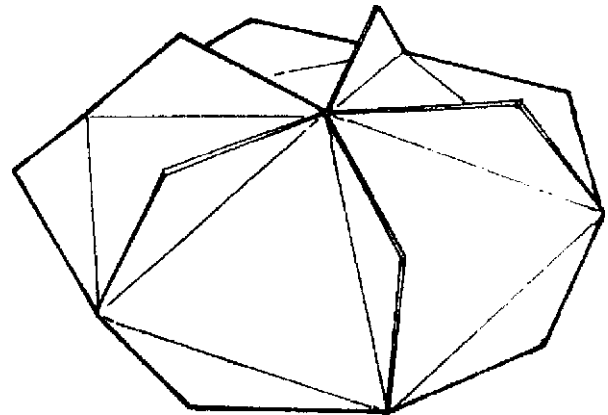
1. Take one hexagon and fold every other one of its corners to the centre. Make firm creases, then let the little triangular flaps so formed stand at right angles to the main area. Do the same with four more pieces.



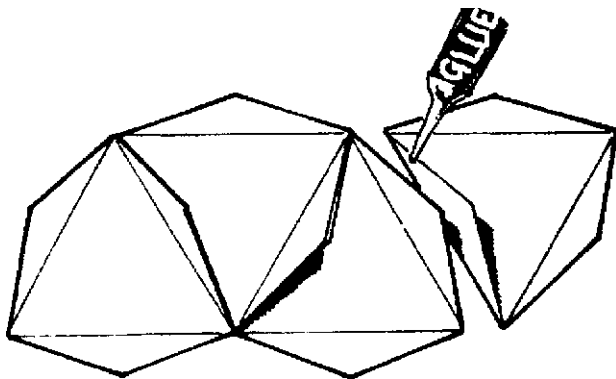
2. Join two pieces by gluing the outer sides of two flaps together.



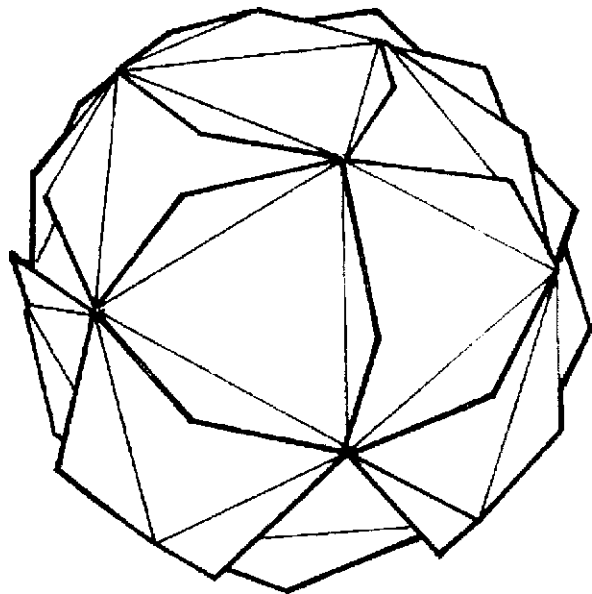
3. Similarly glue a third piece to the first two. Add two more pieces (following direction of the arrow in the diagram) with the fifth piece glued also to the first piece...



4. ... to complete a standing structure which has five triangular sides with little flaps in between. Make another such structure using 5 more hexagons.



5. Now make a chain by gluing the remaining ten hexagons together in line. Note that the first three pieces are joined as shown in step 3 but the fourth piece is differently placed. Glue the two ends of the chain together. Then glue the top and bottom sections in place.



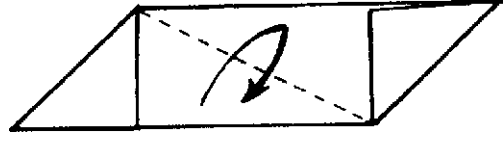
6. The completed twenty-piece ball.

## WOVEN BALL

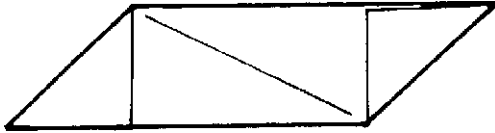
For this ball you will need lots of 1 x 4 strips of stiff paper (about 2-cm x 8-cm).



1. Fold the ends of one strip to the top and bottom edges as shown.

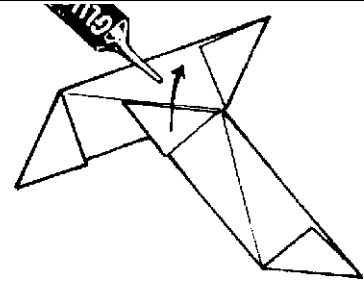


2. Fold the paper on a line between the corners of the two flaps, make a crease and open up...

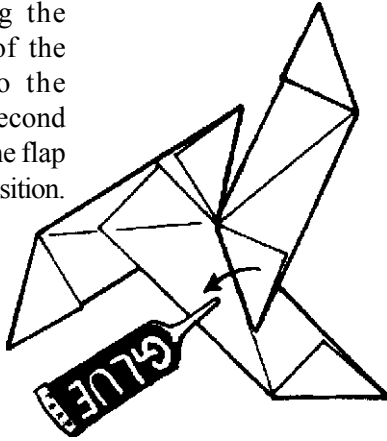


3. ...like this. Do the same with two more strips.

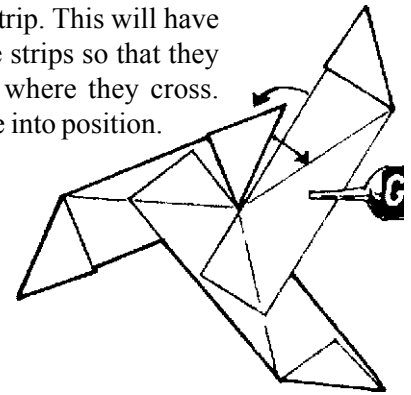
4. Bring the folded edge of one strip to the central crease of another. Unfold the flap and glue in position.



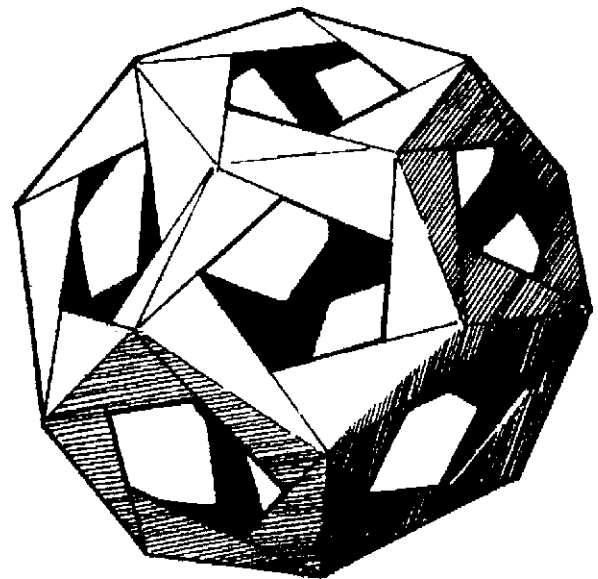
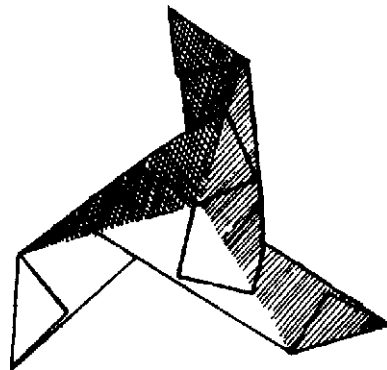
5. Now bring the folded edge of the third strip to the crease of the second strip. Unfold the flap and glue into position.



6. Bring the folded edge of the first strip to the crease of the third strip. This will have the effect of raising the strips so that they form a shallow 'dish' where they cross. Unfold the flap and glue into position.



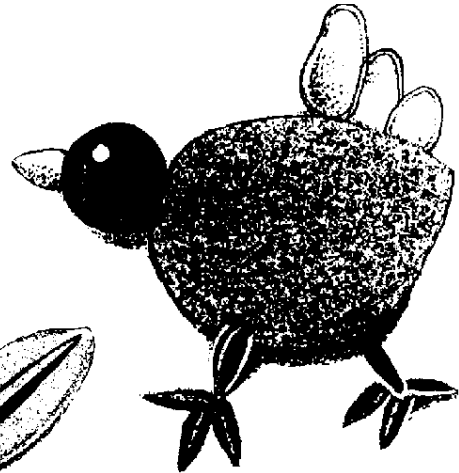
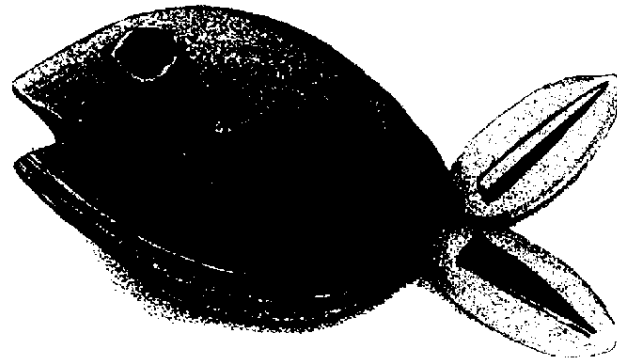
7. This three-cornered structure will form one corner of the final model. Prepare two more strips by completing steps 1-3 and join them to one of the arms in the same way as shown in steps 4-6. This completes a second corner. Prepare more strips and join them similarly to other arms of the growing structure, gradually building it up...



8. ... until the ball is completed.

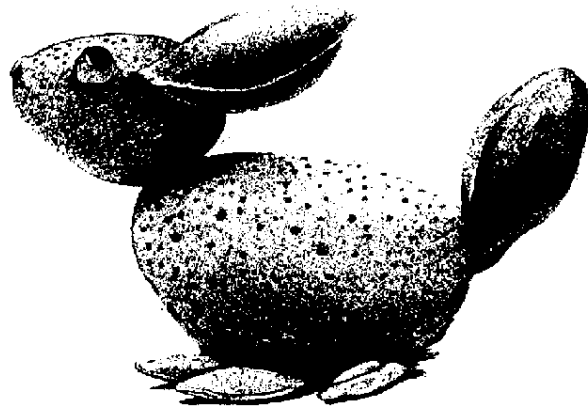
## FUN WITH SEEDS

Chew your fruit  
And smack your lips  
But do not throw  
The stones and pips.

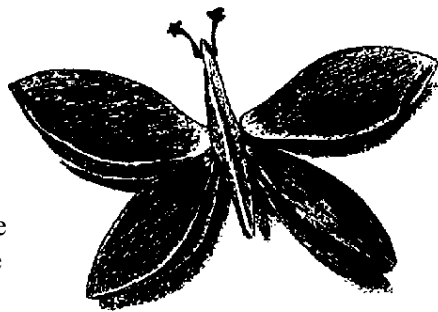


After munching  
Pear or peach  
Keep their seeds  
Within your reach.

Seeds are white  
Seeds are brown  
Pine cones make  
A lovely crown.

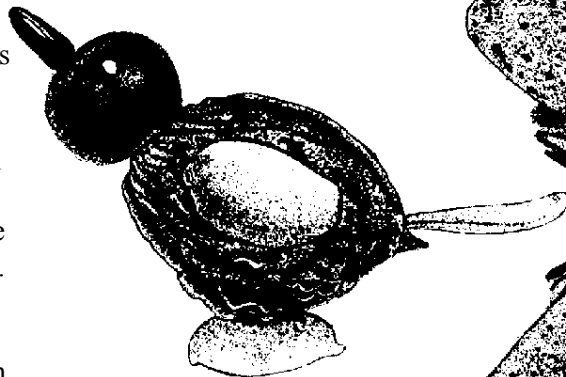


Sort the seeds  
Big or small  
Little animals  
Make them all.

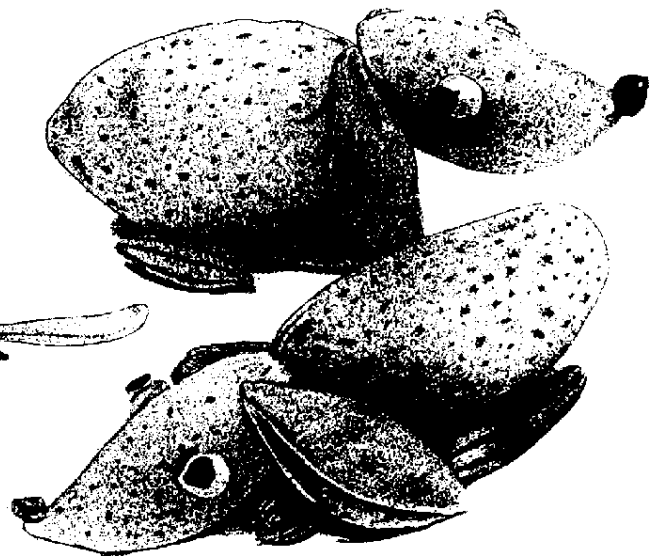


Date seeds have  
A longish shape  
Line them up  
To make a snake

Hard seeds make  
a lovely mice  
Some make penguins  
Which are nice.

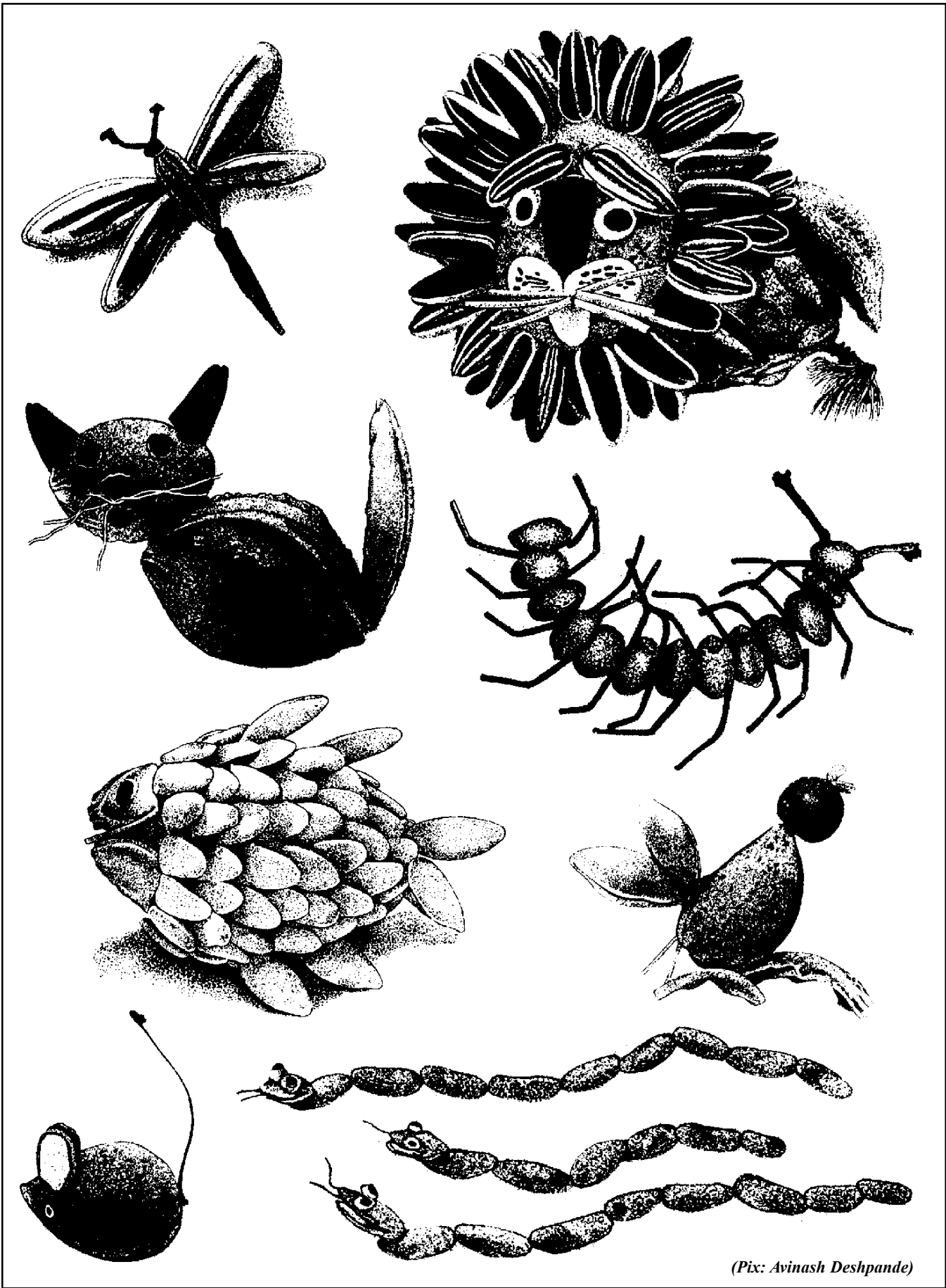


Stick seeds on seed  
And sculpt a beast  
Make lots if you like  
Make some at least.



Scratch your head  
Try Winnie the Pooh  
Some day you might  
Just make a zoo!





(Pix: Avinash Deshpande)

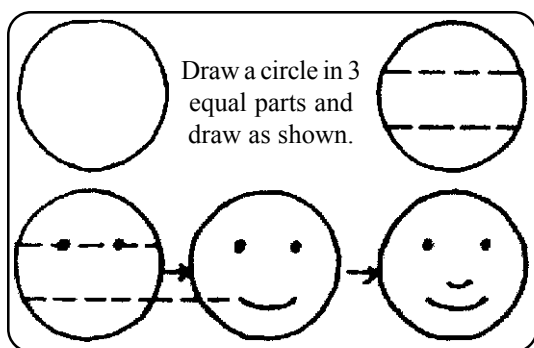
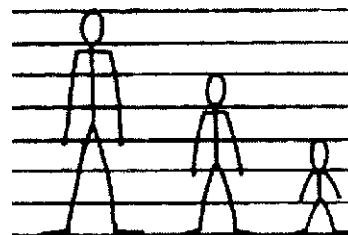
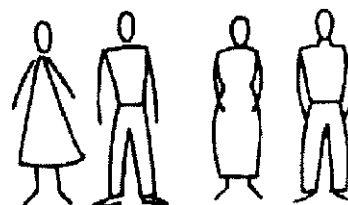
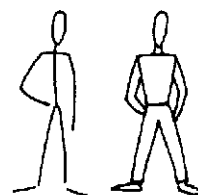
## LOOK AT THAT!

A picture is worth a thousand words. Children think in pictures, not words. Every educator must know how to draw. Simple matchstick drawings make things more lively and easier to comprehend.

Matchstick people are easy to draw and a lot of situations can be depicted using them. Draw a matchstick person first and then fill the limbs out by drawing tubes around them.

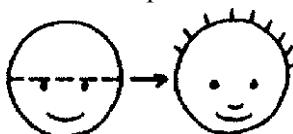
Alternatively, sketch people using a triangle as a basic shape for men and women.

When drawing adults, make the head and the body the same length as the legs. Draw the arms straight first. Draw them to come down below the top of the legs. Do not draw figures with too much detail, for example with noses, ears and so on. To draw adults, children and babies in proportion, notice how many times the head fits into the body. It is a good idea to exaggerate movement when drawing matchstick people. Join up all the lines of the body. Otherwise it may lead to confusion.

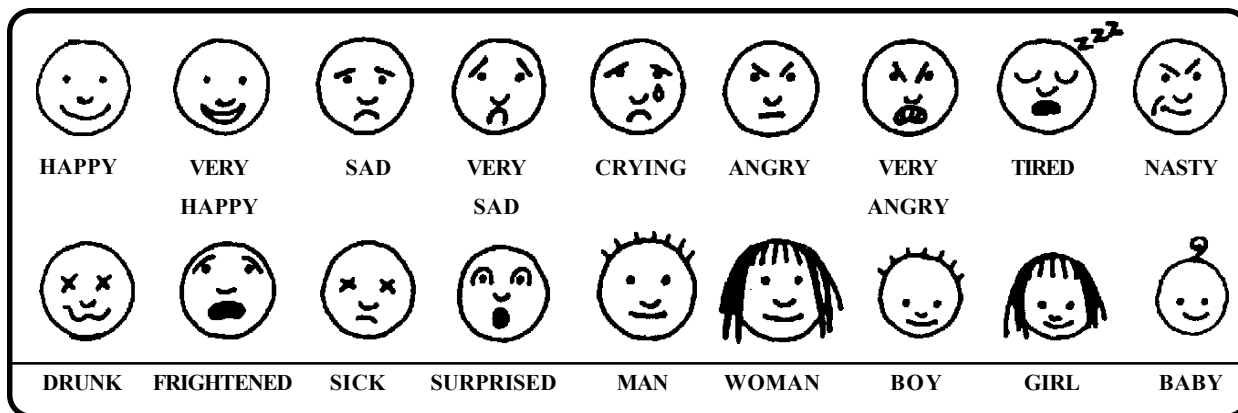


Draw a circle in 3 equal parts and draw as shown.

Draw a simple face.

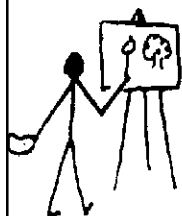


Draw a bicycle.



*(HOW TO MAKE AND USE VISUAL AIDS - Nicola Harford and Nicola Biard, VSO)*

**The Blackboard Book** by Eleanor Watts (Orient Longman, Hyderabad) shows amazing possibilities of depicting things, people, actions and experiences with simple matchstick strokes. A must for every teacher.



ARTIST



BARBER



MASON



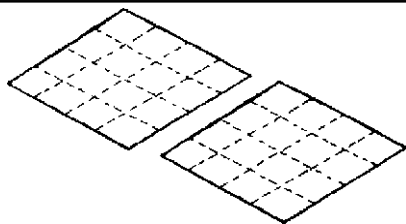
CARPENTER



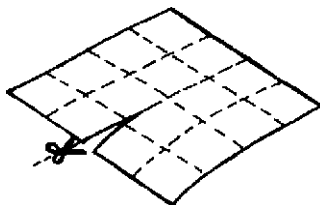
CHEMIST

## THE NEVER ENDING BOOK

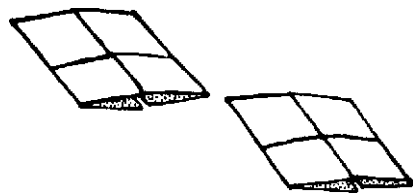
You could flip this fourteen-page book from start to end, and then automatically return to the start!



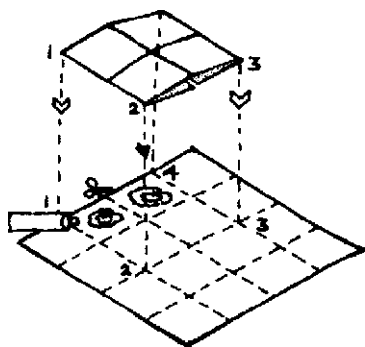
1. Fold 16 small, equal sized squares in two squares (10-cm). They will look like 4 x 4 pieces.



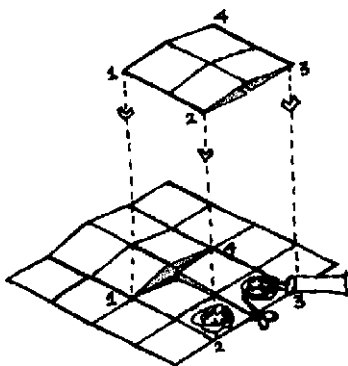
2. Take one 4 x 4 piece and cut it along the midline to make two 4 x 2 pieces.



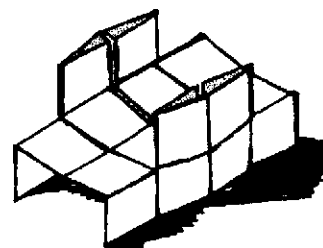
3. Fold the doors of both 4 x 2 pieces.



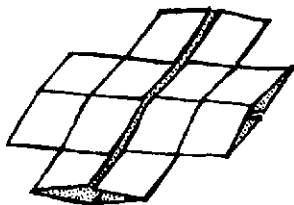
4. Take the other 4 x 4 square and cut it along the midline only up to the centre point. Apply glue to the two little squares and stick one 4 x 2 piece as shown.



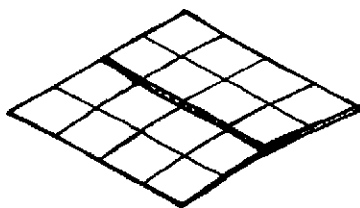
5. Again cut the midline from the other end to the centre point. Apply glue on the two little squares and stick the second 4 x 2 piece in place. The flexagon is complete now.



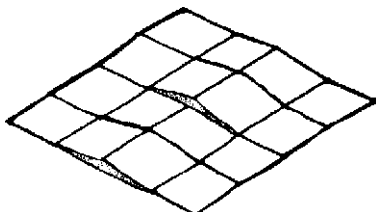
6. The assembly shows two 4 x 2 beds, placed side-by-side. The two 4 x 2 pieces have their folded doors facing each other.



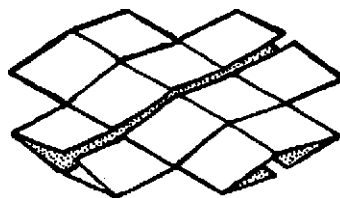
7. Now hold the tips of the head and foot rest and fold them outwards to get a flat, cross shape.



8. On opening out the middle flaps of the cross there will be a flat formation with 16 little squares in it. You can start your 14 page, picture book from here. Each 2 x 2 piece would represent one page. These will be the first four pages. Open out the middle flaps again to get the next four pages.



9. Once again open out the middle flap to get the next four pages. There will now be 12 (2 x 2) pages.

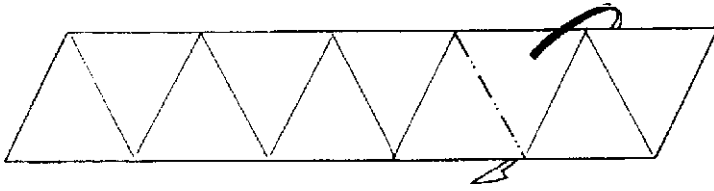


10. On opening the middle flaps of the doors you will get a cross shape and pages 13 and 14.

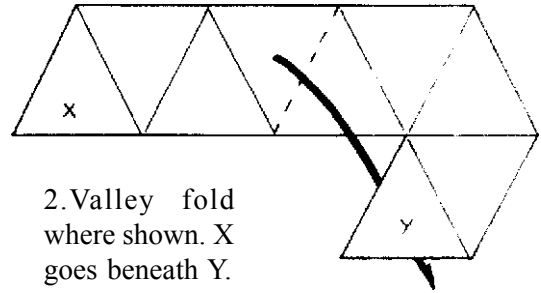
*(Pix: Vishwas Thoke)*

## KALEIDOSCOPE

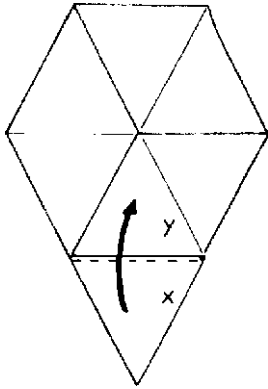
This truly fascinating model will provide you with hours of fun!



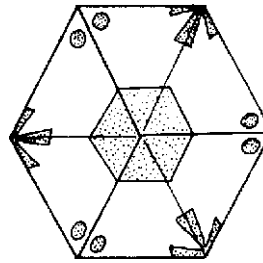
1. With a protractor, make a strip of 10 equilateral triangles; of side length 5-cm. Mountain fold the marked line.



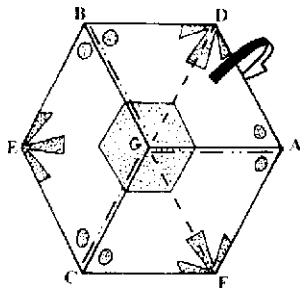
2. Valley fold where shown. X goes beneath Y.



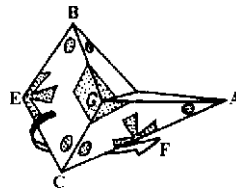
3. Glue triangle X, then valley fold it onto Y to stick them together.



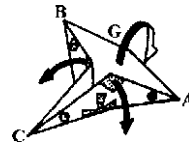
4. The Kaleidoscope is now complete. Decorate as shown. Be careful to put the circles at the three corners, which have, and edge of paper leading into the center of the hexagon.



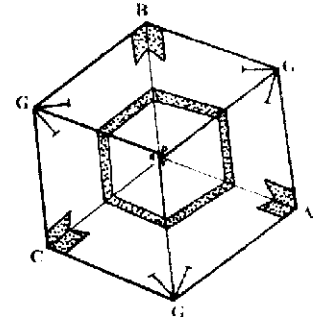
5. To change the pattern, collapse along 5 creases radiating from the centre.



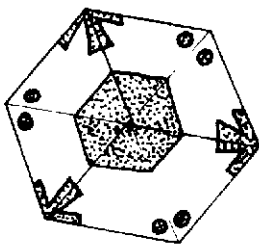
6. Fold E behind to touch F.



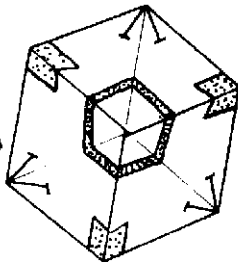
7. If you open out at the top.



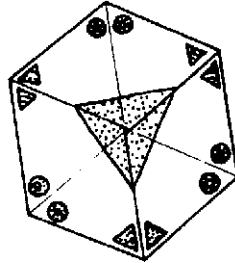
8. Then you will see a blank hexagon.



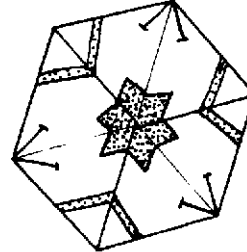
9-a



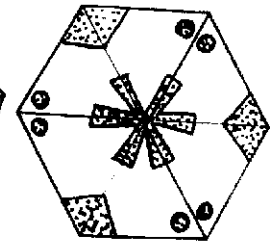
9-b



9-c



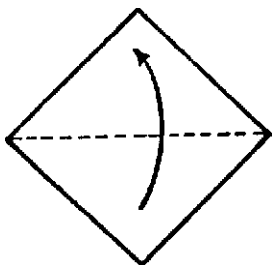
9-d



9-e

9. Decorate this step as shown in 9-b. Flex again to reveal another blank hex. Colour it as shown in 9-c. Flex again to return to 9-a. Turn over. Continue to flex and decorate. Once you learn to change the "patterns" you can make a coloured picture book of your own.

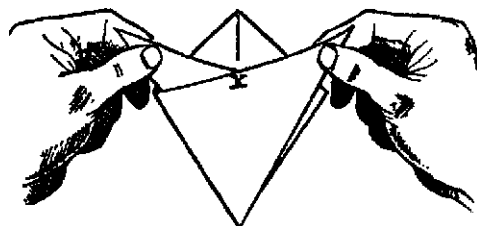
## SNOWFLAKE



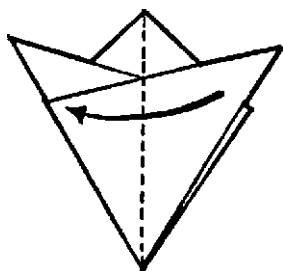
1. Take a big square from a newspaper. Fold two opposite corners to make a crease. Open up again. Fold the other two points together and leave folded.



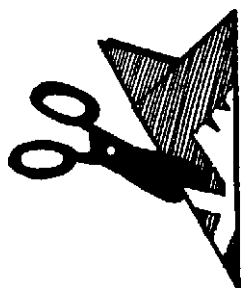
2. Making sure that the creases start from the centre of the folded edge, bring the two side points forward to lie across each other.



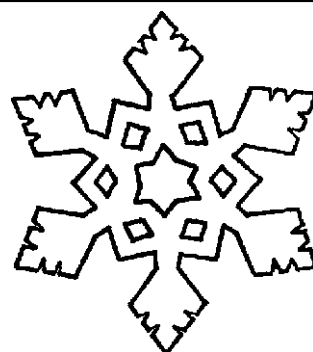
3. Carefully pull the points apart so that the angle where the edges of the two flaps meet (point X) is in line with the vertical centre crease. Now crease firmly.



4. Fold in half from right to left.



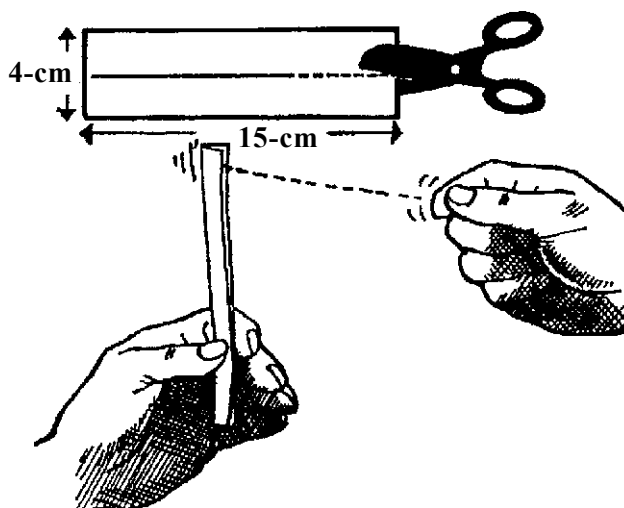
5. Make cuts through all layers, discarding the shaded area, and unfold.



6. To find the snowflake patterns. Make variations to produce more patterns.

## INVISIBLE THREAD

1. Cut out a rectangle of paper about 4-cm x 15-cm. Cut along the centre line to about 5-cm from one end and fold the paper in half once more.



2. You can amuse a younger brother or sister by pretending to tie a thread to the paper and then acting as if you were pulling it. (In fact, you hold the paper at the cut end and secretly move it with your thumb.) By matching the movements of your free hand with those of the paper, you can almost convince onlookers that you are pulling an invisible thread.

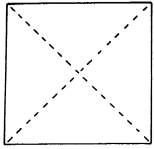
## BABLU'S BOAT - A PAPER FOLDING STORY

An amazing Origami story!

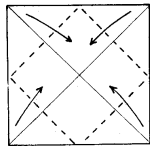
You keep folding the SALT & PEPPER BOX (*Din-Raat*) and simultaneously keep telling the story.

Bablu grew up in the city. Once he visited his grandparents in the countryside. There was a big pond near their house. Bablu wanted to sail in a boat. His grandpa gave him some money to buy a boat.

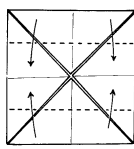
**In the meantime fold a 20-cm square from step 1 to 6.**



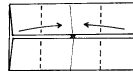
1. Take a square (20-cm side).



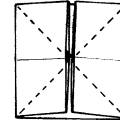
2. Fold all 4 corners to center.



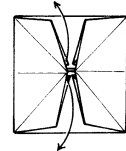
3. Fold sides to middle.



4. Again fold sides to middle.



5. Crease along marked lines.



6. Pull out the two arrow points.

Bablu went to buy a boat. While walking Bablu came to a store where they sold all kinds of interesting trinkets. "There is something I think Grandma would like to have."

"What is it?" Bablu asked the man at the counter.

"Well it is box to keep salt and pepper," replied the shopkeeper. Bablu bought it.

He hadn't gone very far before he came to another store where there were some more interesting trinkets. Bablu found a well-crafted fruit basket in this shop. He went to the shopkeeper and said.

"Will you give me this fruit basket for the salt-cellar?"

The shopkeeper was a kind man. He gave Bablu the fruit basket in exchange for the salt-cellar.

But pretty soon Bablu started having doubts about the fruit basket. "What would grandma do with this silly thing?" Soon he came across a shop selling clothes. "I'll see if I can exchange this basket for something for grandma to wear," he said to himself. He asked the man in the store:

"Why yes, I'll give one of those jackets and some money too, because the fruit basket is worth more than this." And then he held up the jacket.

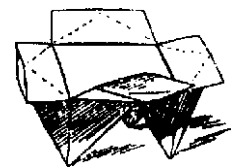
And now that Bablu had something for his grandma he felt he ought to get something for his grandpa. Because he had bought a jacket for his grandma, he thought of buying a pair of trousers for grandpa.

By now Bablu had almost forgotten the purpose of his visit. He suddenly saw the sign: '**BOATS FOR SALE**'.

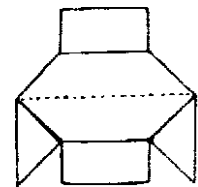
"That's the place I'm looking for," he said and went in. When Bablu told the man what he wanted the man said, "Yes, we have boats for sale, come out in the yard and see them." But then Bablu found that they were motorboats, each with two funnels, and he had to say, "I don't want a motor-boat, I want a boat which, I can row."

"All right, said the man, down the street a little way you'll find another place, which might have a row boat." So along the street Bablu went.

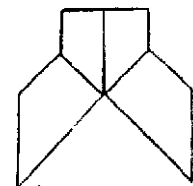
He began to think maybe his grandma and grandpa would like to buy their own clothes, and just then he found himself in front of a furniture store. He spotted a pretty table in the store. He liked it instantly. So he went in and said to the man, "Would you give me that table for this trousers and jacket?" "Why, yes," the kind man said, "I'd be glad to." So Bablu carried the table and started to walk.



**SALT CELLAR  
FRUIT BASKET**



**JACKET**



**TROUSERS**



**TABLE**

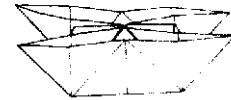


By this time he had walked a good deal and felt very thirsty. He began to wonder where to get water to drink. Suddenly, he spied a windmill. He knew there would be water where there was a windmill and so he went over and got a drink of water.

WINDMILL



And now at last he saw that sign **BOATS FOR SALE**, so he went into the store. "I am looking for a rowboat," Bablu said. "Well," the man said, "I have some rowboats, but they are all twin boats."



TWIN BOATS

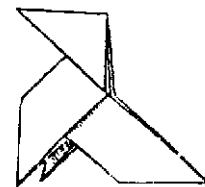
"What in the world could I do with boats like that," Bablu said and walked out. "Well," the man said, "go down to the next corner, and turn to the right: you'll see a place where they sell boats. Maybe that man has rowboats."

So along Bablu went, carrying the table. He came to the store and asked the man if he had boats for sale, the man said, "Why yes, we've got boats for sale. Take a look at them."



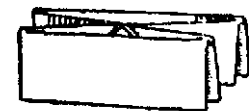
SAIL BOAT

But when Bablu saw them he said, "Why they are all sailboats, whereas I want a rowboat." So he could buy none there.



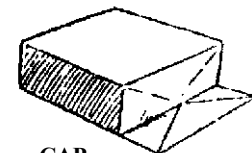
ROOSTER

All this while Bablu had been lugging the table on his shoulder. Suddenly, it began to feel very heavy and he began to wonder, why he bought it in the first place. "Grandma has plenty of furniture," he said. Just then he came out and saw a chicken scurrying in an open field. "There," he said, "we haven't a single chicken in our place. Couldn't I trade this table for one." He spoke to the farmer and the farmer said, "Why yes, how would you like to give me your table for this rooster." That is what Bablu wanted. So he gave the farmer the table and put the rooster under his arm and started on.



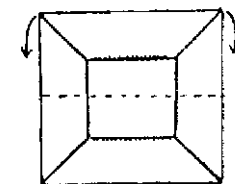
POCKET BOOK

He'd gone a good way by this time. He realized that he still hadn't bought the boat. The thought made him uncomfortable. By now he did not have enough money to buy a rowboat. While he was wondering what he should do a sudden gale of wind blew his hat off, and when he raised his hand to catch it, the rooster got away! There, he had spent a fortune and the rooster flew away and so did his hat! And so he walked along thinking very hard, looking down at the ground. All of a sudden he spied something and stooped over and grabbed it. It was a pocket book with some money in this side and some in this. By this time he was pretty well out of the village. There was not a soul in sight. So he said to himself. "Well, now I'll use this money to buy a boat."



CAP

"But first, I must get a hat. I can't go home this way," he said to himself. So he found a store and bought this cap.

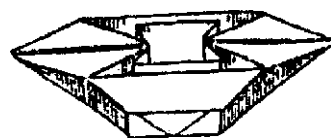


PICTURE FRAME

Then he thought, "I really ought to take something home for grandma." The only thing that didn't cost too much was this picture frame. He thought it would be nice for grandma to put his mother's picture in the frame.

By this time the day was nearly gone and he said, "I'll buy any kind of boat now, I don't care what it's like. The next place I find where they sell boats, I'll buy one of them." So he kept looking for a sign, until after a little while he saw one, **BOATS FOR SALE**. In he went and asked the man, "Can you sell me a boat?" "Yes," the man said, "but I've got the queerest looking boats you ever saw."

Never mind," Bablu said, "I've been looking for a boat for such a long time, I'll take any kind of boat." "Here they are," the man said and when Bablu asked him what they were he said, "We call them Chinese junks." So after all the trouble, Bablu got a boat at last and went home happy.



CHINESE JUNK  
(INTERIM)



CHINESE JUNK

## THINKING OUTSIDE THE BOX!

Some 'tricks' or puzzles can be used to help children realise the importance of looking at things in new ways – of going beyond the limits their own minds have set. Here is an example.

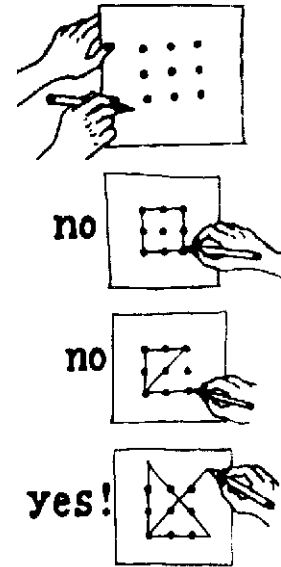
Draw 9 dots on a paper, on the blackboard, or in the dust, like this. Ask everyone to try to figure out a way to connect all the dots with 4 straight lines joined together (drawn without lifting the pencil from the paper).

You will find that most persons will try to draw lines that do not go outside the imaginary square or 'box' formed by the dots.

Some may even conclude that it is impossible to join all the dots with 4 lines.

You can give them a clue by saying that, to solve the puzzle, they must go beyond the limits they set for themselves.

At last someone will probably figure out how to do it. The lines must extend beyond the 'box' formed by the dots.



Teachers will be able to help children *learn by doing* if they, themselves *learn by doing*.

To set a good example, teachers need to:

Treat children as their equal – and as friends.

Respect their ideas and build on their experiences.

Invite co-operation; encourage those who are left behind.

Make it clear that we do not have all the answers.

Welcome criticism, questioning, initiative, and trust.

Always be on the side of the children.

These ideas are beautifully expressed in this old Chinese verse:

*Go in search of your people  
Love them  
Learn from them  
Serve them  
Begin from what they have  
Build on what they know.*



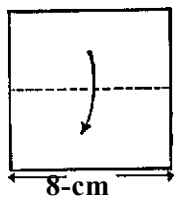
*But of the best leaders  
When their task is  
accomplished,  
Their work is done  
The people all remark  
“We have done it ourselves!”*



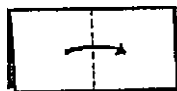
**In what ways do our  
schools help this child  
to meet his needs?**

## FLYING CROSS

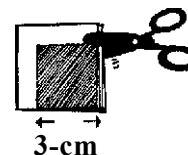
You will need a piece of stiff card sheet, pencil and ruler and scissors for making this model.



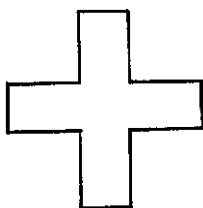
1. Cut a 8-cm square from a card sheet. Fold its top edge to the bottom.



2. Fold the left edge to the right.

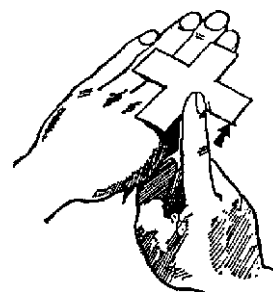


3. Measure 1-cm in from the left hand and down from the top. Draw these lines. Cut along the lines through all four layers and remove the shaded area.



4. Unfold the paper and you will have a cross. Smooth out the creases.

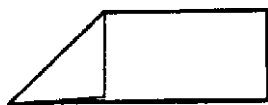
5. Place the cross on the back of your left hand so that one of its arms lies along your forefinger. Keeping your left thumb tucked out of the way, strike the edge of the arm which sticks out with your right forefinger. The cross will spin away and back again like a boomerang.



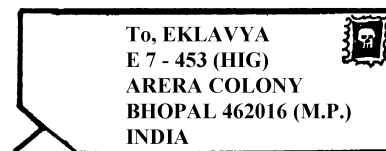
## SELF-OPENING ENVELOPE

This is a very clever way of opening a letter.

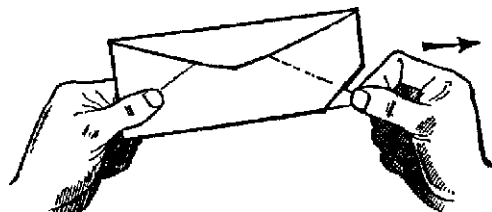
First write a letter and address an envelope in the usual way. Then fold the letter to fit the envelope.



1. Fold the letter so that one end lies along the bottom edge.



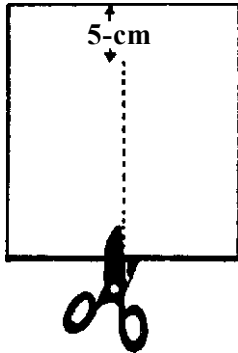
2. Cut off one corner of the envelope. Place the folded letter inside with the pointed end sticking through the hole in the envelope. Seal and post.



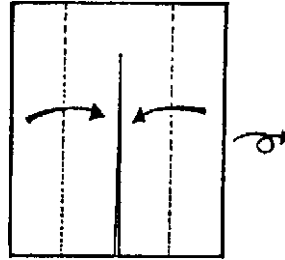
3. To open, just take hold of the point and pull sharply. The letter will slice through the envelope like a knife.

## INSECT RACE

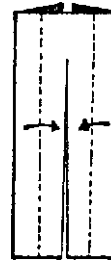
You will need one sheet of paper. One 4-cm square coloured paper, pencil, ruler and scissors.



1. For the track fold the two longer edges of the sheet of paper together, crease and open up. Cut this crease line up to about 5-cm from the top.



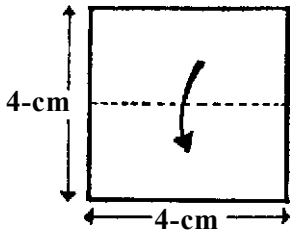
2. Fold the two sides to the centre line. Crease firmly and turn over.



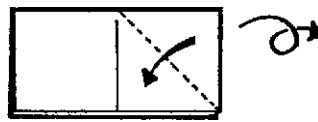
3. Turn over. Bring the two folded edges to the centre line and crease firmly.



4. Draw a horizontal line about 5-cm from the top (where the cut ends). This completes the track.



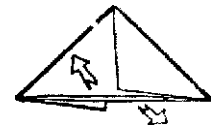
5. To make the insect: fold opposite sides of the little paper square together in turn and leave folded in half.



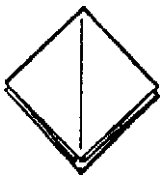
6. Make sure the folded edge is at the top; then fold the top right corner to centre bottom. Turn over.



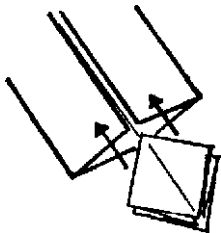
7. Fold the top right corner to centre bottom.



8. Now pull the middle layers apart, opening out the centre. Allow the two sides to flatten out and the corners to come together in the centre.

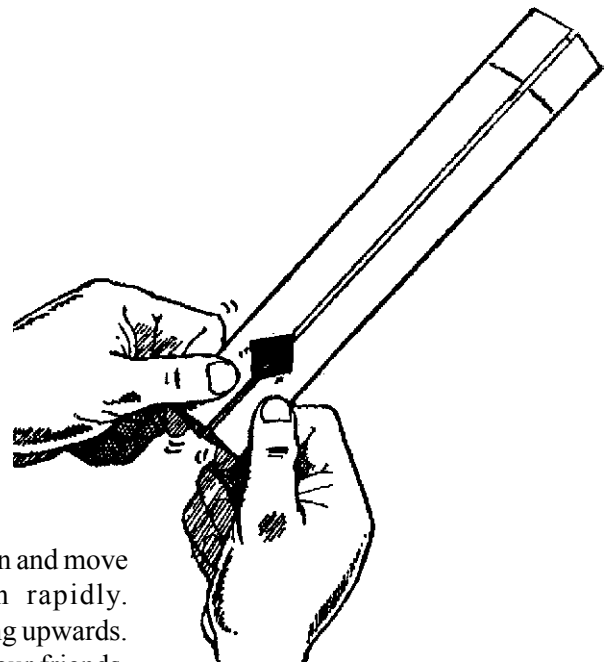


9. This completes the insect.



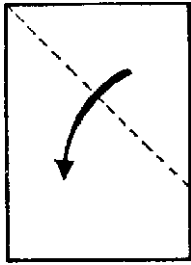
10. Slide the insect into the track - with its triangular flaps in the track.

11. Now hold the track as shown and move each hand back and forth rapidly. You will find the insect climbing upwards. Organize an insect race with your friends.

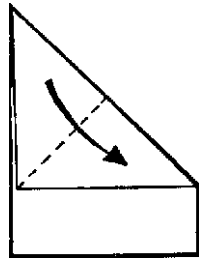


## ORIGAMI PLANE

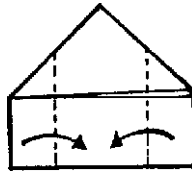
For making this delightful plane you will need a sheet of bond paper.  
First fold the two longer edges together, crease and open out. This is to make the vertical centre line.



1. Fold the top edge to lie along the left edge.



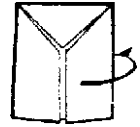
2. Fold the left edge to lie along the horizontal edge.



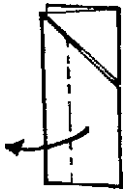
3. Fold the two sides to the centre.



4. Fold the top point down.



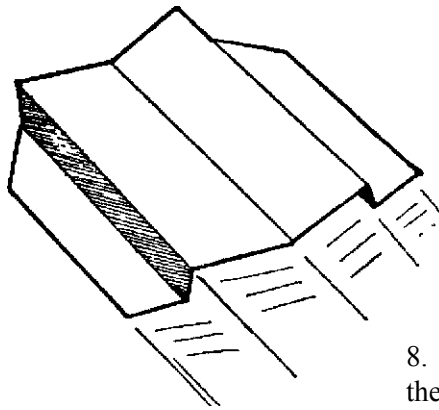
5. Fold in half behind.



6. Fold the top flap to the left. Fold the rear flap in the same way...



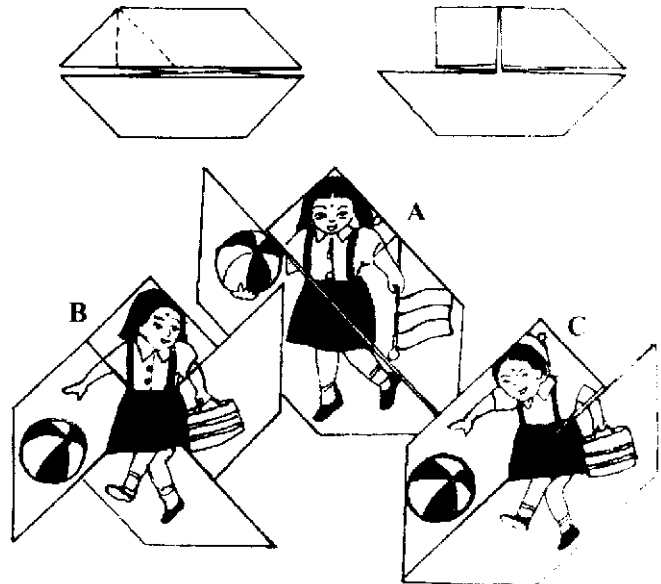
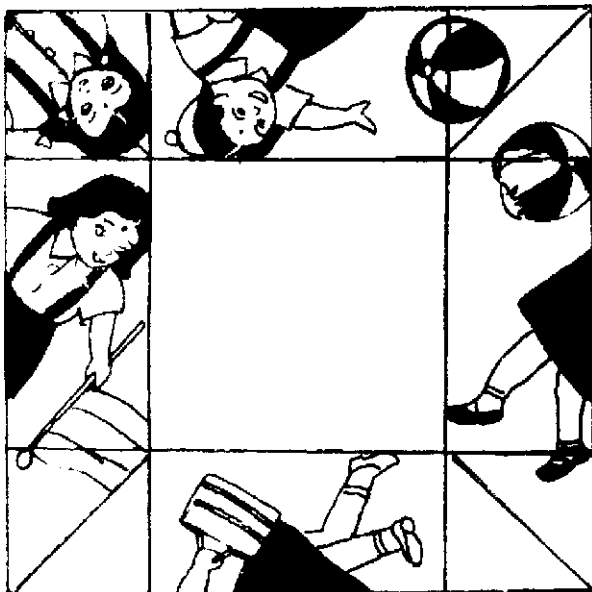
7.... like this. Open out.



8. Launch the plane into the air and watch it fly.

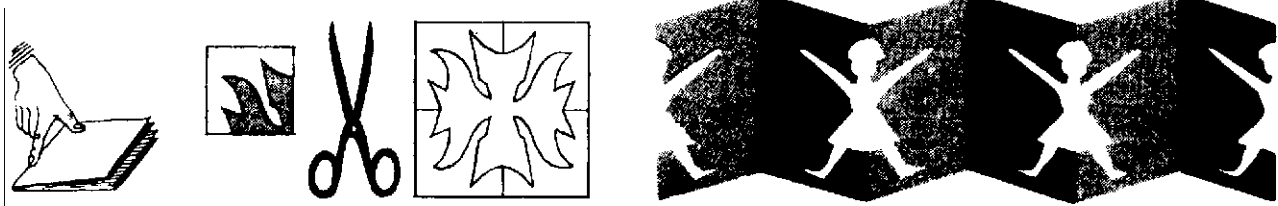
## PICTURE MAGIC

Take a 15-cm square of white paper and copy the picture shown in the diagram. Fold it like a double boat - see *Bablu's Boat* (page 32). When you lift up one corner of the model and squash, you will see the picture in A. By opening and closing the flaps of the folded model you will see pictures B and C.



(ORIGAMI Volume II - Indu Tilak)

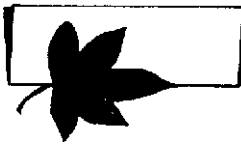
**PAPER-FOLDING AND CUTTING**



Fold twice and cut out shape:

Make multiple fan-folds in a paper and then cut out half a figure.

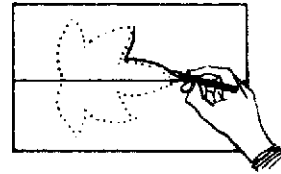
**PAPER FOLDING AND PRICKING**



Take a leaf and place it on a folded piece of paper:

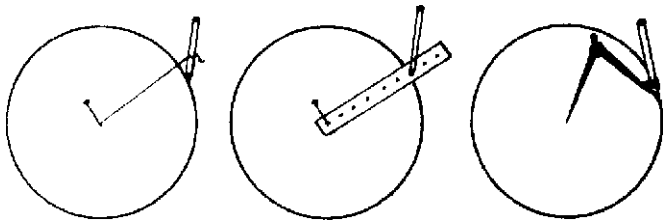


With a pin prick round the half shape:



Draw round the pin marks and you will have a shape that balances.

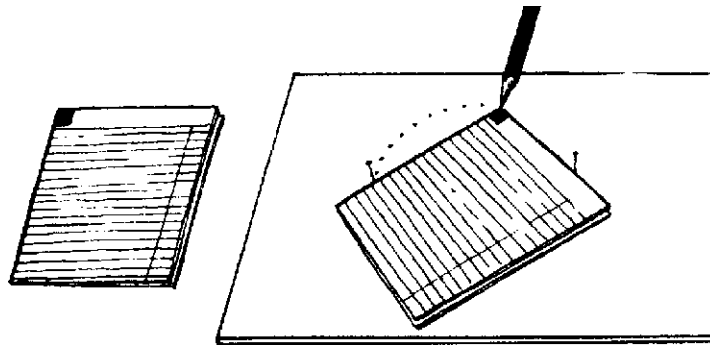
**DRAWING CIRCLES**



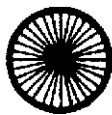
These are the regular ways of drawing a circle.

But here is an unusual way.

Take a rectangular piece of paper. Place two pins on a piece of board about 4-cm apart. Move the right angle between the two pins so that the sides of the paper touch them. Mark a dot at the right angle and move the position several times. When you have completed the semi-circle point the right angle the other way and complete the circle.



clock



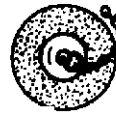
wheel



eye



potter's wheel



bath plug

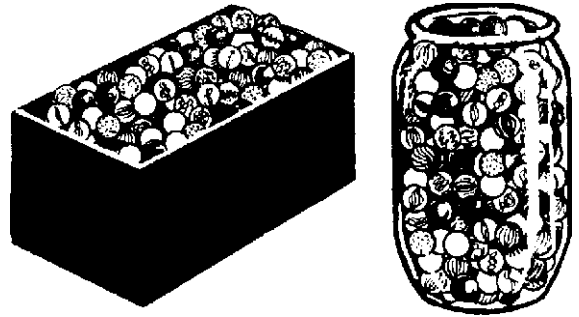


fried egg

**CIRCLES ARE IMPORTANT AND WE FIND THEM EVERYWHERE**

## CLOSE PACKING

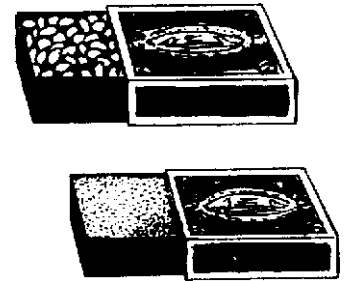
Make a collection of containers and investigate the amount each holds. How many marbles can be packed into an empty jam bottle? First make a guess. Then test your estimate by actually filling the bottle with marbles. Do the same thing with a rectangular chalk box. Try filling a number of matchboxes with different objects.



## TINY THINGS

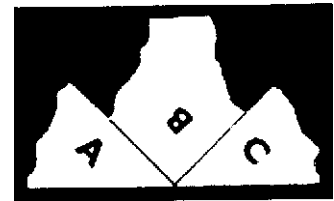
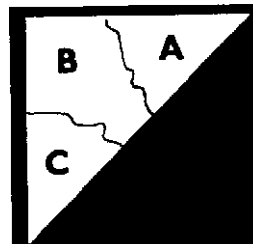


How many different things (one specimen of each) can you fill in a standard matchbox? For doing this you will have to start looking for the tiniest things around you. One school girl was able to pack more than 250 different specimens in a single matchbox! (Start collecting things like hair, mustard seed etc.)

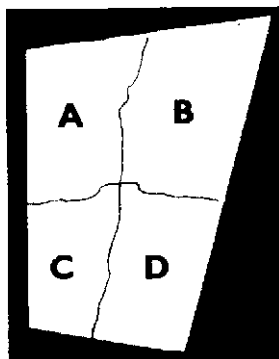


## ANGLES OF A TRIANGLE

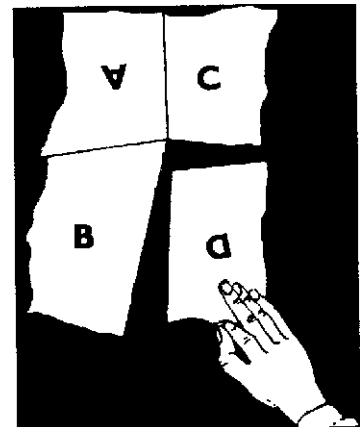
Tear the triangle into three parts and then bring the three angles together to make 180 degrees. Try this with different triangles.



## ANGLES OF A QUADRILATERAL

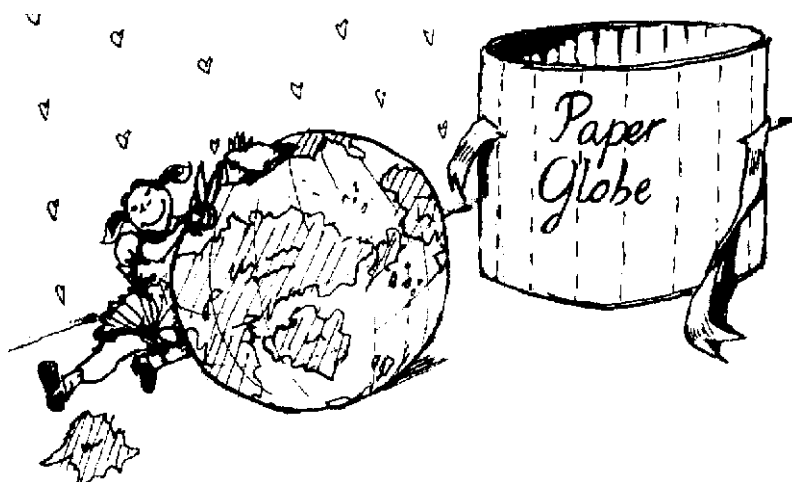


Take any four-sided quadrilateral. Tear it as shown into four parts. Then bring the four-corners of the quadrilateral together. They will snug into each other to add up to 360 degrees. Try this exercise with different shapes of quadrilaterals.





## SURFACE AREA OF A SPHERE



An impulsive little girl who had just been given a paper globe found nothing better to do with it than to cut it into thousands of tiny pieces. Since she still had the cylindrical container (like a tube) that it came in, she decided to unroll the box and glue the pieces inside. The box was originally big enough for the whole globe, so she assumed that there would be plenty of space.

She was astonished to discover that she needed to use the entire surface to glue all the pieces of the globe. Her impulsiveness did not prevent her from having a flair for geometry, so she realised that the surface area of the cylindrical box must be equal to the surface area of the enclosed sphere.

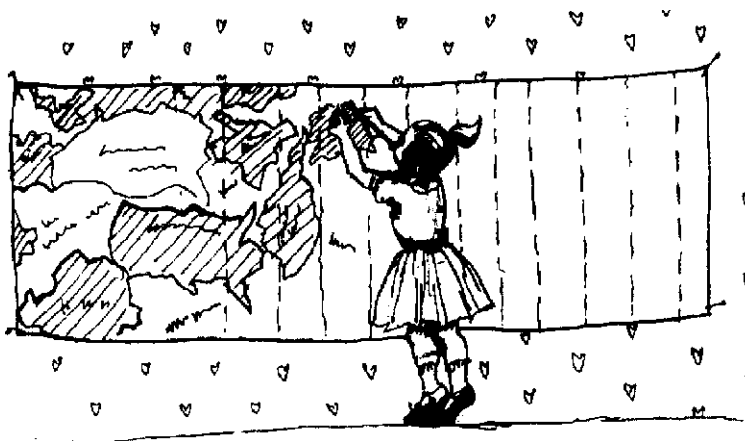
Since the height of the cylinder is twice the radius  $R$  of the sphere.

The circumference of the base of the cylinder will be  $2 \times 3.14159 (\pi) \times R$

The area of the cylinder will be  $A = 2 \times R \times (\pi) \times R$  or  $A = 4 \times 3.14159 \times R \times R = 4 (\pi) R^2$

Reflecting on her discovery, she concluded that since the radius of the earth is about 6400 kilometres, its surface area must be approximately

$A = 4 \times 3.14159 \times (6400) \times (6400) \text{ km}^2 = 515 \text{ million square kilometres.}$



(Pix: THE MOST BEAUTIFUL MATHEMATICAL FORMULAS, Salem)

## MATCHSTICK MATCHING

Move only as many matches as directed and create as many squares as requested.  
(Squares can overlap or have corners in common.)

	CHANGE 2 STICKS	CHANGE 3 STICKS	CHANGE 4 STICKS
MAKE 2 SQUARES			
MAKE 3 SQUARES			
MAKE 4 SQUARES			
MAKE 5 SQUARES			

## WHERE WE COMPETED WITH OURSELVES



My school in Japan was a British School called St. Michael's International School. It was in Kobe. When I went to Japan I had passed Standard III from St. Anthony's High School in New Delhi, so I was admitted to Standard IV and was in that school for three years.

This year I finished my schooling and now I am in a college! When I look back at the eight different schools I attended, I realise that St. Michael's has made me what I am today. My teachers there taught me to enjoy studies, to do original thinking, to love myself and to love the world.

In Standard IV my teacher was Mr. Shand. He taught us everything except music, physical training, Japanese and a subject called as reading skills. There was no fixed curriculum or textbooks, which had to be covered. At least Mr. Shand seemed to have all the freedom to decide how best he would develop his students to pull them up to the level of mental growth expected of a particular age group.

In history we chose topics of our interest from the ones Mr. Shand gave. Mr. Shand told us to collect all the information on the topics of our choice by referring to the books in the library, which were selected after consultation with the librarian. We worked either individually or in twos. Geography was taught partly in the same way, and partly in outdoor lessons when he took us out for walks in the mountain and showed us how rivers and lakes were formed, how plantation was done to stop the erosion of soil and so on. In the same way, from the top of the mountain he explained to us why population is dense on the plains, and why industries grow around the port. We had no tests, no homework exercises, no examinations, and yet we thought we had learnt geography very well.

For English we not only read books recommended by the teacher but also the books we thought we should enjoy. In the class we wrote our own stories and poems. The teacher would sometimes give us a topic, sometimes he gave us a line or sometimes he showed us a picture on which to write the story. Mathematics constituted of sets of cards of different levels. We were required to work through them at our own speed and capacity. So at any given time in a class, there would be students doing Math of the level of a class below or two classes above.

Science consisted of studying slides ranging from cells to the moon. Everything we were taught was supported by practical examples. For example, in Standard V we were to study parts of the human body. We were given two plastic models - actually we were given parts - one male and one female. We had to identify each part, paint it and fit it in its place to construct the model. In science too, the emphasis was on understanding and not on reproducing. We did not have to write answers to questions. While studying blood cells, we were asked to prick our own fingers and make slides, which we observed. And all this we did in standard IV!

Music lessons were great fun! Our teachers taught us all kinds of songs and moreover taught us how to play them on a recorder. We would also play musical Bingo where prizes, would be rubbers and chocolates, the aim would be to teach us various kinds of musical instruments and musical notes. We had lessons in folk dancing, which we thoroughly enjoyed. But what we enjoyed most was the play-acting. Our teachers told us to select a story, write a short play on it, form groups, distribute the roles and enact it. Everyday our first period was used this way and we all thought it was the best possible start for the day at school.

In one term Mr. Shand hit upon a novel idea! He announced in the class that we were going to make a film during the term and the film included all our studies! So he suggested a few themes for the story. We selected 'The Time Machine'. We invented a suitable story making the time machine run into the remote past and also the remote future.

We wrote the dialogues. We made costumes. We made the time machine. Mr. Shand taught us about the make-belief world of films and so we decorated our time machines with all sorts of things like springs, wheels, tapes and what not! We had outdoor shooting in a forest and we wore strange costumes as barbarians! It took us two and a half months to complete the film and we thought we had learnt a lot during those days, much more than what we would have learnt from textbooks. In Christmas parents were invited to see this ‘great’ film made by Standard IV pupils and the parents were so proud of their little ones who had turned into stars!

We had library period once a week. It was not just for returning and borrowing books, but we were also shown how the library works - how books are registered, how they are arranged on shelves and so on. Two students were actually made to sit next to the librarian and they stamped the books given out and put back the books returned.

Once Mr. Shand asked us in the class what we wanted to do in life and I was the only one who said, “I want to be a writer”. Mr. Shand liked that idea. He said, “Why not start from today? Write a storybook for our K.G. classes. Draw some pictures. Make it a neat manuscript. And then I will ask the K.G. teacher to read it out to the students. We will go and see how they like it!” I was so thrilled! I remember at least five of my books were read this way, and the little children told me, “Radhika! It’s a beautiful story. I liked it!” But Mr. Shand did not stop there. He said to me, “Radhika, when you will become a great writer, you will need to know typing. I am arranging typing lessons for you everyday in the recess. Let’s go to the office and fix it”. So for two years I learnt typing from the age of nine!

Mr. Jackson, who was my teacher in Standard V, has etched a permanent corner in my heart for himself. He was 40 years old and a confirmed bachelor. He hated competition and wanted each child to think highly of itself. In Standard V there was a girl who was still doing Standard IV Math, but when we did our respective sums correctly we all got ‘excellent’ in our notebooks.

Once he said to my mother, “If at all you must compete, you must compete with your own self. Try to improve yourself day after day. That is the message of Hinduism, isn’t it? In every life your soul becomes purer till it attains freedom. What a wonderful idea!”

I don’t remember the exact wording of the motto of St. Michael’s but its meaning was, ‘A child should never feel that it is treated unfairly’ and every teacher strove to live up to it. We were free to argue with our teachers. They always wanted to understand why we were doing a particular thing. Not one teacher was authoritative, nothing was forced on us.

*(Radhika Aradhya)*

#### Solutions to Cryptograms

1. S = 1, O = 7, I = 3, L = 4, B = 6, Y = 2.
2. S = 3, L = 0, Y = 6, R = 5, I = 9, G = 1.
3. C = 1, R = 4, A = 9, B = 5, S = 0.
4. M = 4, E = 6, A = 2, L = 1, S = 5.
5. T = 9, E = 0, P = 1, I = 5, L = 7.
6. P = 8, E = 1, N = 3, R = 6.
7. D = 8, O = 4, G = 9, F = 1, A = 0, N = 2, S = 7.
8. H = 9, O = 3, T = 2.
9. L = 6, U = 7, S = 1, H = 9, E = 0, R = 5.
10. S = 5, P = 9, I = 4, T = 6.
11. T = 2, A = 5, P = 8, E = 6.
12. S = 9, E = 5, N = 6, D = 7, M = 1, O = 0, R = 8, Y = 2.
13. W = 0, I = 6, N = 2, L = 5, A = 7, S = 8, T = 9.
14. A = 4, H = 6, O = 2, G = 5, T = 1, I = 0, E = 7.
15. O = 6, N = 9, E = 3, R = 8, Z = 1.
16. T = 7, H = 5, I = 3, S = 0, V = 1, E = 9, R = 4, Y = 2, A = 5.
17. C = 9, R = 6, O = 2, S = 3, A = 5, D = 1, N = 8, G = 7, E = 4.
18. M = 1, E = 3, T = 7, R = 4, L = 6, I = 9, G = 5, A = 7, S = 2, C = 8.
19. J = 8, U = 4, N = 3, E = 2, L = 7, Y = 5, A = 1, P = 6, R = 9, I = 0.
20. **FIND OUT FOR YOURSELF!**

## CRYPTOGRAMS

Here are some tough puzzles.

These are sums with a difference, and the difference is obvious: instead of numbers you've got letters!

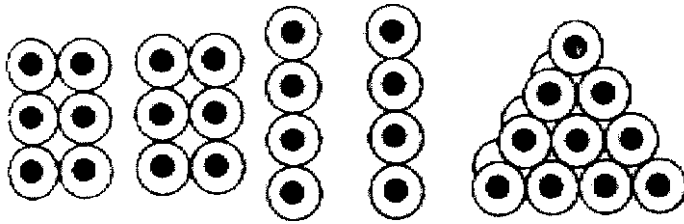
Each letter for one of the ten digits from 0 to 9, and a particular letter can stand for only one digit.

The challenge is to find out what each letter stands for, and do the sums!

(It is a big challenge, so don't be surprised if you have to look up the answers)

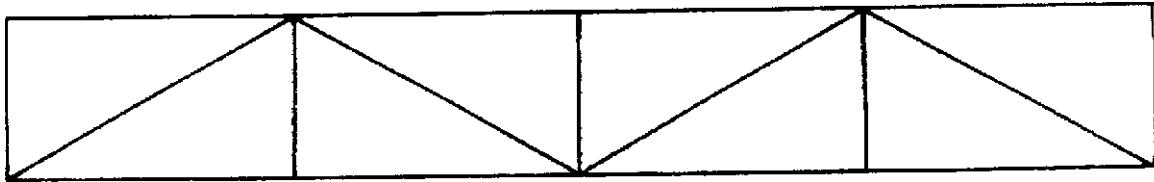
<p>1.</p> $\begin{array}{r} \text{BOYS} \\ + \text{BOYS} \\ \hline \text{SILLY} \end{array}$	<p>2.</p> $\begin{array}{r} \text{GIRLS} \\ + \text{GIRLS} \\ \hline \text{SILLY} \end{array}$	<p>3.</p> $\begin{array}{r} \text{ARCS} \\ + \text{BRAS} \\ \hline \text{CRASS} \end{array}$	<p>4.</p> $\begin{array}{r} \text{LLAMA} \\ - \text{SEAL} \\ \hline \text{SEAL} \end{array}$
<p>5.</p> $\begin{array}{r} \text{LIP} \\ + \text{LIT} \\ \hline \text{PIPE} \end{array}$	<p>6.</p> $\begin{array}{r} \text{PEP} \\ + \text{PEN} \\ \hline \text{ERNE} \end{array}$	<p>7.</p> $\begin{array}{r} \text{GOOD} \\ + \text{DOG} \\ \hline \text{FANGS} \end{array}$	<p>8.</p> $\begin{array}{r} \text{TOO} \\ \text{TOO} \\ \text{TOO} \\ + \text{TOO} \\ \hline \text{HOT} \end{array}$
<p>9.</p> $\begin{array}{r} \text{HER} \\ + \text{HURL} \\ \hline \text{SEL LS} \end{array}$	<p>10.</p> $\begin{array}{r} \text{SPIT} \\ + \text{SIP} \\ \hline \text{TIPS} \end{array}$	<p>11.</p> $\begin{array}{r} \text{PET} \\ \text{PET} \\ + \text{PET} \\ \hline \text{TAPE} \end{array}$	<p>12.</p> $\begin{array}{r} \text{SEND} \\ + \text{MORE} \\ \hline \text{MONEY} \end{array}$
<p>13.</p> $\begin{array}{r} \text{STILL} \\ \text{STALL} \\ + \text{STILT} \\ \hline \text{NITWIT} \end{array}$	<p>14.</p> $\begin{array}{r} \text{EIGHT} \\ + \text{EIGHT} \\ \hline \text{TATTOO} \end{array}$	<p>15.</p> $\begin{array}{r} \text{ONE} \\ + \text{ONE} \\ \hline \text{ZERO} \end{array}$	<p>16.</p> $\begin{array}{r} \text{THIS} \\ \text{IS} \\ + \text{VERY} \\ \hline \text{EASY} \end{array}$
<p>17.</p> $\begin{array}{r} \text{CROSS} \\ + \text{ROADS} \\ \hline \text{DANGER} \end{array}$	<p>18.</p> $\begin{array}{r} \text{METRE} \\ \text{LITRE} \\ + \text{GRAMS} \\ \hline \text{METRIC} \end{array}$	<p>19.</p> $\begin{array}{r} \text{JUNE} \\ + \text{JULY} \\ \hline \text{APRIL} \end{array}$	<p>20.</p> $\begin{array}{r} \text{THREE} \\ \text{THREE} \\ + \text{FOUR} \\ \hline \text{ELEVEN} \end{array}$

### TETRAHEDRON PUZZLE



A lovely puzzle can be made from 20 plastic balls. Glue the spheres together to form two rectangular blocks each containing six spheres, and two strings of four spheres as shown. The puzzle is to fit the four sphere structures together to form a tetrahedron. It may seem difficult at first, but it is certainly possible!

### SIMPLE PAPER TETRAHEDRON

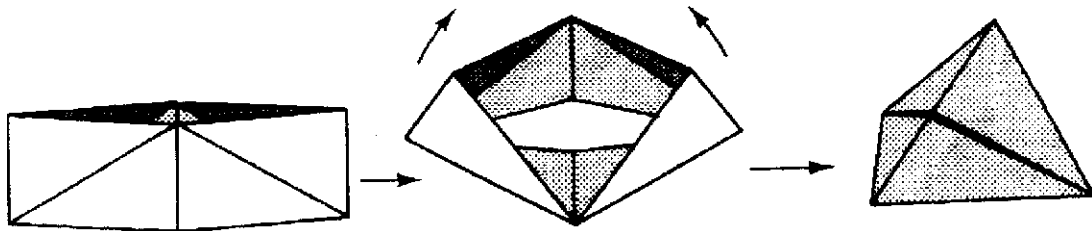


This is a simple tetrahedron and it will fold instantly. For this you will need a card sheet 28-cm long and 4-cm wide. Divide the long rectangle into four small equal rectangles (7-cm long and 4-cm wide). Mark the diagonals as shown.

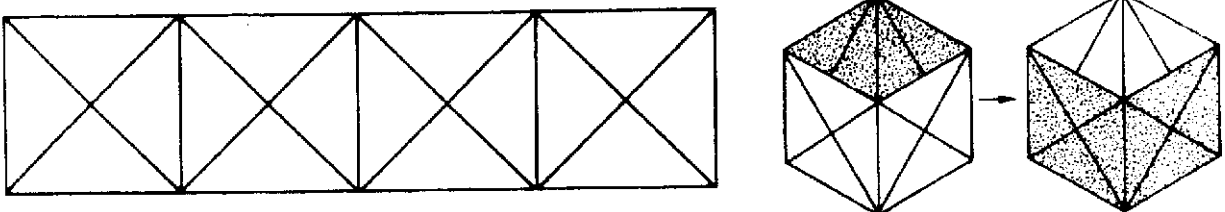
Carefully score all the vertical and diagonal lines using an old ball pen refill.

Now join the ends of the long rectangle together using sticky tape to form a circular hoop.

This band can now be easily folded into a tetrahedron.



### INSIDE OUTSIDE FLEXIBLE BOX



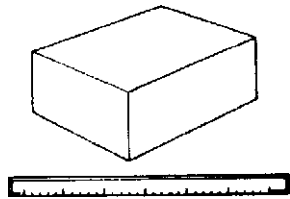
This flexagon is simple to make. Cut out a rectangle from a thin card equivalent to four squares (20-cm x 5-cm is a good size) and draw the diagonals of the squares. Carefully score all the lines and flex the rectangle along each of them to ensure ease of movement. Colour the two sides of the rectangle differently. Join the ends to form an open and bottomless box.

Now, by folding the edges and diagonals of the squares it is possible to turn the box inside-out.

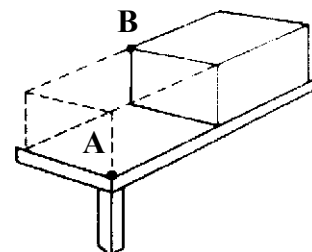
While doing it you will encounter several interesting configurations including a box approximately half the height of the original.

Don't give up if you don't succeed at first. Keep trying!

### DIAGONAL OF A BRICK



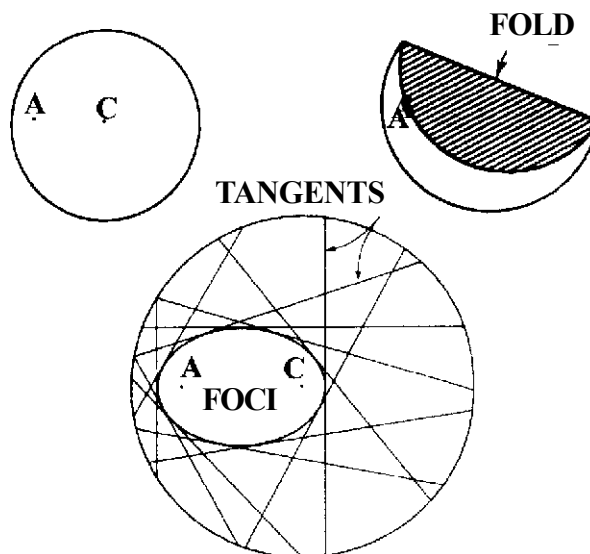
How can you use a ruler to find the length of the long diagonal – from one corner of the brick to its opposite corner? The solution is surprisingly simple. First place the brick at the corner of the table and then move it along equal to its length. The length of the diagonal from *A* to *B* can then be easily measured.



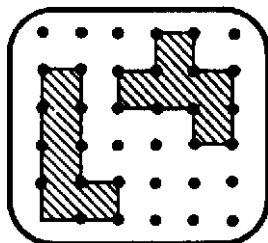
### FOLDING AN ELLIPSE

On a plain paper draw a large circle of 16-20 cm diameter. *C* is the centre. Cut the circle and mark a point *A* as shown, say 2-cm from the edge. Now fold the circle along any line that makes the circle just touch the point *A*. Keep repeating this process of folding. Soon you will see an ellipse - surrounded by all the fold lines. What would happen if *A* were nearer the centre of the circle?

What happens if *A* coincides with the centre? Notice the way in which *A* and the centre of the circle *C* are symmetrically placed for the ellipse. They are called the foci of the ellipse.

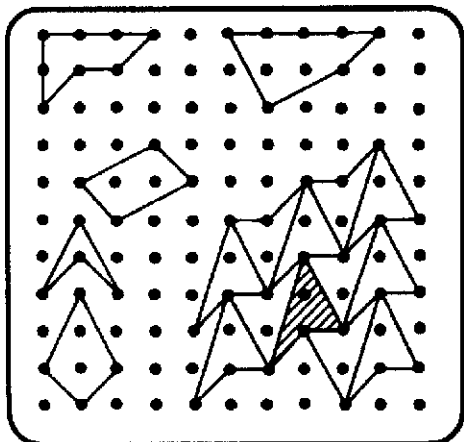


### PERIMETER AND AREA



Make as many shapes on the pin-board as possible with a perimeter of 12 units. Record your shapes on a square copy. The two examples given have an area of 5 units each. Find the area of each of your shapes?

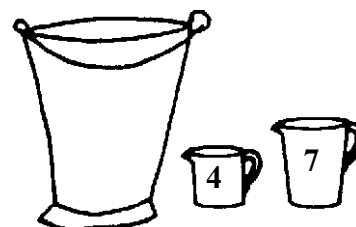
### TESSELLATIONS



The shaded quadrilateral is repeated over and over again to form a tiling pattern. Some other shapes have been given. Make tiling patterns with them. Try experimenting with some new shapes.

### MEASURING OUT

You have two measures of 4-liters and 7-liters and a bucketful of milk. How will you give 2-liters of milk to a customer?



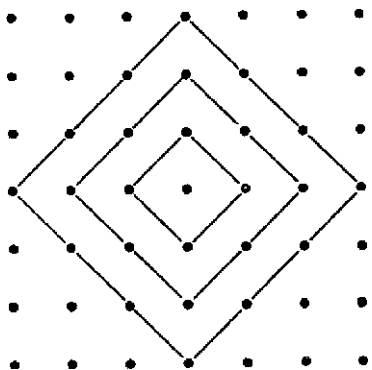


## NUMBER PATTERNS WITH DOTS

Make a pattern and count:

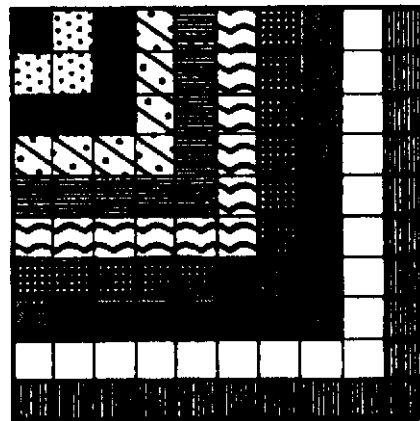
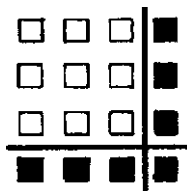
a. The number of dots on the perimeter of each square: 4, 8, 12...

b. The number of dots inside each square: 1, 5, 13...

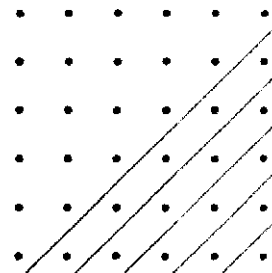


### Another pattern for Square Numbers

This diagram might help you to discover an easy way of finding the next square number.



Triangular numbers are formed by making a sequence of right-angled triangles as shown and counting the number of dots in each triangle.

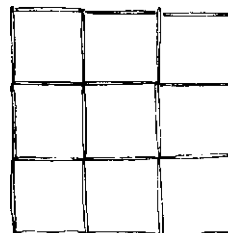


1 3 6 10 ...

How many dots would there be in the twelfth triangle?

## FUN WITH BROOMSTICKS

Get 24 same size broomsticks and arrange them as shown. How many squares do the toothpicks make? (Certainly not 9!) Remove only 8 toothpicks so that only 2 squares are left. Is it possible?



What's the least number of broomsticks required to make a square? Four!



What about 2 squares? Seven. (That's wonderful!)



Three squares?

Can you find a pattern?

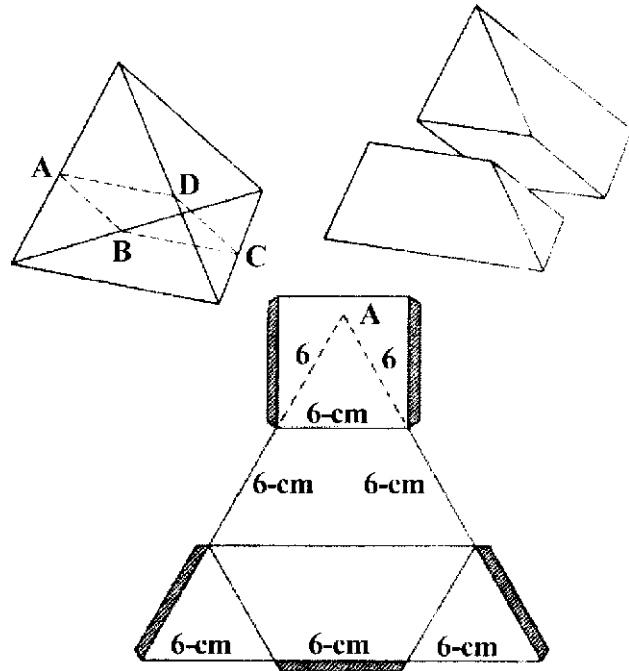
Use 12 broomsticks. Place them any way you wish.

How many different numbers of squares can you make?

BROOMSTICKS	SQUARES
4	1
7	2
?	3
?	4

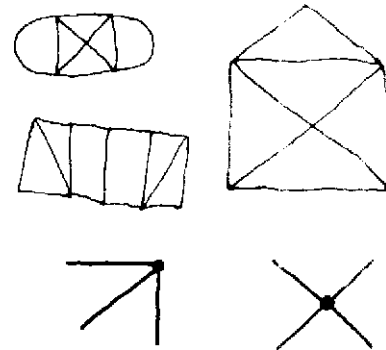
## TWO-PIECE TETRAHEDRON

In the picture shown the tetrahedron has been sliced into two equal parts. The points **A**, **B**, **C**, and **D** are the middle points of each edge. To make the half tetrahedron you will need some card. Make an equilateral triangle **ABC** whose each side is 18-cm. By marking off points at intervals of 6-cm most of the net can be easily constructed. Now only the square remains to be added to the top. Before cutting out mark the tabs (shown shaded) and score all the folds with an old ball pen refill. Make two such nets. Cut them, fold and glue them to form two exactly similar shapes.



## DRAWING WITHOUT LIFTING THE PENCIL

Can you draw this shape without lifting your pencil from the paper? And without retracing any line? When you have figured it out, ask a friend to draw it on the ground. You can actually predict by just looking at a shape whether it can be drawn without lifting the chalk or retracing a line. The points where the lines meet are called vertices. Depending upon the number of lines meeting at the point it could be an odd or an even vertex. Just count the odd vertices in any shape. Does it give you a clue?



ODD  
VERTICES

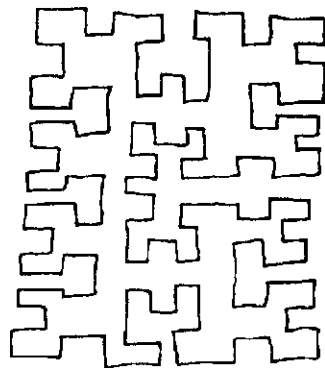
EVEN  
VERTICES

You can try the same thing with the letters of the alphabet.

**E** NO

**B** YES

Put a point somewhere in the middle of this figure. Is it on the inside or the outside? You can find it by drawing a line from the point to the outside, and counting the number of times the lines crosses the drawing. If it crosses an odd number, the point is inside. Do you know why?



SHAPE	ODD VERTICES	IS IT POSSIBLE?
	2	YES
	0	NO
	4	NO

## THE MAN WHO PLANTED HOPE AND GREW HAPPINESS

This story of an unschooled shepherd has inspired millions across the world. A green classic.

In 1913 a young Frenchman Jean Giono was trekking in a remote and barren area in France. After a few days he was stranded without water and the scorching sun parched his throat. There he met an old shepherd with 30 sheep, who provided him with food and a resting place. Every day the unlettered old man - Elzeard Bouiffier planted 100 acorns in that devastated land. To count 100 he made 10 piles of 10 seeds each. Then he dug holes in the ground and sowed the seeds. The old man did not own the land. Who owned the land? That did not bother him. The land probably belonged to some rich people who didn't care about it, or maybe it was part of the commons. He only knew that the land was dying. This pained him deeply. To rejuvenate it, he planted trees. In 3 years he planted over a hundred thousand seeds. Out of which only 10,000 grew up. The rest either got burnt in the harsh sun or were nibbled by rats. Still there were 10,000 oak plants where there was nothing before.

Jean was unimpressed. He thought the old man was a crackpot - a crank. Some people collect stamps and coins. This man probably liked digging holes and sowing seeds.

Jean completed his journey and forgot all about this episode.

Soon he went to fight the First World War. After the war he got leave. Once again he founded himself travelling down the same road. He could not recognise the place. Perhaps the war had affected his memory. No, the place had actually transformed beyond recognition in the past six years. Instead of a treeless, erosion-scarred landscape, Jean could see a kind of hazy mist that covered the hills like a carpet. Everywhere young trees swayed in the wind. There was a scent in the air. Fresh water gushed from dried mountain streams.

Suddenly Jean remembered the old shepherd. The old man must be dead, he thought. What can an old man of fifty-five do, but die? This surely was not sun-scorched sheep country? Six years ago this land had been barren - almost dead. But now the vegetation was burgeoning - the air was tranquil and trees stretched as far as Jean could see.

The old shepherd was very much alive and all the while he was planting trees. Jean could scarcely believe the transformation. The old man took Jean for a long stroll into the forest. He nodded and gestured at the trees growing all around, with the pride of a father presenting his first-born.

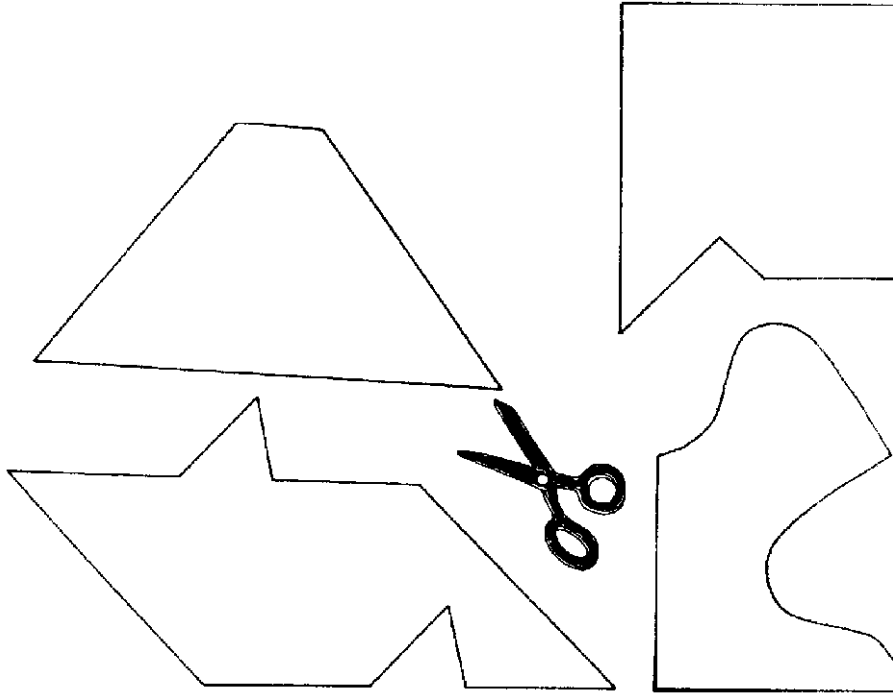
He was no longer a shepherd - he had only 4 sheep now, and instead looked after 1,000 beehives. A vast forest of saplings - oaks, beeches, and birches - stretched around them in three sections for a length of 11 kilometres and up to a width of 3 kilometres. Jean was struck dumb as the former shepherd led him all day around his shoulder high forest. It was incredible to imagine that in 1915, when Jean was fighting the First World War, the old man had been planting birches that now stood slender and delicate as young dancers. It was incredible that a forest could have sprung from the toil of one man's effort, from one man's vision and patient toil. Jean began to think. We have a choice, he thought - to either kill people in the name of nation, religion etc. or we can do god's own work by greening up the earth.

Now there were farms everywhere. Along the roads you met hearty men and women, boys and girls who understood laughter and delighted under the bountiful trees. All and all, more than 10,000 people owed their happiness to the unfailing greatness of spirit and tenacity of purpose of a single man - an old unschooled man who planted trees and grew happiness. At the age of 83 Elzeard Bouiffier died peacefully under a tree.

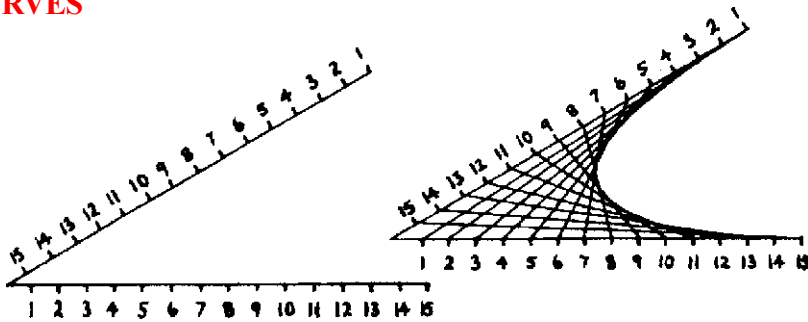


## SQUARE UP!

Copy these shapes on to another card sheet. There is something special about these shapes. Now with just one cut you should be able to divide the shape into two pieces, and then put the 2 pieces together to make a square!



## CURVES



If you throw a ball its flight is curved. Many objects move in a curved path. We can make curves from sets of straight lines. By joining pairs of numbers 1 to 1, 2 to 2 and so on you will make a curve from a straight line. Change the angle between the lines and see the difference.

**GIVE A MAN  
A FISH...  
AND YOU FEED HIM  
FOR A DAY.**



**TEACH A MAN  
TO FISH...  
AND HE'LL FEED  
HIMSELF FOR LIFE.**

## PALINDROME WOW!

A Palindrome is a regular number. It can be approached anyway. Look at it from the front or from the back. It looks the same. It can be any size – small or big. It can turn up anywhere – in your maths sum, house number, scooter number plate, telephone, anywhere.

You can get a Palindrome with a bit of addition.

Take **132** for instance. It is not a Palindrome. But reverse it and add to itself.

$$132 + 231 = 363$$

Sometimes it may take much longer for you to get to a Palindrome.

Take the number **68** for instance.

$$68 + 86 = 154 + 451 = 605 + 506 = 1111$$

Sometimes it takes a very-very long time to get to a Palindrome.

There are word Palindromes too. Like:

**DAD!**

**RADAR!**

**EVIL OLIVE**

**MADAM I'M ADAM**

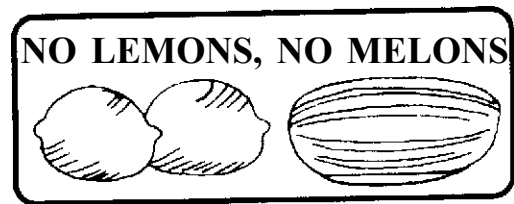
**DO GEESE SEE GOD?**

**NEVER ODD OR EVEN**

**MA IS A NUN AS I AM**

**A DOG! A PANIC IN A PAGODA!**

**CIGAR? TOSS IT IN A CAN, IT IS SO TRAGIC**



## JUMPING RUBBER BAND

With an ordinary rubber band you can perform an extraordinary feat. You can make the rubber band jump from the little and ring finger on to the middle and index finger. It will take a little practice. But it is quite simple.

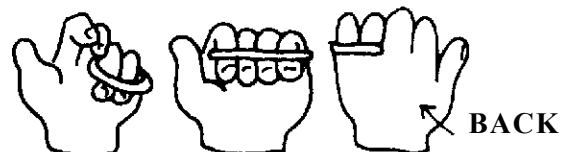
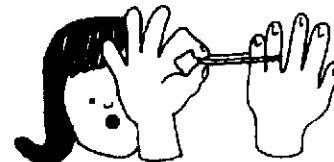
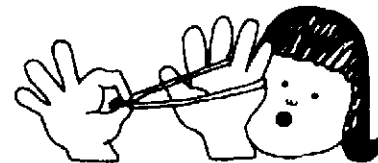
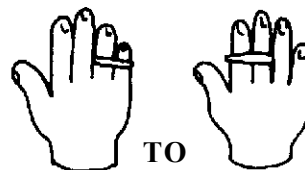
This is how it's done.

Put the rubber band around the 3<sup>rd</sup> and the 4<sup>th</sup> fingers. Pull it out so everyone can see. Turn your palm out and pull it again so they can see the other side. Then turn your hand back palm down, but as you do it, make a loose fist and stick your other 2 fingers under the band like this.

This is the part that will need some practice.

When you straighten your fingers, the rubber band will leap to your other 2 fingers!

When you are doing this trick, you are demonstrating a topological principal involving insides and outsides. Watch the rubber band closely as you do the trick.



## FROM NET TO BOX

You will need some card sheet and scissors.  
Cut five squares like this from thick paper.  
Arrange them in different ways. Their edges must be touching.  
And their corners must be neatly lined up.



This is wrong.

There are just a few ways - only 12. Find all 12. A golden rule to follow is:  
if one shape fits exactly on top of another, then they are the same.

Both these shapes  
are same.

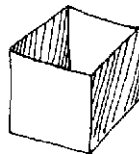
This is right.

**X**

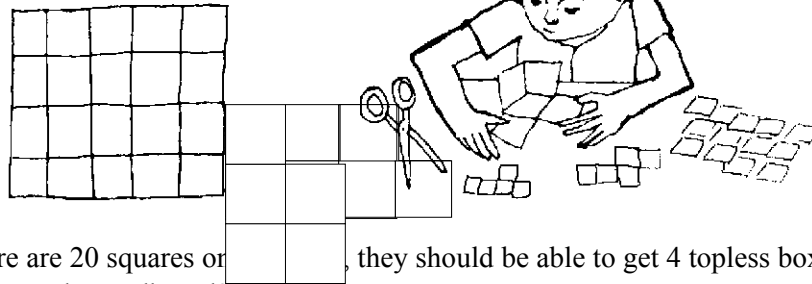
These shapes made from 5-squares are called pentominoes. Look at these pentominoes. **X** marks the bottom of the box. Now, look at the 12 pentominoes you've drawn. If you drew all 12, 8 of them should fold into boxes. Find them and mark the bottoms. Then cut them and fold them out to see if you are right.

This one wouldn't fold up into a box.      This will fold up into an open box (without a lid).

A toy factory needs topless boxes like this.

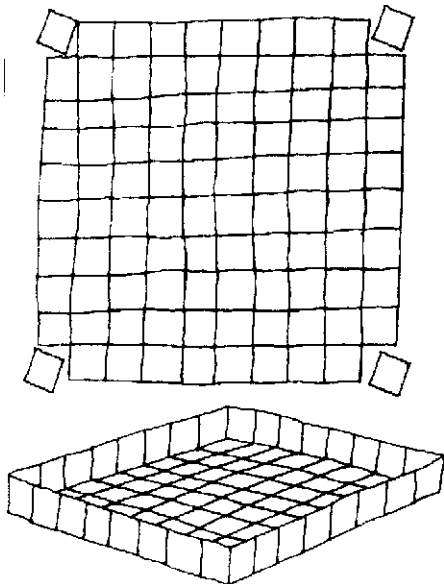


The purchase department has bought a lot of cardboard like this.



Each box takes 5 squares. Since there are 20 squares on each big sheet, they should be able to get 4 topless boxes out of each big sheet. How will they cut the cardboard?

## BIGGEST BOX



Cut a piece of paper with 100 small squares in it from a square notebook. Stick it on a thick paper to make it stiff. Cut one little square from each corner as shown.

Now fold it up to make a box. This box would be quite shallow and will not hold much.

What size squares would you cut from each corner to make a box, which will hold the most?

You could do this experiment with an old post card (size 9-cm x 14-cm). Make a box with a post card, which will hold the most?

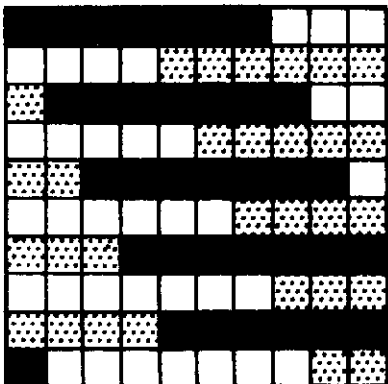
This simple experiment connects the volume of the box with its surface area.

## EXPERIMENTING WITH PATTERN

Children often use a notebook with 1-cm squares (not graph paper) to add and subtract sums.

One can discover some beautiful patterns using a 'square' copy.

Fifty years back an American mathematician Leah Mildred Beardsley wrote an amazing book titled *1,001 Uses of the Hundred Squares*.



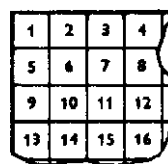
Make your own 100 squares. Choose a pattern and shade it in. Choose a number and see what kind of pattern you get. Can you discover what pattern the square above shows?

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Make a large number square and write the numbers. Place another card with windows cut out to show 'the threes' and other patterns on top of your square and see what numbers show through. We have cards for 'twos' and 'threes' placed on top of the 100 square. What pattern does it show?

100	90	80	70	60	50	40	30	20	
99	89	79	69	59	49	39	29		9
98	88	78	68	58	48	38		18	8
97	87	77	67	57	47		27	17	7
96	86	76	66	56		36	26	16	6
95	85	75	65		45	35	25	15	5
94	84	74		54	44	34	24	14	4
93	83		63	53	43	33	23	13	3
92		72	62	52	42	32	22	12	2
	81	71	61	51	41	31	21	11	1

The 100 squares can be numbered in different ways. Try as many different ways as possible and see what patterns you discover.



You need not always use a 100 square.

Do you know what the shaded numbers are? Can you see any pattern? Now shade in the same numbers using a spiral pattern.

1	2	3		5	6	7	8		10
11	12	13	14	15		17	18	19	20
21	22	23	24		26	27	28	29	30
31	32	33	34	35		37	38	39	40
41	42	43	44	45	46	47	48		50
51	52	53	54	55	56	57	58	59	60
61	62	63		65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	

	99	98	97	96	95	94	93	92	91
65		63	62	61	60	59	58	57	90
66	37		35	34	33	32	31	56	89
67	38	17		15	14	13	30	55	88
68	39	18	5		3	12	29	54	87
69	40	19	6	1	2	11	28	53	86
70	41	20	7	8		10	27	52	85
71	42	21	22	23	24		26	51	84
72	43	44	45	46	47	48		50	83
73	74	75	76	77	78	79	80		82



## LEARNING FROM GANDHI

*Bahuroope Gandhi* by Anu Bandopadhyaya, is a remarkable book. For children, it is the best book ever on Gandhi. The conception of the book is unique.

In 1964, Jawaharlal Nehru wrote in the foreword:

“It is extraordinary how in many things he took interest and when he took interest, he did so thoroughly. It was not a superficial interest. It was perhaps his thoroughness in dealing with what are considered to be the small things of life, which emphasized his humanism. That was the basis of his character.”

The book has been divided into 28 chapters, each depicting the ordinary aspects of an extra-ordinary man. Gandhiji’s life as a toiler, barrister, tailor, washer man, barber, scavenger, cobbler, servant, cook, doctor, nurse, teacher, weaver, spinner, bania, kisan, auctioneer, beggar, looter, jail bird, general, author, journalist, printer-publisher, fashion-setter, snake-charmer, priest. Some of the caricatures are by the legendary R. K. Laxman; others by Nicky Thomas. This book needs to be translated in all languages of the world.

Gandhi did not simply preach. He lived his convictions. Nothing was menial for him. He laid emphasis on working with the hands. He believed that true learning involved the hands, the heart and the head. Instead of cramming from textbooks he wanted children to engage in productive work for society.



First published by Popular Prakashan in 1964. Republished twice by the NCERT (1970, 1995).  
In 2004, republished as *Learning from Gandhi* by the Other India Press, Mapusa, Goa.  
The entire text of the book can be accessed from <http://arvindguptatoys.com>

## THE BULL WHO LOVED THE SMELL OF FLOWERS

Seventy years back one Sunday afternoon in 1935, Munro Leaf decided to write a children's story so that his close friend Robert Lawson (a relatively unknown illustrator) could show his talents. In less than one hour, Leaf composed the beloved 800-word story.

When published in 1936 as *The Story of Ferdinand*, this anti-war book sparked controversy. With the Spanish Civil War waging, political critics charged it was a satirical attack on aggression. In Germany, Hitler ordered the book burned while fellow dictator Stalin granted it privileged status as the only non-communist children's book allowed in Poland. And India's spiritual leader Gandhi called it his favourite book. The passive resistance of a peaceful bull is being retold here:

Long time ago in Spain lived a small bull. His name was Ferdinand. All his friends did the whole day was to fight – they tried to poke each other with their sharp horns. But Ferdinand was different. He hated fighting. He loved one thing – the smell of flowers. There was a cork tree on top of a hill. Ferdinand liked to sit under the tree and enjoy the sweet scent of its blue flowers.

Ferdinand's mother sometimes worried about him. What good is a bull that doesn't fight? What will he do when he grows up? But she was very wise. So she let her son do what he liked.

Years passed and Ferdinand grew up into a very strong and powerful bull. One day five people wearing funny hats came from Madrid to choose the strongest bull - for the Bull Fight. At the sight of the selectors all the young bulls went mad. To show their macho they started fighting fiercely and poking each other with their horns.

Ferdinand was not interested in fights. So he climbed up the hill to sit under his pet cork tree. He did not look below. By mistake he sat on a bumblebee. The bumblebee stung him. Ferdinand cried with pain and ran like a mad bull.

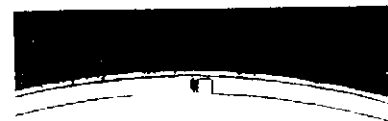
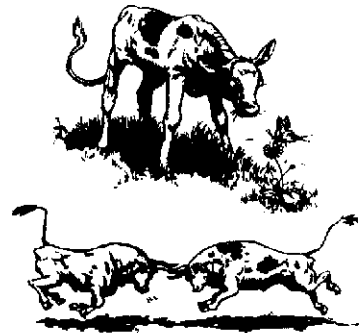
The five men were delighted to discover Ferdinand. "We've found the strongest bull!" they exclaimed. So Ferdinand was tied up and carried away to Madrid for the Bull Fight. Lots of women also came to see the Bull Fight. Many women had flowers in their hats. Flags fluttered everywhere. There was music in the air.

There was a big parade. First came the Picadors with spears. In the end came the Matador. The Matador was supposed to fight the bull with his sword. In the end came – you know whom - Ferdinand. Everyone was terrified at the sight of the powerful Ferdinand. They called him 'Bloody Ferdinand!' Everyone expected a bloody, bull-fight.

Ferdinand ran and came to the centre of the fighting ring. People started clapping and cheering. They wanted Ferdinand to fight fiercely. But Ferdinand had his own ideas. When he reached the centre of the ring he smelled the scent of beautiful flowers. He sat in the middle of the ground enjoying the exotic aroma of flowers. Ferdinand decided not to fight or to kill anyone.

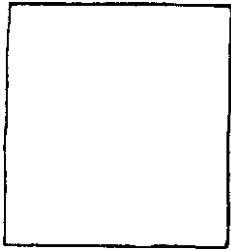
The fighters – Picadors and Matadors tried their level best to instigate Ferdinand. But Ferdinand did not budge. In the end Ferdinand was packed off home.

I think Ferdinand is still sitting under the shade of the cork tree and smelling its aromatic flowers!

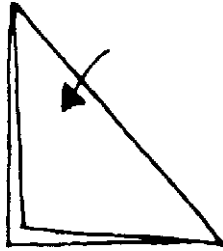


## FLAPPING BUTTERFLY

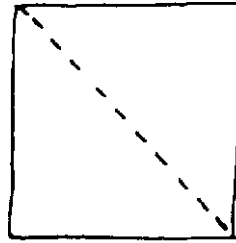
This simple paper butterfly flaps its wings like a real one.



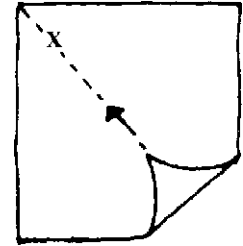
1. Take a 15-cm square paper.



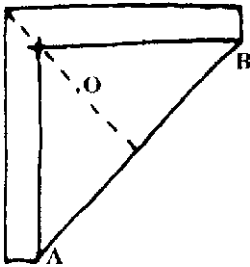
2. Fold it along the diagonal.



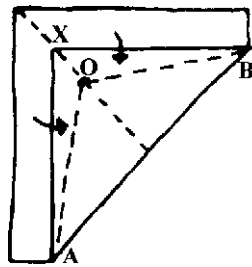
3. And reopen.



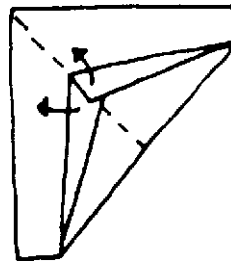
4. Fold right corner to X, 2-cm before the top left corner.



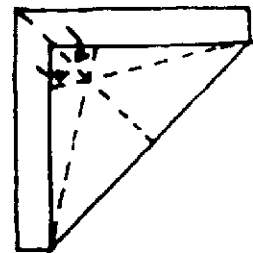
5. Mark a point O about 1.5-cm from X.



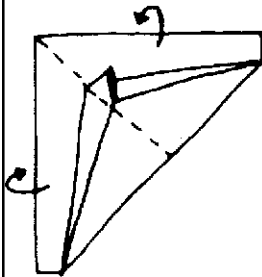
6. Crease the lines OA and OB.



7. Fold them up.

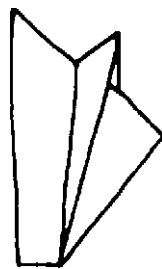


8. Fold little triangles into a standing nose.

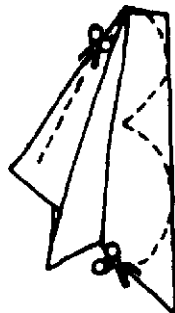


9. Fold the model along the dotted diagonal...

*(Pix by Anu Gopinath)*



10.... into half.

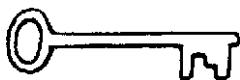


11. Cut along the dotted lines, to make the butterfly's wings and antennae.



12. Hold the front tip of the butterfly with your left hand and pull the arrow down with your right hand to make the butterfly flap its wings.

**DOUBT  
THROUGHOUT**

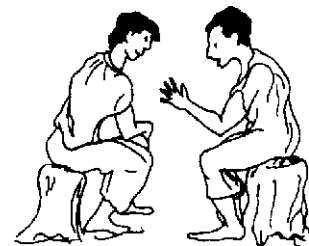


THE KEY TO THE  
SCIENTIFIC METHOD

*How* something is taught is just as important as *what* is taught.

And the most important part of how something is taught is caring, respect and shared concern that go into it.

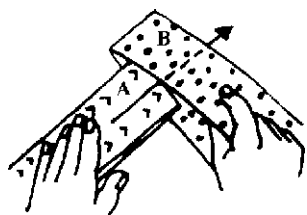
Aristotle, "Father of Science," wisely said...



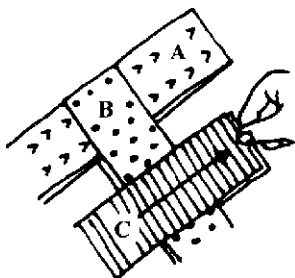
**HOW CAN I TEACH  
BUT TO A FRIEND**

## WOVEN FISH

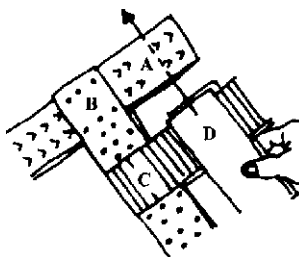
You will need several long rectangular strips of slightly stiff paper for weaving this fish.  
Fold four long strips of paper (2-cm wide, 50-cm long) in half. These strips have been shown in different designs and have been named A, B, C and D. Don't turn around the strips too much.



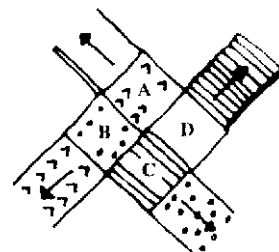
1. Take strips A and B and put A inside B as shown.



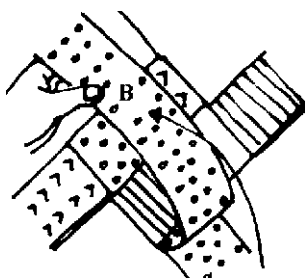
2. Weave strip C into place.



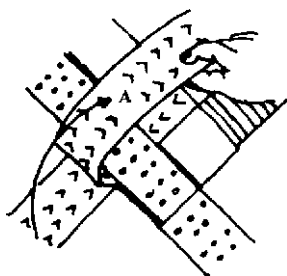
3. Now, weave strip D into place.



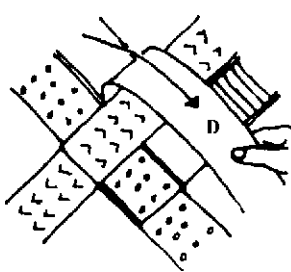
4. Pull the strips to make a paper knot.



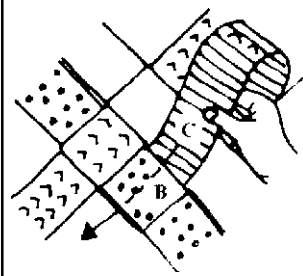
5. Fold the top layer of strip B up over the knot.



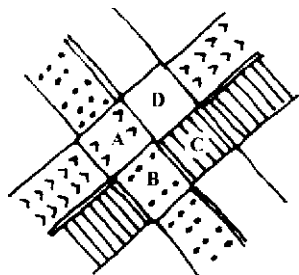
6. Fold the top layer of strip A up over the knot.



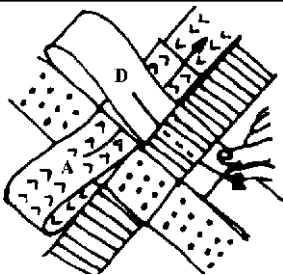
7. Now fold the top layer of strip D over the knot.



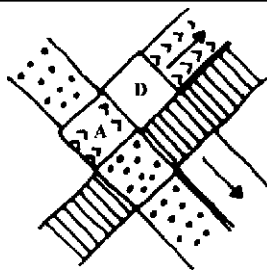
8. Fold top layer of strip C over the knot. Take care to weave it through.



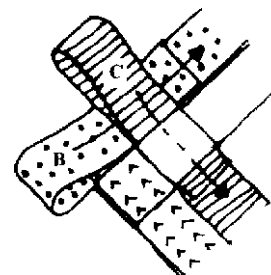
9. The design should now look like this.



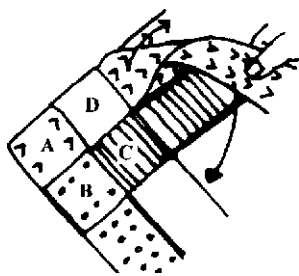
10. Fold over the bottom layers of strips A and D and weave them through.



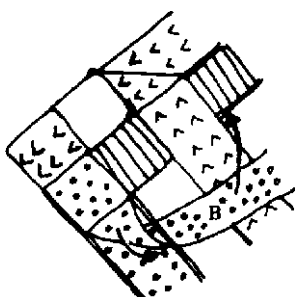
11. Pull the strips tight. Turn the paper over from top to bottom.



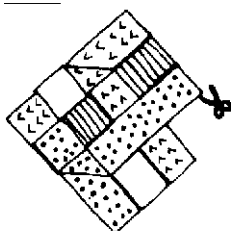
12. Fold bottom layers of B and C and weave them. Upturn paper.



13. Fold the top layer of strip A backwards.



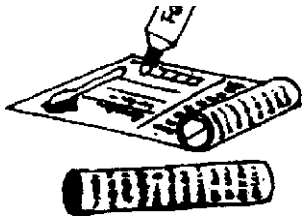
14. Fold the top layer of strip B backwards.



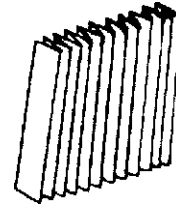
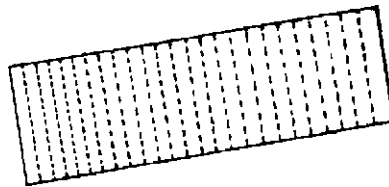
15. Trim each strip to the same length. Don't trim them too short. Tuck the double strips C and D inside the body of the fish. Cut ends to make the tail of the fish. Make a mobile.

## MAGIC FAN

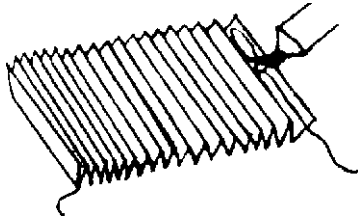
This captivating traditional folk toy could at one time be bought in village fairs.  
You can't buy it today, but you can still make it.



1. Roll and stick an old post card to make a cylindrical reel of 2-cm diameter.



2. Fold a sheet of glazed newspaper (Sunday supplement) 10-cm x 50-cm into a fan with 32 creases. Make sure that all the zigzag creases are of the same width.



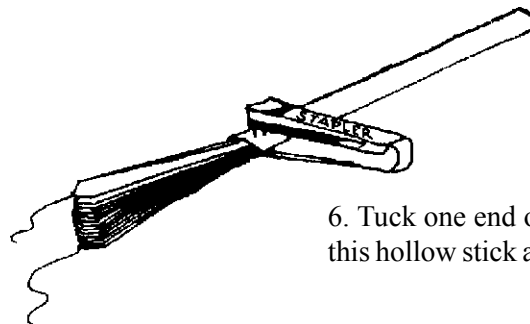
3. Fix a thread each on the two extreme ends of the corrugated fan. 5-cm of the thread should be left trailing out.



4. Trim the triangular edges of the folded fan as shown.



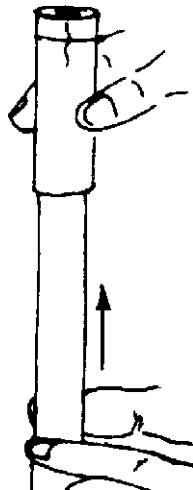
5. Cut a 20-cm edge square from a newspaper. Roll it into a hollow stick and glue its edge.



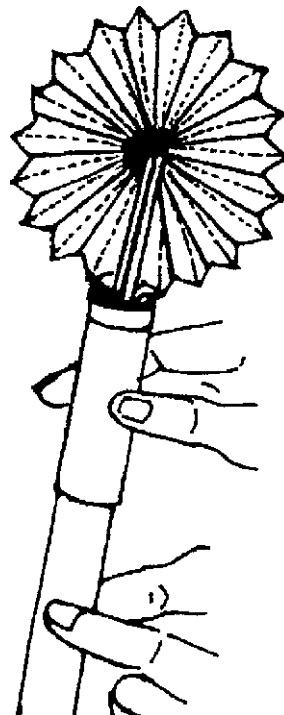
6. Tuck one end of the fan in this hollow stick and staple it.



7. Slip the postcard reel over the fan. The top of the reel and the fan should be at the same level, with the free ends of the threads hanging out.



8. Fix the threads to the postcard reel with cello-tape.

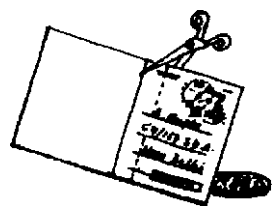


9. If you now hold the newspaper stick with one hand and slip down the postcard reel with the other, the fan opens out gloriously like the wings of a peacock. On sliding the reel upwards, the fan pleats fold in and settle snugly in the reel.

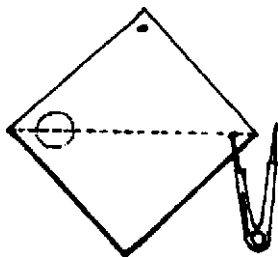
Before creating the fan you can inscribe a message, such as **HAPPY BIRTHDAY** on it. On opening the fan the message will flash, much to the surprise of your friends!

## LETTER BALANCE

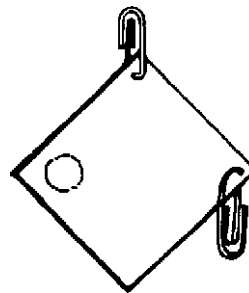
This simple balance is very convenient for weighing small letters.



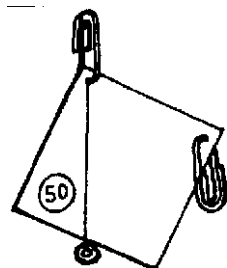
1. Cut a 9-cm square from an old postcard.



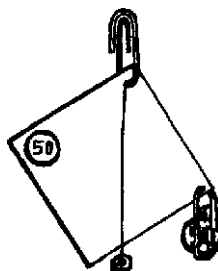
2. Draw a diagonal and poke two holes with a divider.



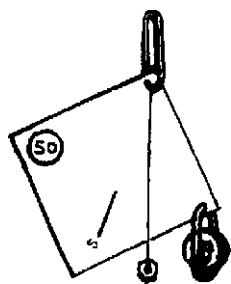
3. Insert paper clips in the two holes. The top clip will make the pivot. The right clip will hang the letters.



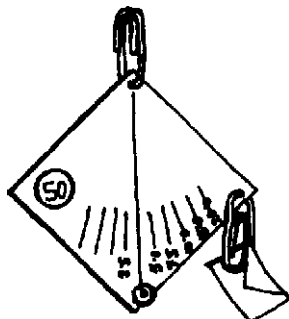
4. Stick a 50-paise coin (weight 5-gms) in the left corner. Tie a thread to the pivot clip and hang a small steel washer at its end. This will be the plumb line – always pointing vertically down.



5. Now suspend a 50-paise (the old 50-paise weighed 5-gms) from the right clip and mark the position of the pointer on the card. Again hang 7.5-gms (one old 50-paise and one old 25-paise coin) from the right clip and mark the position of the thread on the card.



6. Using the standard weights of coins indicate 2.5, 10, 15, 20-gms marks on the card.



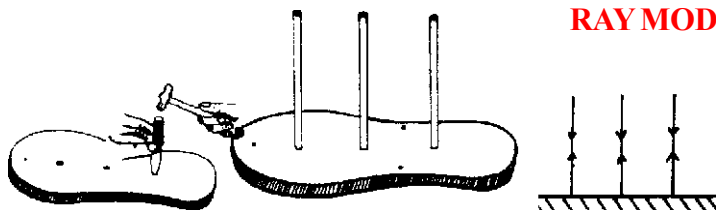
7. This calibrated balance can now be used to weigh letters.



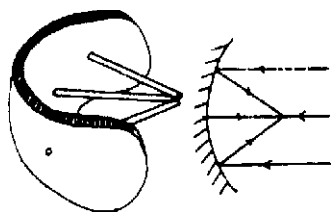
2 gms. 2.5 gms. 5 gms. 6 gms.

8. Some of the old coins (still in circulation) had interesting, easy-to-remember weights. These coins could be used as standard weights.

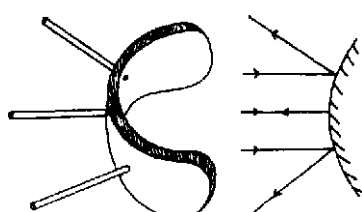
## RAY MODEL



PLANE MIRROR



CONCAVE MIRROR



CONVEX MIRROR

Punch out three holes 5-cm apart in an old rubber slipper. Press fit sticks or pencils in these holes. When the slipper is lying flat the sticks stand upright. If the slipper was a plain mirror strip, then light rays striking at right angles will retrace their path as shown.

What if it were a concave mirror? Just bend the slipper inwards and see. The three sticks now converge at a point called the focus.

What if it were a convex mirror? Bend the slipper the other way and you will see the sticks diverging.

As glass cannot be flexed and light rays are invisible, this model will help in concretising the ray diagrams of curved mirrors.