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ABSTRACT

This volume presents instructions for 61 low-cost and indigenous teaching materials that were developed from recommendations of the Fifth Regional Consultation Meeting on APEID (Asia and the Pacific Programme of Educational Innovation for Development) held in March 1978. Third in a series, this document describes materials that not only contribute to entertaining children, but to the achievement of several educational objectives, such as cognitive development, acquisition of manipulative skills, and individual and collective creativity. Each description lists the subject area, grade levels, objectives, materials needed, and the source. Instructions tell both how to make and how to use the item, and describe possible modifications when applicable. Educational games and toys are among the materials described, which include play activities or crafts for use in teaching basic science, physical education, storytelling and creative expression, basic arithmetic, mathematics, the language arts, music, physics, biology, and general science. Instructions are illustrated with line drawings. (DJR)

Low-cost Educational Materials

APEID inventory: low-cost educational materials; how to make, how to use, how to adapt, vol. 3. Bangkok, Unesco, 1984. 117 p. (Asia and the Pacific Programme of Educational Innovation for Development)

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INTRODUCTION

This is the third volume of the APEID Inventory of Low-cost Educational Materials.

The first volume of the inventory describes "How to make, how to use, how to adapt", 85 teaching/learning aids. The second volume of the inventory comprises descriptions of 52 educational materials.

A distinctive feature of this third volume is the inclusion of 61 items including educational games and toys, which, besides entertaining the children, contribute to the achievement of several educational objectives, such as cognitive development, acquisition of manipulative skills, individual and collective creativity.

The publication of the inventories of low-cost educational materials was undertaken in pursuance of the recommendations of the Fifth Regional Consultation Meeting on APEID, (Bangkok, March 1978), and is aimed at meeting the increasing demand for the popularization of original, indigenous, low-cost educational materials, developed by many individual educators and by the collective efforts of teachers, audio-visual specialists, teacher educators and educational researchers. The earlier volumes are in constant demand by teachers, teacher educators and curriculum specialists who have to meet the challenge of reducing cost, while improving the quality of education.

ACEID would welcome comments on this volume, and contributions for possible inclusion in the subsequent volumes of the inventory.

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KENDAMA GAME

Level : Pre-school and primary
Subject area : Play activities

Brief description

This is a Kendama made from an empty can or container. If a suitable ball cannot be found, a big button can replace it. The game itself is very simple, but children become absorbed in it. It would be more fun if played with two different sized containers.

Figure 1 shows how to play the Kendama game using an empty can.

Materials used

1. An empty can, or an empty half coconut shell.
2. A small ball, or a large button.
3. A piece of string.

How to make

1. Chose a suitable empty can, and make a hole on the bottom using a nail and a hammer.
2. Thread a string through the hole in the bottom of the can and tie a big knot to secure it. The string could be 40 to 50 cm. long.
3. Tie a ball at the other end of the string. A solid ball is better than a hollow ball. It is difficult to fix the ball to the string without making a hole through it, so a hole should be made through the ball. If a ball is not available, a big button or a small stone can be tied to the string.
4. Paint the empty can or decorate it in some other way to make it more attractive.

How to play

Children can compete in trying to get the most points by giving one point when the ball goes into the big can, five points when the ball goes into the small can successfully. Children usually make new rules on their own.

Educational objectives

1. Through this game, the children develop muscular coordination by constantly repeating the actions.
2. The game can also be used as an introductory stage in counting and adding scores.
3. The game is also an attempt to create conditions for allowing the children to make their own rules and to suggest innovations.

These objectives cannot be attained by playing the game of Kendama alone. However, in combination with a variety of games and experiences, these objectives can be achieved.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Narikazu Ohsumi, NIER, Tokyo, Japan, 1978.

FORK AND KNIFE EQUILIBRIUM

Level : Pre-school and primary
Subject area : Play activities and basic science

Brief description

This is an example illustrating one of the ways everyday utensils can be used in a scientific experiment. Here a knife and a fork are used to conduct a "balancing" or equilibrium experiment.

Materials needed

1. A knife and a fork.
2. A matchstick.
3. A cup or a drinking glass.

How to use

1. It is better to use a fork and knife of matching size. Fix them together as shown in Fig. 1, and insert a matchstick as shown in Fig. 2 so that the knife and fork do not come apart when suspended.
2. Place the supporting matchstick on the edge of a glass or other suitable object.

It is important to make sure that the knife and fork remain balanced. Find which point on the matchstick creates this balance. This will need some patience in the beginning.

In the beginning, the knife and fork slip rapidly and do not balance easily. With some patience, it begins to work.

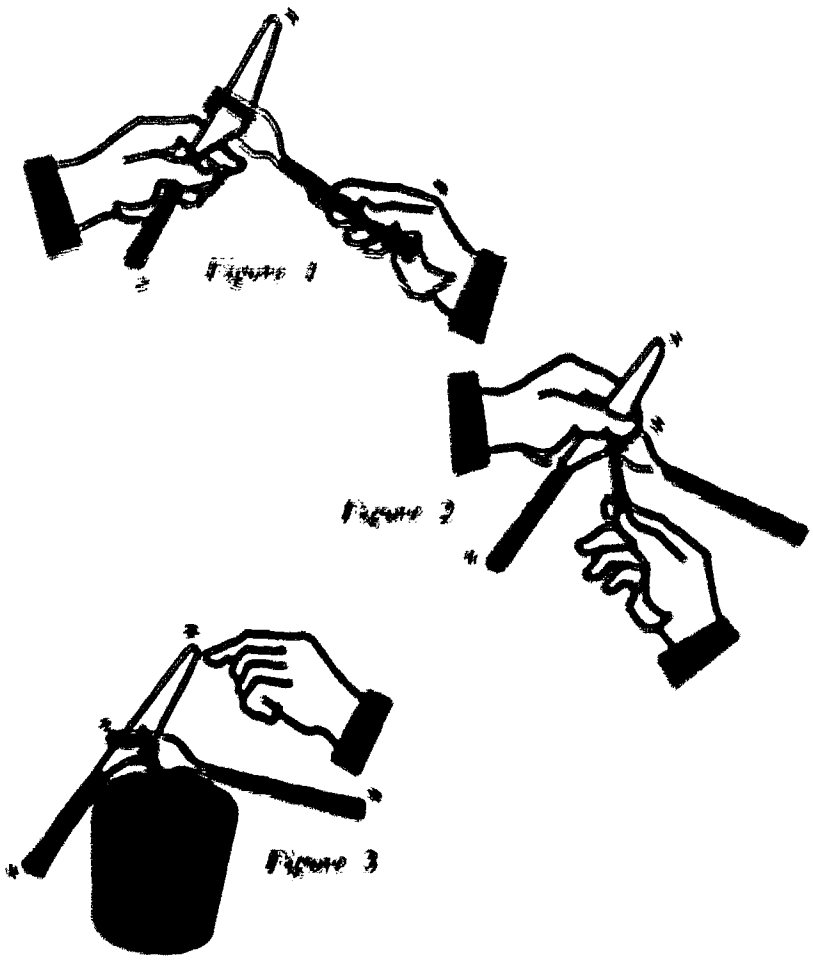
3. Lightly tap the balanced knife and fork with the tip of a finger (as shown in Fig. 3).

With the matchstick on the edge of the glass as the fulcrum, the knife and fork rock back and forth. Without using any adhesive anywhere, this state of balance or equilibrium is created and maintained by the pressure and friction between the objects.

How to use and play

1. The experiment itself is a game.
2. There is one more interesting question. That is, if the matchstick on the edge of the glass is set aflame, what would happen to the balance between the knife and fork?

This is a problem of interest not only to children but to adults as well. After proposing some possible outcomes, set the match aflame. The flame goes up the length of the matchstick, and just at the point when it seems it will go over the



Fork and knife balancing experiment

edge of the glass, the flame goes out, and the state of equilibrium between the knife and fork is maintained. It would be useful here to urge the students to think about rational reasons for this fact.

The reason probably is that the heat generated from the burning matchstick is absorbed by the coolness of the glass.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Naokazu Ohsumi, NIER, Tokyo, Japan.

A COIN BALANCING GAME

Level : All levels
Subject area : Play activities and home activities

Educational objectives

1. To enjoy playing this game while developing muscular control in balancing a coin placed as shown in Fig. 1.
2. To exercise and improve co-ordinating the movements of the eyes and hand.

Materials needed

1. An ordinary wire coat hanger
2. Five or six coins.
3. A pair of pliers
4. A metal file.

How to make

1. Shape wire coat hanger, (or you can use 3 mm thick wire) as shown in Fig. 1.
2. Prepare a flat surface at the end of the hook of the hanger with a file.
3. Adjust the end of the hook with the pliers to align it just below the fulcrum point as shown in Fig. 2.

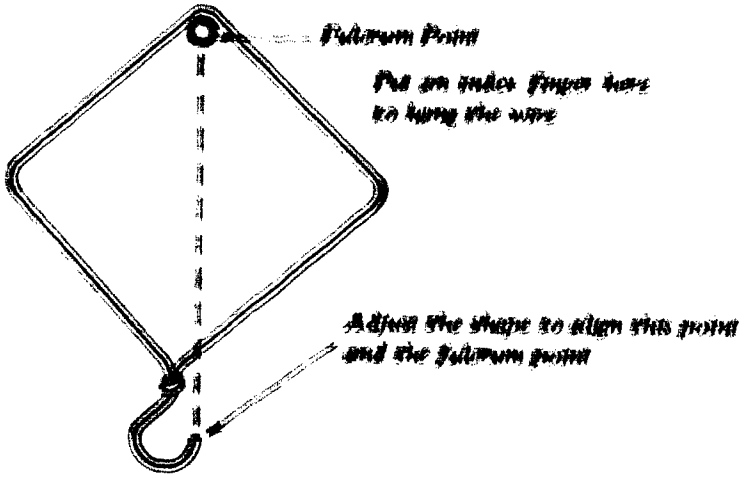


Figure 1 Shape a wire coat hanger.

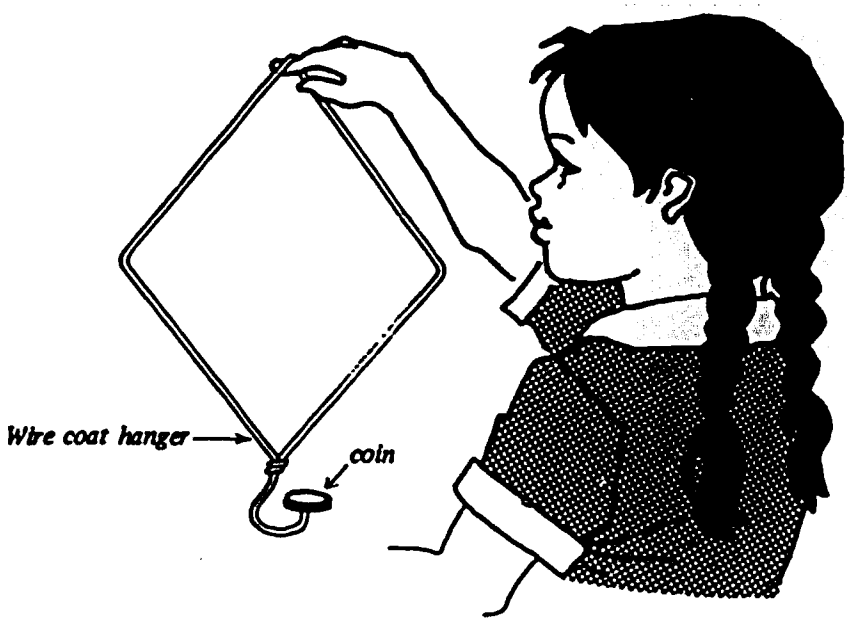


Figure 2 Put a coin on the end of hanger hook.

How to play

1. Put a coin on the flattened end of the wire.
2. After making sure that the coin does not fall off, lift up the hanger slowly, holding with a finger at the fulcrum point (Fig. 2).
3. Move it slowly from right to left. If you do it well, the coin does not fall off.
4. Try more complicated movements in horizontal and vertical directions and then combined with circular movements while balancing the coin on the hanger.
5. Next challenge: Turn the hand with the hanger around your head. Where is the coin? Still on the hanger?
6. Try to put two or three coins one above another.

Source: Case study of Simple Low-cost Teaching Materials, Games and Toys, prepared by Narikazu Ohsumi, NIER, Tokyo, Japan.

Level : All levels

RECOGNITION OF MELODIES

Subject area : Music

Brief description

This is a game which increases the musical experience of the pupils and develops their hearing as well as singing abilities. It can help them master a musical instrument.

Materials needed

Sheets of paper and pencils.

How to play

One player hums, sings or plays on an instrument a few bars of a number of familiar songs and melodies and the other players write the names of each song or melody; each having been supplied with paper and pencil. They then check to see who has the most correct answers. The pupils change roles so that another one becomes player.

Source: An Inventory of Low-cost/Simple Educational Materials, Games, and Toys in the Philippines. 1979.

DROPPING A HANDKERCHIEF

Level : Pre-school and primary
Subject area : Play activities

Brief description

This game is played by any number of children sitting or squatting in a circle on the ground.

How to play

A child is chosen as "It". "It" goes around and drops a handkerchief behind any child of the circle. Every child in the circle tries to detect the handkerchief with his hands behind. If the player behind whom the handkerchief is dropped fails to discover it, the "It" picks up the handkerchief and whips the inattentive player with the handkerchief until the player has run around and resumes his former place. If the player behind whom the "It" dropped the handkerchief finds the handkerchief, he picks it up and chases the "It" until the "It" has run around the circle and has taken his place. The chaser then becomes the new "It".

Source: An Inventory of Low-cost/Simple Educational Materials, Games, and Toys in the Philippines.

CAT AND MICE

Level : Pre-school and primary
Subject area : Play activities

Brief description

This is a game in which one child, "the cat" chases the other children ("the mice").

How to play

A "cat" hides behind the teacher's desk. A number of "mice" creep up to the desk and scratch on it. Immediately the cat gives chase to the mice who run for safety to their holes (seats). Any mouse caught becomes "cat" for the next game.

Source: An Inventory of Low-cost/Simple Educational Materials, Games, and Toys in the Philippines.

Sheet 7

FLYING DUTCHMAN GAME

Level : Pre-school and primary
Subject area : Play activities

Brief description

This is a fairly common outdoor game. A group of 10 to 20 children (even number) can play.

How to play

All children holding hands, form a single circle. One pair of partners become the runners. The two runners run around the circle, holding hands. While running, one of the runners tags the joined hands of two players standing in the circle. The pair that have been tagged, retaining their hands in a clasp, start running around the circle in the opposite direction. The two pairs of partners attempt to outrun each other to occupy the vacant place. The pair who fail to get the vacant place continue running around the circle.

Source: An Inventory of Low-cost/Simple Educational Materials, Games, and Toys in the Philippines.

FOLLOW THE LEADER GAME

Level : Pre-school and primary
Subject area : Play activities and physical education

Brief description

Depending on the weather, this game can be played outdoors or indoors. A group of children immitate the deeds of one of them, called "leader".

How to play

The children form a single line behind a leader. They must try to do everything the leader does. He may jump, touch things that are high up, walk backwards, or walk along the top of a narrow board. Anyone who fails to follow the leader either goes out of the line or becomes the leader.

Soure: An Inventory of Low-cost/Simple Education Materials, Games, and Toys in the Philippines.

NUTS AND HOLES (MARK KHUM)

Level : Primary and lower secondary
Subject area : Basic arithmetic

Brief description

This game is popular in southern Thailand. Two players compete.

Materials needed

1. A boat – like piece of wood with two rows of seven holes each carved along its length and two big holes, one at each end. The big hole is called 'home'
2. Nuts or dried seeds, or small stones; 98 of them.

How to play

1. Each of the two players owns seven small holes and one big hole or 'home' on his left hand side.
2. Each one puts 49 nuts in the small holes (7 in each).
3. With some kind of agreement such as coin flipping or card drawing, the first player begins the game.
4. He picks all the nuts in any one of the small holes on his side and puts one nut in each hole clockwise including his 'home' hole (but not the opposite player's "home".)
5. If the last nut falls in any hole where some nuts have remained, he may take all of them out and continue playing by repeating the same process.
6. When the last nut falls into an empty hole, then the turn is shifted to the other player. In each case when the last nut is dropped into an empty hole on his side, and even though the turn is shifted, he can take all the nuts from the opposite hole and put them in his 'home' hole.
7. Thus, they take turns to play until one player cannot continue because many of his holes are empty.
8. Then they take all the nuts from their homes and refill the small holes the same way they started the game. The one who wins the game is the one who has all of his small holes filled with seven nuts in each and has some more nuts left.

Possible modification

In case it is difficult to carve holes in a wooden piece to make the "boat" shown in the picture, this boat may be replaced by 16 half shells of coconut arranged in the same order.

Source: Inventory of Low-cost Instructional Materials, Games and Toys, prepared by Dr. Pruang Kumut; Department of Educational Technology; Faculty of Education, and Srinakarinvirot University, Bangkok.

BOLINTEC (MARBLE GAME)

Level : Pre-school and primary
Subject area : Play activities

Brief description

This is an outdoor game, which can be played by two to five players.

How to play

The players dig five small holes in the ground equidistant from each other in a straight line. A short line is traced on the ground at some distance from the first hole. This is where they start the game. Each player is provided with a perfectly round stone or a marble.

The players take turns trying to roll their marbles into the first hole. If a player succeeds, he goes on to the next hole. If he fails, the next player takes his turn.

In the course of the game, any one playing may hit one of the marbles belonging to the other players. If a player hits a marble, he advances one hole; two hits, two holes and so on. The player whose marble was hit must start all over again.

The last player to finish is declared the loser. The penalty could be that he does everything the first winner orders him to do.

Source: An Inventory of Low-cost/Simple Educational Materials, Games, and Toys in the Philippines.

BEAST, BIRD OR FISH GAME

Level : Pre-school and primary
Subject area : Play activities and basic science

Brief description

This is a game which promotes quick thinking and responses with a time limitation, and also widens knowledge of zoology.

How to play

The players sit in a circle with one in the centre. The player in the centre points at one of the players and says, "Bird, beast or fish?" He then repeats one of these nouns for example, "fish" and counts quickly from one to ten.

The player at whom he continues to point must name a fish before he finishes counting. Should the pointed player fail to name a fish or should he repeat a name which was already mentioned during the game he exchanges places with the player in the centre.

The player in the Centre may vary the game by saying, "Beast, bird or fish," and adds "Vulture" whereupon the other player must say "bird".

Source: An Inventory or Low-cost/Simple Educational Materials, Games, and Toys in the Philippines.

BLACKBOARD RELAY

Level : Primary
Subject area : Basic arithmetic

Brief description

This is a game developing children's creativity, speed and competitive spirit in solving arithmetic problems.

How to paly

The players are divided into two or more teams. The leader of each team starts from a starting line, runs to the blackboard, writes two numbers one under the other, and either adds or subtracts them, putting down the sum. Each runs back and hands the chalk to the second player who is on the starting line. He runs to the board and puts a number under this sum and either adds or subtracts the numbers. The game continues until the last player has his turn. He must add or subtract so as to secure a final number which has been previously determined. For instance, if 35 is to be the final number and the figure left by the next to the last player is 77, the last player must subtract 42.

Possible modification

This game may be played by having each player contribute one word toward a complete sentence which must be finished by the last player regardless of the number of words he uses.

Source: An Inventory or Low-cost/Simple Educational Materials, Games, and Toys in the Philippines.

Sheet 13

NOUNS CHANGING GAME

Level : Primary
Subject area : Reading and Writing

Brief description

This is a funny game in which all players participate by substituting nouns in a story being read by the leader.

Materials needed

1. A story book, or a popular poem
2. Sheets of paper
3. Pencils

How to play

After supplying the players with paper and pencils, the leader selects a story, a poem or a Mother Goose rhyme, which is familiar to the group but does not disclose the name of his selection. Then he reads it aloud and asks the first player to write a concrete noun beginning with the letter with which the first concrete noun in the story begins; the second player, the second noun and so on, until all the nouns in the story have been assigned. A player must not repeat nouns in his own list even though he may be given the same letter more than once. When all nouns are assigned, the leader begins to read aloud, waiting for each one in turn to supply the nouns instead of reading those in the book. Let us suppose "The Three Little Pigs" has been selected and begins, "Once upon a time three little pigs who lived with their mother in a pen", etc. The first player has written a noun beginning with "p" (ponies) the next noun beginning with "m" (master), the next a noun beginning with "p" (piano). The leader reads, "once upon a time there were three little ponies who lived with their master (supplied by the next player) in a piano (supplied by the third player). The outcome of the nouns changing game will prove interesting and funny.

Source: An Inventory of Low-cost/Simple Educational Materials, Games, and Toys in the Philippines.

FILL-INS

Level : Primary
Subject area : Writing drills and spelling

Brief description

In this game players complete words by inserting the missing letters between the initial and last letters.

How to play

Each player is given the first and the last letters of a series of four letter words such as l–p, t–k, etc. Within a limited time, he is required to fill-in the missing letters so as to complete the list of words, and scores one point for each acceptable word. The list should contain around 20 to 30 words. This game is essentially a test of speed and for this reason all players must be given the same amount of time. Only familiar words should be selected. Completing such words may appear easy enough, but when one is pressed for time, it is surprising how difficult it may be to complete l–p as lamp and t–k as talk.

Source: An Inventory of Low-cost/Simple Educational Materials, Games and Toys in the Philippines.

Level : Primary
Subject area : Writing drills

BURIED WORDS

Brief description

This is a game in which all players have to identify some concealed or hidden words, which are in some given text and each player makes a list of these words.

Materials needed

Sheets of paper with a proverb or a sentence typed, and pencils.

How to play

A proverb or some sentence is announced and each contestant writes it on a sheet of paper. Then he writes down as many hidden words as he can form by combining successive letters from the given sentence. All words must use the letters in the exact order in which they appear. No one-letter words may be used nor any word as it appears in the original. For example, the proverb, "Appearances are often deceitful", provides at least the following words; pear, ear, ran, an, ten, tend, end, deceit and it. Although it is easy to overlook a word, the process of finding the words is a fast one, and players should be allowed only a very short time. At the end of the prescribed time, all should stop writing at once and the number of acceptable words should be compared in order to determine the winner.

Source: An Inventory of Low-cost/Simple Educational Materials, Games, and Toys in the Philippines.

WORD BUILDING FISH-CATCHING TANK

Level : Pre-school and primary
Subject area : Learning alphabet and spelling

Brief description

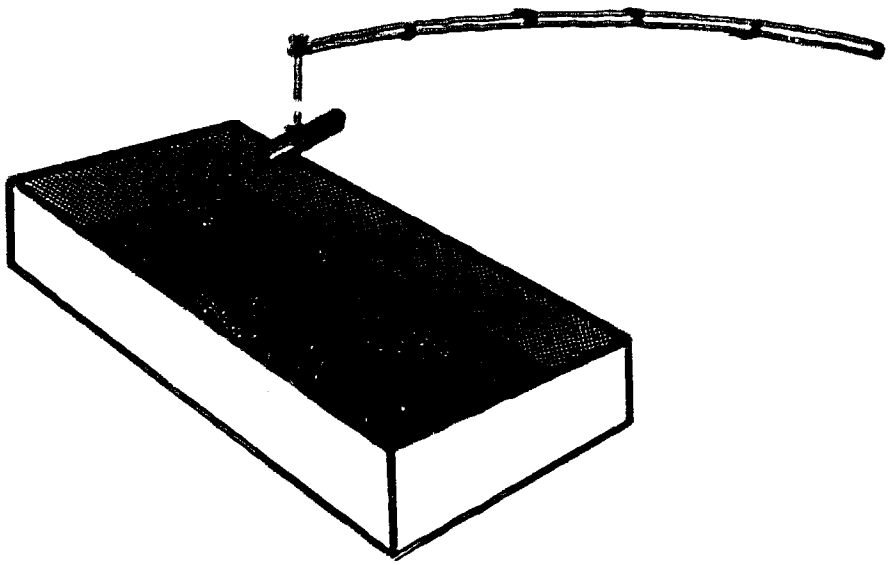
This is an empty shoe-box full of letters of the alphabet, written on fish-like shaped pieces of cardboard with metal eyelets or paper clips. The players "catch" fish and assemble the letters into meaningful words.

Materials needed

1. An empty cardboard box (from shoes or other empty discarded box).
2. Thin cardboard pieces cut into the shape of fish.
3. Crayon or felt pen.
4. Metal eyelets or paper clips attached to the fish.
5. A bamboo stick (fishing rod) with a cotton thread and a small magnet attached to it.

How to make

1. Cut fish-shaped figures.
2. Write on each fish a letter with crayon or felt pen.
3. Attach to each fish a metal eyelet or a paper clip.
4. Put the fish in the cardboard box.
5. Prepare a fishing rod using a bamboo stick, a thread and a small magnet.



How to play

1. Let the children prepare all: fish-letters, tank and fishing rod.
2. Each child catches a fish and places it on the table.
3. The next fish bearing a letter should be placed next to the first fish.
4. Gradually the letters should form meaningful words. If a player fails to make up a word by reshuffling his letters (the fish caught by him,) he drops out of the game.

Source: Bangladesh Education Extension and Research Institute – Report of a National Workshop on Educational Technology.

Level : Primary

WINDOW-ENVELOPES FOR DRILL EXERCISES

Subject area : Arithmetic

Brief description

This device consists of an envelope with an irregular shaped window (so that first, the problem is shown and later the correct response) and a deck of cards on which the problems are written.

At the back of each card there are such things as cartoons, comic strips, jokes, etc.

Educational objectives

Repetition is important in the learning process for mastering certain skills. It also facilitates the understanding of concepts and rules and the ability to retain what is learned for a long time. However, the drill exercises can be too boring for the children and rather tedious for the teacher. It takes time to check and mark the correct responses of the students. A way out is to individualize learning i.e. provide a means whereby the student can check his answers or obtain marking for his responses without involving the teacher and also progressing at his own pace. This device provides an extremely simple way of doing this.

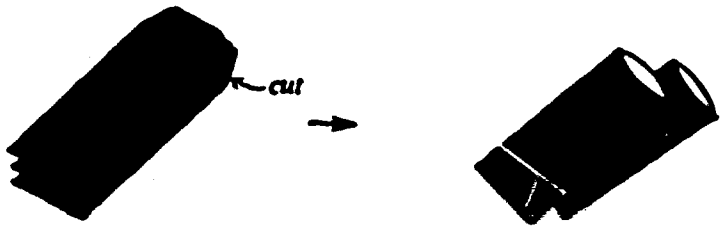
Materials needed

1. A few manila envelopes (the size could be 7 x 12 cm).
2. A set of cards – appropriate size to fit the envelopes.
3. A pair of scissors.
4. A pointed paper cutter (See also sheet 55)
5. A set of felt pens or crayons.

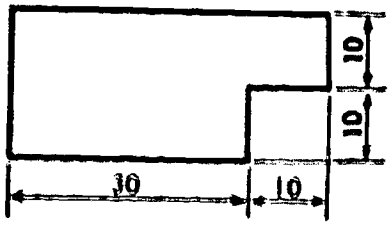
How to make

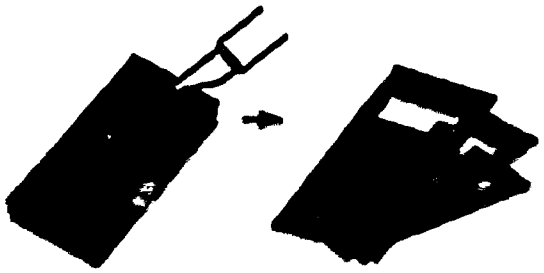
A. *The Envelopes*

1. Take a few manila envelopes together and cut off one end with scissors as shown in the figure. (A convenient size for the envelopes is 7cm x 12cm)



2. Stack them together neatly and with a sharp knife, cut out the shape shown in the figure.



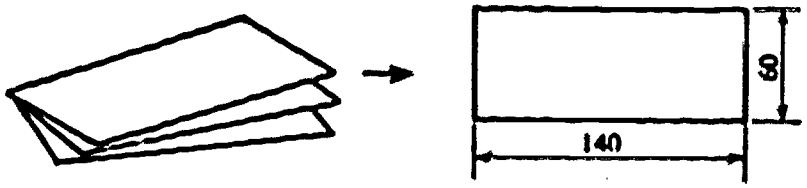


(Note: The same shape is also made through the back side of the envelopes, but it does not matter.)

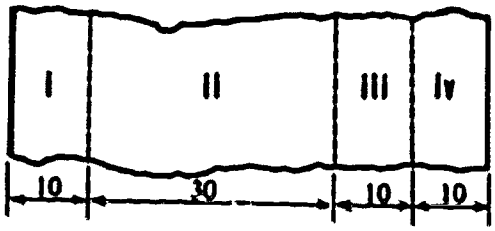
3. Now the envelopes are ready for use. Have enough for the whole class.

B. *The Problem Cards*

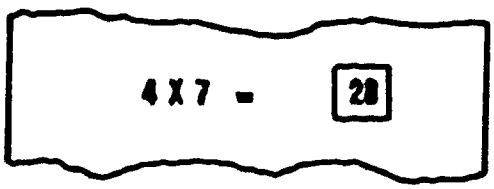
1. Cut a few cards of the size 6cm x 14cm (the size must be such that it fits inside the envelope easily).

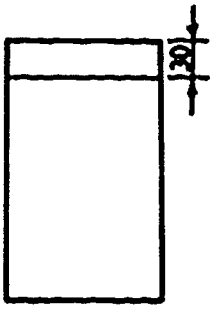


2. Divide the space on each of the cards as shown.



Do not write anything on the regions (i) and (iv). Write the problem on the space marked (ii). Leave a blank space for the children to write the answer. The correct answer must be given in the space marked (iii).





Note: Leave about 3cm of the top end of the card blank.

3. A large number of exercise sets can be prepared easily with the help of students:

   a) Write the first line at the top of the card.

   b) Tell an able child a rule to generate the rest of the lines.

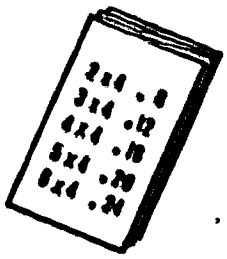
      e.g. add 1 to both numbers

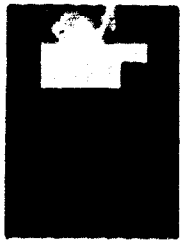
      4 x 7 = 5 x 8 = 6 x 9 = etc.

      When sufficient number of masters are ready, they can be transferred to a stencil and a large number of copies, enough for the whole class duplicated.

4. Grade the exercises in the order of difficulty. Make enough sets of exercises for the whole class.

5. Insert a set into an envelope with the window already cut as described above.





The system is now ready for use.

6. Cartoons, witty jokes, pictures for making simple toys etc., can be printed on the back of the exercise cards for making the task rewarding. This will contribute to motivating the children.

How to use

a. Explain to the students that correct answers to the problems can be seen on the right hand side of the window if the card is pushed up a little bit.

b. Some children may first look at the answer and then write the correct response on the space provided. Explain to the students that doing that will not help them to learn. Draw their attention to the following points:

   i) The exercises are not a test of some sort;
   ii) The teacher will not be marking or grading them;
   iii) They can proceed at their own pace.

c. In order to arouse and sustain interest in the task, tell the children that *only* if they complete all the problems, can they take the card out from the envelope and look at the interesting thing at the back of it.

Source: CRADLE/Instructional System with Simple Materials, Tokyo, Institute of Technology.

Sheet 18

MULTIPLICATION GAME

Level : Primary
Subject area : Arithmetic

Brief description

This is a game consisting of two octagonal "number tops". Each number top consists of a card with an octagonal shape, at the centre of which is inserted a large wooden pin. The octagon is divided into eight equal parts and the numbers from 2 to 9 are written on it, one number in each part.

It can spin just like a top and when it stops, it rests on one of its sides. If two such number tops are made to spin, they generate two numbers when they come to rest. For example when one rests at 4 and another at 6 we have the pair (4, 6), which can be used in a problem: either to add these two numbers, or to multiply them.

Educational objectives

Children like to play. There are many games and toys that may incorporate playing as an essential element of the learning process. The "number tops" described below can be considered as toys that can be used for a number of games in arithmetic. They can be used for creating a game-like context for learning arithmetic.

Materials needed

1. Cardboard, two sheets 6 × 6cm or 8 × 8cm.
2. A wooden pin (or short pencil).
3. Crayon or felt pen.
4. A pair of scissors.

How to make

1. Cut out from cardboard as many octagons as possible. The diameter of each could be 6cm or 8cm. Coloured cardboard is preferable.
2. Divide each octagon into 8 triangular sectors (Fig. 2).
3. Write a number on each sector clearly with a crayon or a felt pen (Fig. 3).
4. Make a small hole in the centre so that a pencil will fit in tightly.

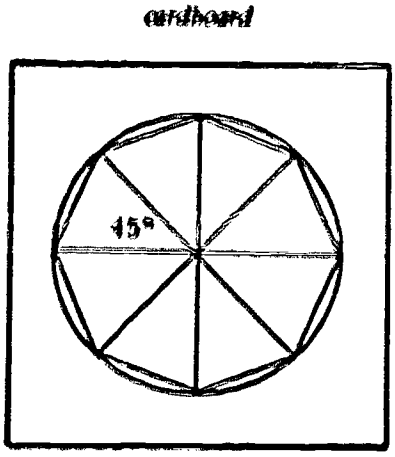


Figure 2

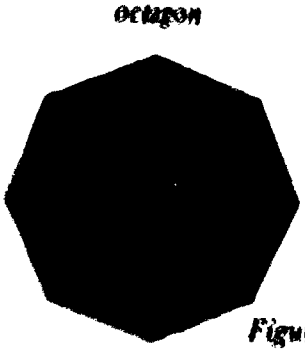


Figure 3

5. Select appropriately sized wooden pins or take some pencils and cut them so that they are about 10cm long.
6. Push the pencil into the disc as shown so that about 3cm of the pencil protrudes over the other side. (Figure 4)

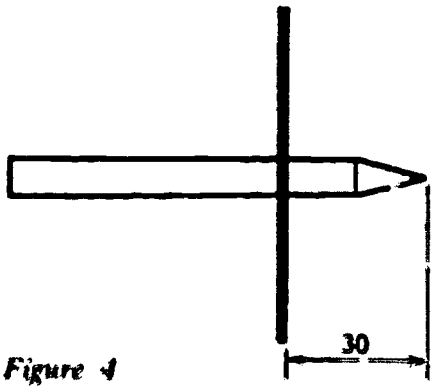
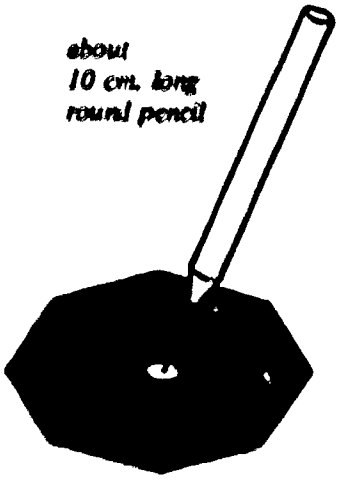


Figure 4



7. Spin it to check whether it is well balanced and whether it stops so that different numbers are generated in a random manner.
8. Secure the pin or the pencil to the disk with glue or scotch tape.

How to use

Tell the class that they are going to play a game with numbers. Each student forms a pair with his friend. Two number tops and an arithmetic multiplication table will be given to each pair. The procedure for the game is as follows:

One student will spin both tops and generate two numbers. e.g. 3 and 5. Then he will write on a sheet of paper the problem 3 x 5 = The other pupil will try to solve the problem. If necessary the first student will check the response in the arithmetic table. If the response is correct,

then he should say 'good' or something to that effect. If it is not so, he should give the correct answer. Now they change roles. The second pupil generates the numbers and the first pupil tries to guess the answer. And the game is continued in this manner. An element of competition can be introduced by allowing each pupil to solve about 10 problems and nominating the winner as the one who gets the most right answers.

Possible modifications:

1. The preparation of these tops can be made a classroom activity. During the arts and crafts lessons, these spinning tops can be made.
2. Instead of cardboard, other materials such as plastic, or plywood can be used.
3. Instead of a pencil, any round stick about 0.7cm to 1cm in diameter can be used. Chopsticks, bamboo, etc. are perhaps easy to obtain in some countries.
4. The number of sides of the disc vary though 8 seems to be very convenient. The numbers written on each sector may also vary. Figure 5 shows a disc divided into nine sectors.

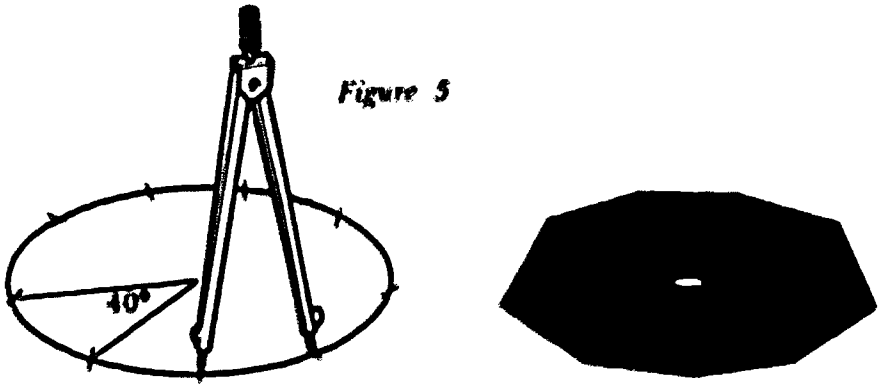


Figure 5

Disc with 9 sides

Source: CRADLE – Instructional Systems with simple materials, Tokyo Inst. of Technology.

ROLLING CAN

Level : Pre-school and primary
Subject area : Play activities

Brief description

This toy is an empty cylindrical can. Merely rolling it around makes this a toy for playing games but some simple alterations make it even more fun.

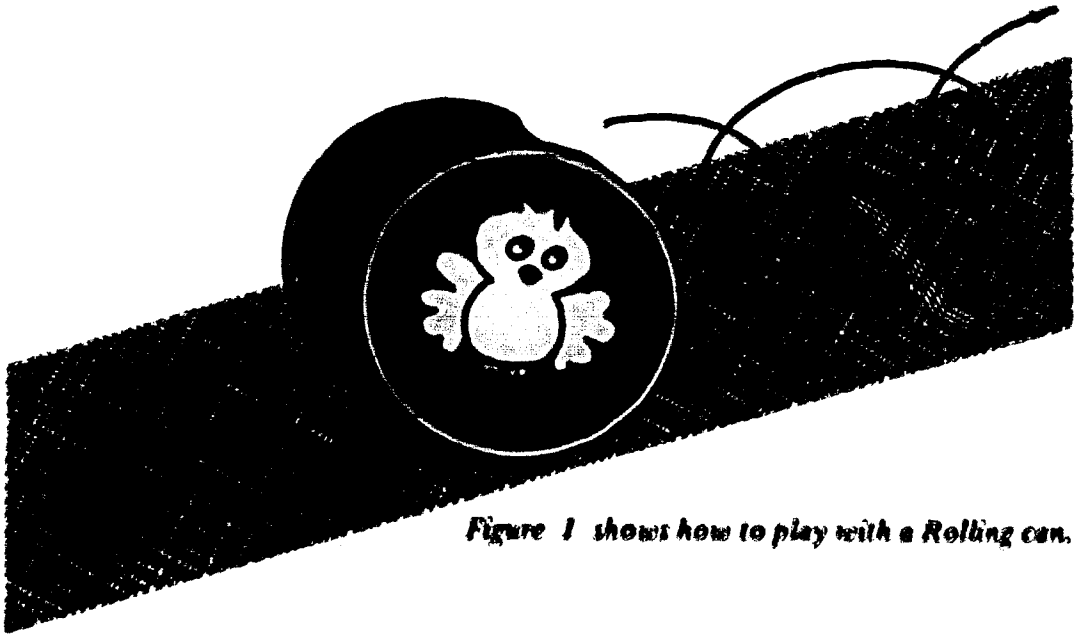


Figure 1 shows how to play with a Rolling can.

Materials used

1. An empty can
2. A piece of clay or plasticine
3. A piece of lead and some universal glue.

How to make and play

1. The cylindrical can should be large rather than small. By using a larger can, the movements become more dynamic and appeal more to the children. Smooth out the rim of the can so that the children will not be hurt if they put their hands inside the can.
2. After the children get tired of just rolling the empty can around, have them draw a picture by tracing the outline of the bottom of the can on a piece of cardboard, and cut it out (see Figure 2)
3. Let the children draw a picture on this circular cardboard and paste it onto the bottom. It is possible to combine scientific play with creative activity by drawing various spirals or other shapes that produce an interesting image when rotating.

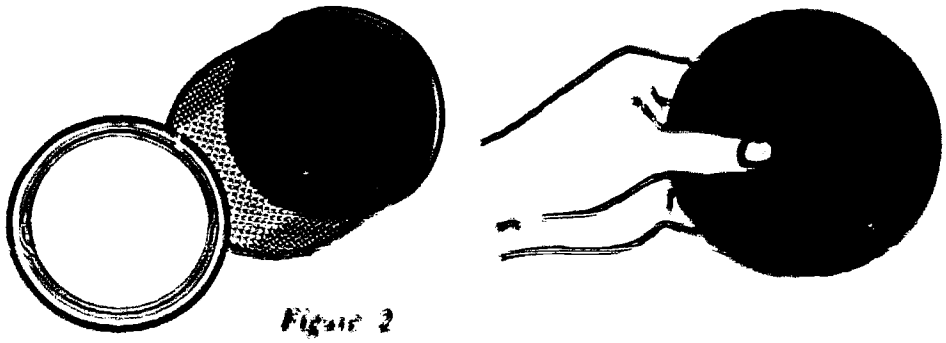


Figure 2

4. To add variation in the movement of the empty can, fix a weight inside of the can. For example, adhere a piece of clay inside the can as shown in Figure 3. The difference in the way the can rolls can be clearly seen. Some other object such as a piece of lead can be fixed inside the can.

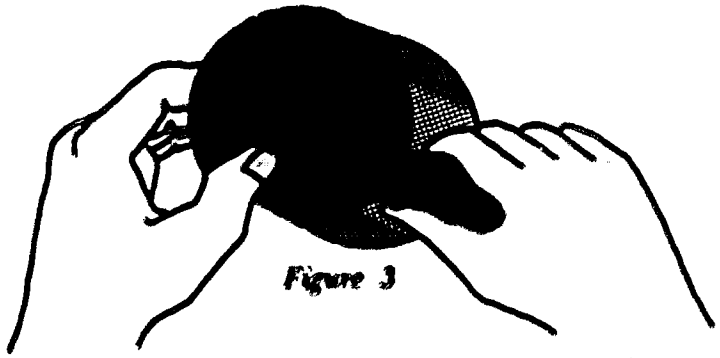


Figure 3

If a weight such as a piece of clay is fixed to the inside of the can, the can moves in a variety of ways when it is rolled.

Possible modifications

It would be more interesting if the children do not see the weight fixed inside the can, covering its open side with a cardboard circular bottom and after playing with a similar empty can, change it with the weighted one and let them try to figure out what is going on. After they have thought of several possibilities, if they did not discover the trick; let them see the inside. There are several ways in which this off-centered rolling could be demonstrated to the children:

1. Make a slight slope with a piece of board. When the weighted can is released, it climbs up the slope, while the empty can rolls downwards.
2. If the hand holding a weighted can on a tabletop is released, it looks as if it is about to roll off the edge of the table, and one is tempted to catch it. However, the can does not fall off and starts rolling in the opposite direction, after which it rolls back and forth a few times. Eventually it rolls less and less and stops with the weight down. By varying the demonstration, the interest and curiosity of the children can be stimulated.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Narikazu Ohsumi, NIER, Tokyo, Japan.

"WALKING" PAPER CUP

Level : Pre-school and primary
Subject area : Play activities

Brief description

This is a simple toy made of a discarded paper cup which makes funny movements caused by a rotating round piece of clay using the energy of a released twisted rubber band.

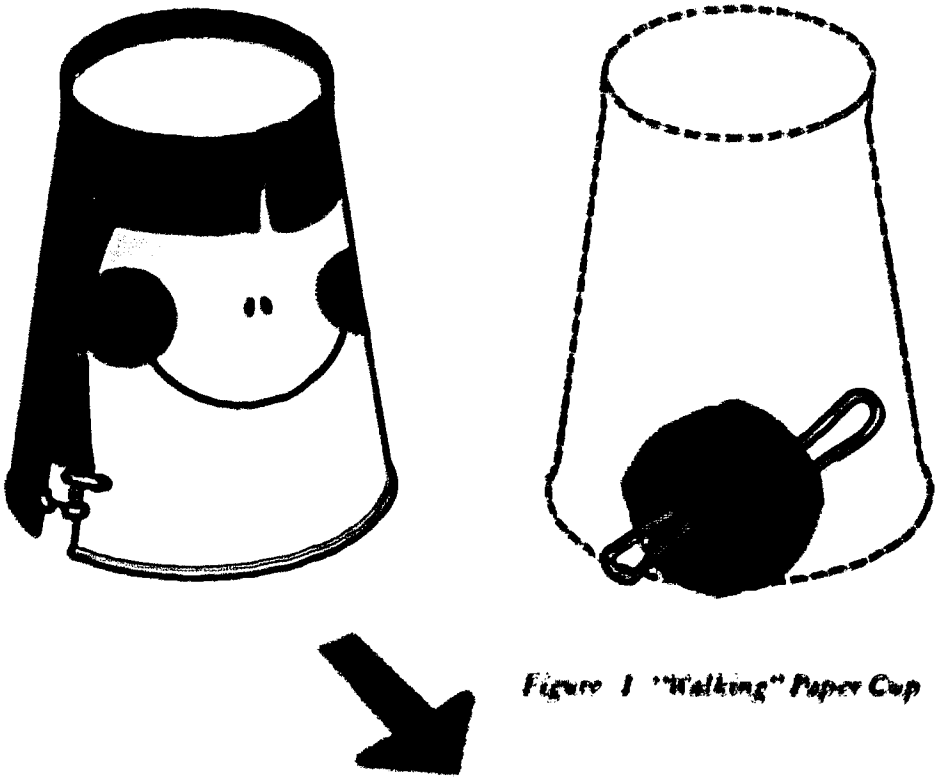


Figure 1 "Walking" Paper Cup

Materials used

1. A discarded water cup.
2. A piece of clay.
3. A strong, elastic rubber band.
4. Adhesive tape or stapler.

How to make

1. Obtain a 150-200 ml paper cup.
2. Cut with scissors two slots on the two opposite sides of the cup. The two slots should be about 5-10 mm apart and about 10 mm from the rim.

3. Obtain a regular-sized strong, elastic rubber band.
4. Stick a piece of clay around the rubber band. The clay should not be very soft. If using soft clay, leave it aside and let it dry for a while before using.

Figure 2

5. Wrap the middle part of the stretched rubber band in the piece of clay and shape the clay into a ball, or a cylinder.
6. Hook the 2 loops of the rubber band encased in the lump of clay onto the two opposite slits of the paper cup.

   The lump of clay should hang in the air inside the cup, protruding slightly above the level of its rim.
7. Fix the notches to the wall of the cup with some scotch tape or staples so that they will hold the rubber band.
8. Draw a funny face or some design on the outside of the paper cup to give it some character.

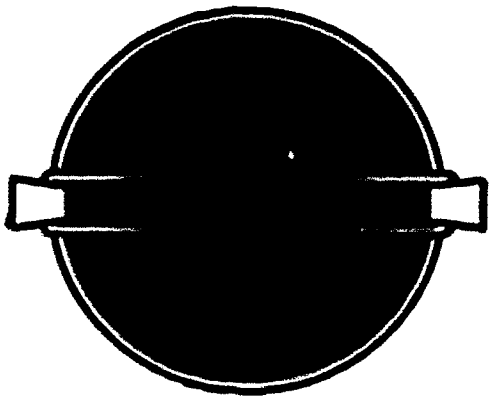


Figure 3 shows the bottom view of a "Walking" paper cup which moves with a rubber band (seen from below)

How to use and play

1. Before placing the cup on a table top, take the lump of clay in your fingertips and rotate it in one direction, winding the twisted rubber band.
2. Hold the piece with your fingers and place the cup face down on a table or on to the floor.

3. Release, and the unwinding twisted rubber band will make the cup "walk". If the piece of clay is uneven, the cup will move in a very funny way. Its movement will differ depending on the quality of the rubber band, how well the clay has been kneaded, the size and weight of the clay piece, etc.

Educational objective

This mechanism is extremely simple and children can easily form some concepts of potential and kinetic energy on their own as they construct and play with this toy. This is the educational purpose of the project.

Possible modifications

A paper cup was used here to make matters simple. However, one need not be limited to paper cups; various empty cylinders or boxes can be used. Size, too, can vary. Something of a larger size may be more interesting. If an ordinary rubber band is not strong enough, 2 bands can be put together or the children can be encouraged to find some other suitable material.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Narikazu Ohsumi, NIER, Tokyo, Japan.

PUPPET HEAD

Level : Pre-school and primary

Subject area : Play activities and story-telling; art and craft

Brief description

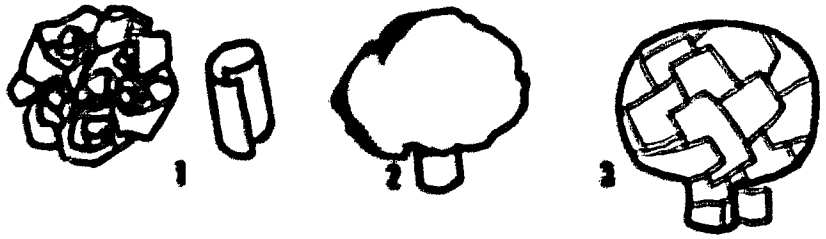
This is a toy made of easily available materials, which promotes children's skills and creativity and can be used in an improvised puppet theatre.

Materials needed

1. Paper
2. Cardboard
3. Tissue paper
4. Starch
5. Glue
6. Water colours or felt pens and
7. Cloth material

How to make

1. Crumple an old newspaper to form an egg-shape of about 10cm in diameter. This will be the puppet head.



2. Make a cardboard tube about 8 cm long and 2 cm in diameter or small enough to fit the index finger. This will be the neck of the puppet head.

3. Fasten the cardboard tube to the egg-shaped puppet head with a piece of string.

4. Soak several pieces of tissue paper in semi-liquid starch and model on the head foundation. Make nose, ears, chin, and other desired features by building up layers of the wet tissue paper.

5. Allow to dry in room temperature. Then cover the entire head and neck with about 2 more layers of tissue paper soaked in starch to make the features smooth and even.

6. When dry, paint the entire head with water colour and paint the eyes, nose, lips, cheeks, and ears.

7. Frayed rope or abaca fibers or corn hair may be glued on the head for the hair.

8. Beads, thumbtacks or buttons may be used for the eyes, nose, and mouth, if desired.

9. The puppet head can now be dressed with scraps of cloth or crepe paper.

Source: An Inventory of Low-cost/Simple Educational Materials, Games, and Toys in the Philippines, 1979.

STOCKING DOLL AND SPOOL DOLL

Level : Pre-school and primary
Subject area : Play activities

Brief description

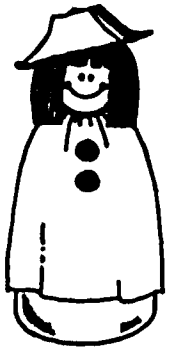
This is an improvised toy made of empty discarded thread spools, wire, cork and crepe paper.

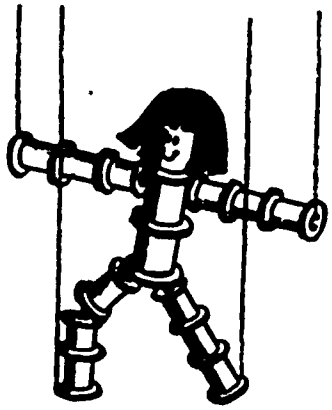
Materials needed

1. Old stocking
2. Bottle
3. Various sizes empty thread spools
4. Wire
5. Crepe paper
6. Scisors
7. Crayons
8. Cork
9. Corn hair and
10. Glue

How to make

1. Stocking dolls are made of stuffed cotton stockings with painted or embroidered faces. They can be made to stand by slipping them over empty tall bottles. The face features may be painted on; the hair of yarn or abaca or corn hair may be topped with a small hat; and the clothes may be fashioned from cloth scraps or crepe paper.
2. Spool dools are made by stringing various sizes of empty wooden spools, with cord, soft wire, or pipe cleaners. When the wire is bent it makes the dolls stand or sit as desired.





A few large spools should be used to form the body and regular size spools for the legs. The arms can be made of smaller spools. The head can be made of rounded cork with hair of yarn or corn hair. The eyes, nose and mouth can be painted with water colour or crayon, as desired.

Source: An Inventory of Low-cost/Simple Educational Materials, Games, and Toys in the Philippines.

MONKEY TAMBOURINE

Level : All levels
Subject area : Music

Brief description

This is a primitive percussion musical instrument made of no-cost materials.

Objectives

To give the children opportunity to make their own percussion instrument and play with it while singing songs, or listening to music.

Materials needed

1. A long flat strip of bamboo
2. About 2 metres of wire
3. 12 soft drink bottle lids hammered flat

How to make

1. Bend both ends of the bamboo strip and secure them with the wire in a circular form (a ring).
2. Make 4 holes around at the stde of the bamboo ring.
3. Insert a short piece of wire through the middle holes of the three bottle lids and tie both ends of the wire to the bamboo strip with the lids in between each of the four holes along the bamboo ring.

Source: Inventory of Low-cost Instructional Materials, Games and Toys, prepared by Dr. Pruang Kumut; Department of Educational Technology; Faculty of Education, Srinakarinvirot University, Bangkok.

Sheet 24

Level : All levels
Subject area : Music

CASTANETS

Brief description

This is a simple percussion instrument made of wood and string.

Objective

To motivate the children to produce their own castanets and clap rhythmically to the tone of some song or melody.

Materials needed

1. Three flat pieces of hard wood, like paddles, one of them twice the length of the other two to serve as a handle.
2. A piece of thick, strong string.
3. Chisel, hacksaw and drill.

How to make

1. Trace the outline of the three paddles as shown in the photograph. The short paddles on each side have holes carved in the middle.
2. Drill the holes for the string.
3. Tie them loosely together.

Source: Inventory of Low-cost Instructional Materials, Games, and Toys, prepared by Dr. Pruang Kumut; Department of Educational Technology; Faculty of Education, Srinakarinvirot University, Bangkok.

MARACAS

Level : All levels
Subject area : Music

Brief description

This is sort of musical instrument for producing rhythmical drum-like noises along with a molody or song.

Materials needed

1. 2 empty coconut shells.
2. A handful of dried seeds
3. Two round pieces of wood used as handles (e.g. bamboo sticks).

How to make

1. Cut a smooth round hole at the bottom of each coconut shell so as to fit a round wooden handle.
2. Put some seeds in each of the coconut shells.
3. Insert the handle through the bottom hole until its top end reaches the top of the coconut shell and secure it with a small screw. If necessary, apply some glue between the handle and the hole.

How to play

Shake the two marakas in your hands to the rhythm of some song or melody.

Source: Srinakarinvirot University Elementary Demonstration School, Bangkok, Thailand.

MILK CARTON AND BALLOON BOAT

Level : Pre-school and primary
Subject area : Play activities and basic science

Brief description

This is a "motor-boat" made of a milk carton and a rubber balloon.

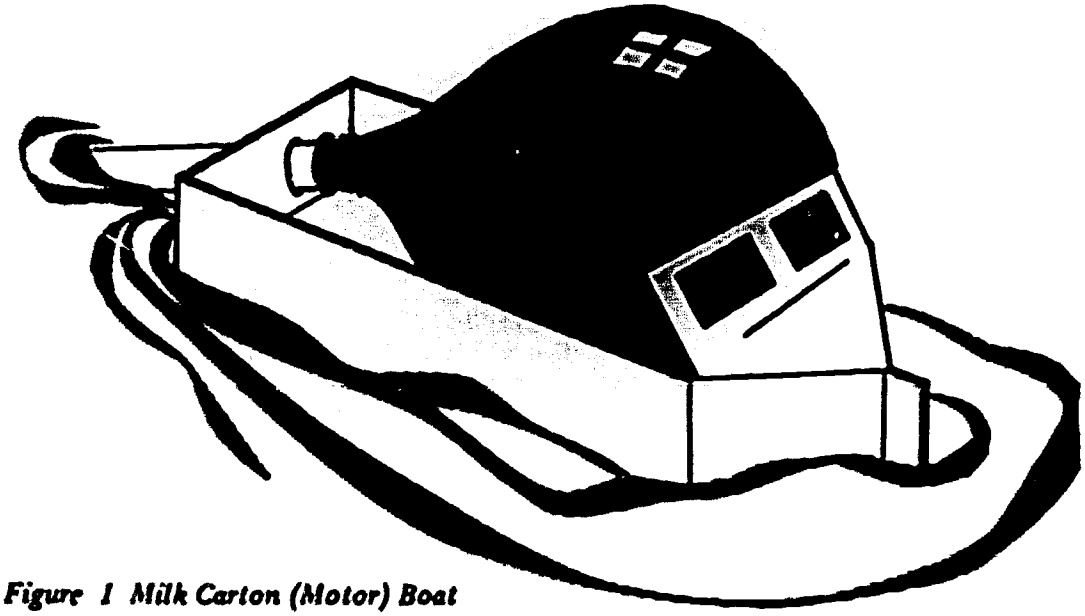


Figure 1 Milk Carton (Motor) Boat

Objective

To make a toy for entertainment using a discarded milk carton and a rubber balloon.

How to make

1. Take a one litre milk carton. Juice cartons will also serve the purpose since both are waterproof and are easy to handle.
2. Using a cutter knife, slice the carton lengthwise into two. Discard the half which has the opened spout at the top, as this half will not be used.
3. Make a small, round hole in the centre of the lower end of the bottom of the remaining part of the carton. Use a paper punch to make an even hole. Enlarge it until it fits the end of a plastic tube.
4. Insert the empty tube into the hole and secure it in position at an angle so that its end will be touching the surface of the water or be slightly underwater when the boat is placed in water.

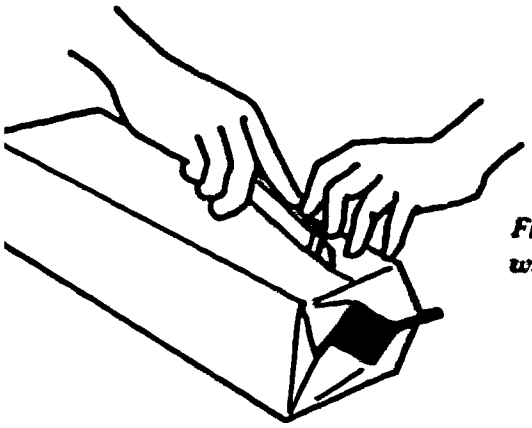


Figure 2 Slice carton lengthwise into two.

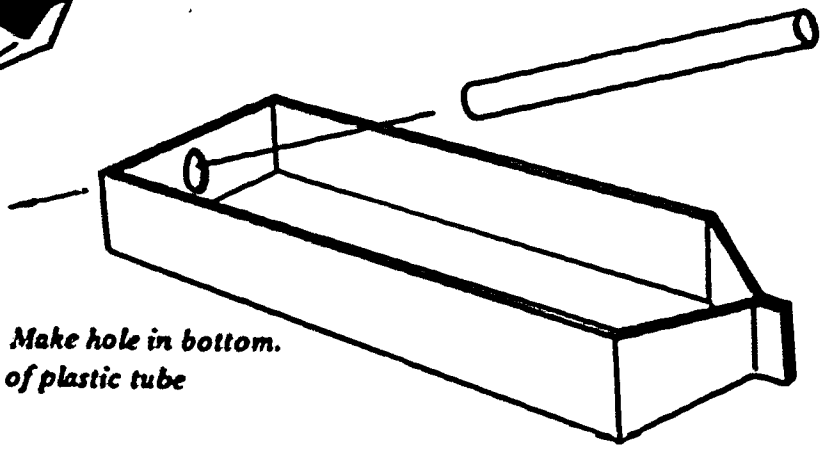


Figure 3 Make hole in bottom. Insert tip of plastic tube

5. Insert the other end of the tube into the mouth of a rubber balloon. Secure it firmly with a rubber band so that it will not pop out when air is blown into the balloon.
6. Decorate the body of the boat.

How to use and play

1. Take a deep breath, then blow into the tube through the end attached to the boat until the balloon is blown up.
2. Hold the tip with your finger so that the air will not escape. Float the boat in water. Release your finger and the boat will be pushed across by the released air.
3. Adjust the "nozzle" of the boat so that it will run smoothly.
4. Attaching a rudder to the side of the boat would be an interesting addition.

Possible modifications

Milk cartons are usually easy for children to work with and will allow children to experience a sense of satisfaction in constructing something successfully, but in place of milk cartons other waterproof containers and various different materials can be also used.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Narikazu Ohsumi, NIER, Tokyo, Japan.

PLASTIC BOTTLE "DIVER"

Level : Pre-school and primary
Subject area : Play activities and basic science

Brief description

The floating 'diver' will go up and down no matter what part of the plastic bottle is pressed.

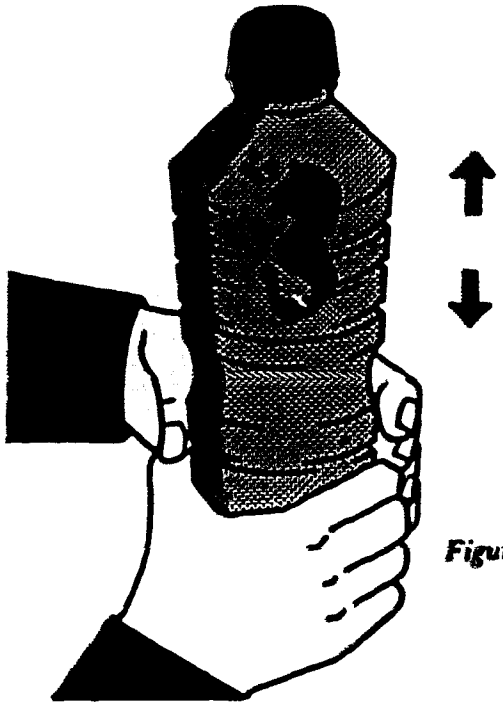


Figure 1

Materials used

1. An empty plastic bottle (about one-litre size).

It is better to use one that is clearly transparent so that you can see the inside well. A large bottle will be easier for children to handle and to make observations.

2. Coloured transparent plastic sheet.
3. Vinyl cell mat.
4. Adhesive tape or glue.

How to make

1. Cut out a figure from a coloured, transparent plastic sheet, that is small enough to pass through the opening of the bottle. Figure 2 shows a small sea-horse.
2. Attach air chambers to the 'diver'

The figure cut out in the desired shape will not function as a 'diver' until air chambers are fixed onto it. A good, ready-made air chamber can be obtained easily by using 'bubbles' from a vinyl cell mat, a kind of cushioning often found at the bottom of cookie cans. Cut out two unpopped 'bubbles' and stick one on each side of the transparent figure. A quick way is to use double-sided adhesive tape, but other adhesive glue will also do.

3. Attach a weight to the 'diver'

The 'diver' will function much better with a weight attached to it. Coil a short piece of wire. Before placing the 'diver' inside the bottle, test it in a basin of water. If it sinks, the weight is too heavy. It should barely float below the water surface level.

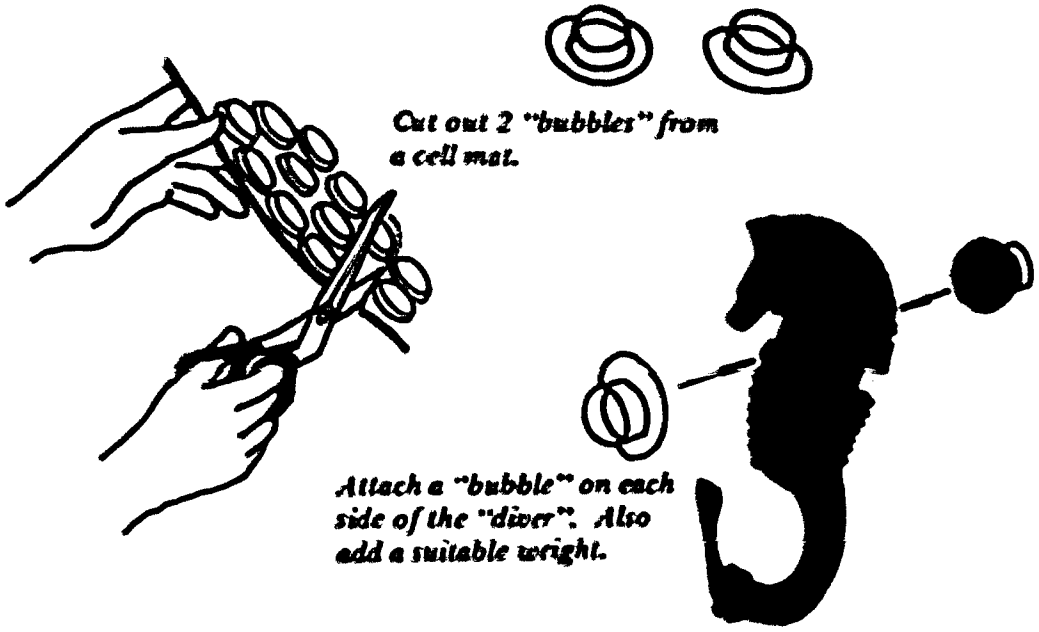


Figure 2 Making a "diver"

4. Insert the 'diver' in the bottle, fill it with water, and screw the cap firmly. Try squeezing the bottle in your hand; if water leaks out from the top, seal it with some plastic sheet in the cap.

How to use and play

Press the sides of the water-filled bottle with your hands and the "sea-horse" will float downwards. Release pressure from your hands and the 'diver' will rise. Invert the bottle or hold it in horizontal position and the same phenomenon will take place.

Let the children make whatever shape of a 'diver' they want to insert in the bottle.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Narikazu Ohsumi, NIER, Tokyo, Japan.

Sheet 28

MOBILE TOY MADE OF WIRE

Level : Primary
Subject area : Craft and basic science

Brief description

This toy is made from readily available wire.

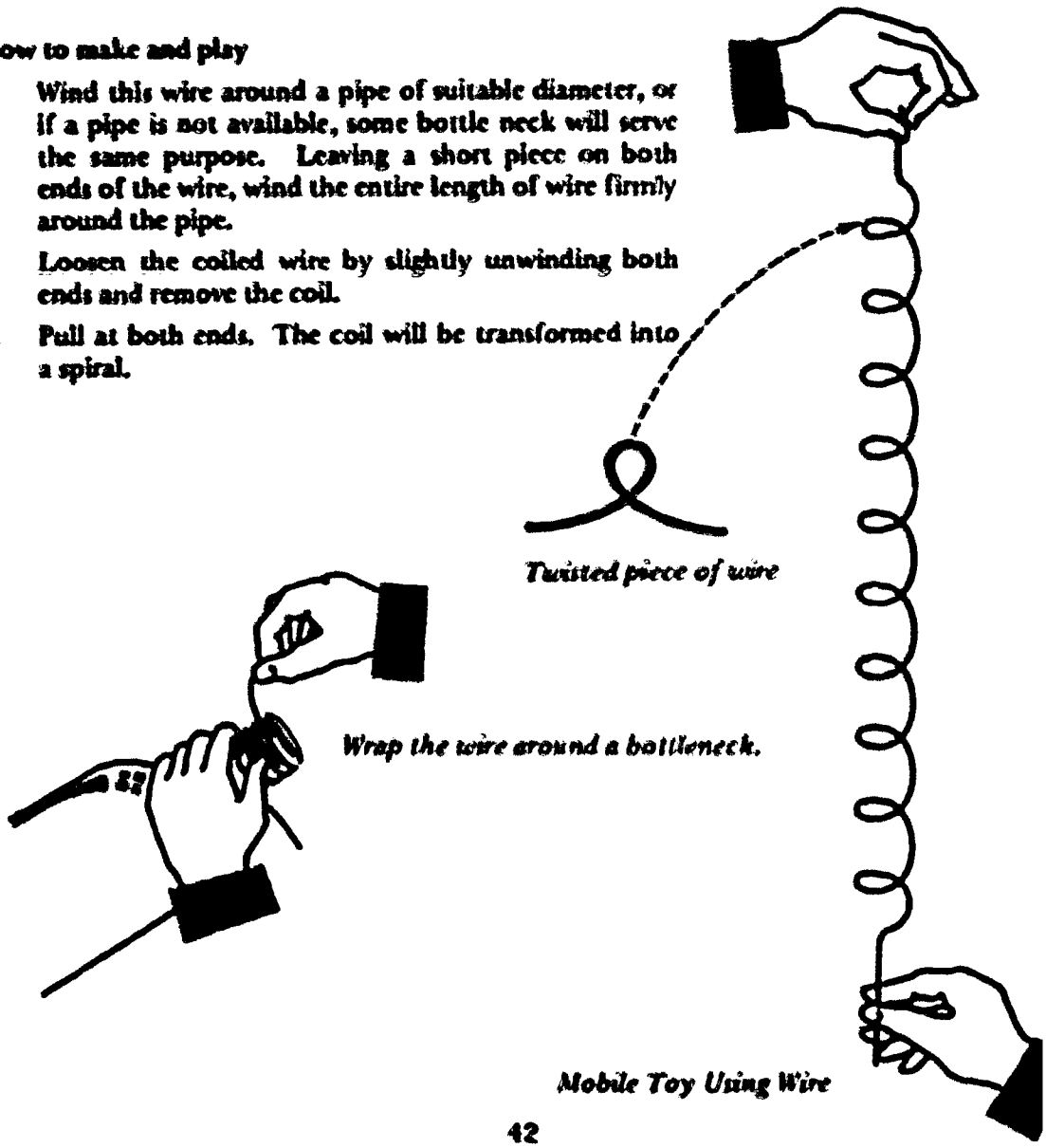
Children can make and enjoy playing with these rotating mobile wire toys.

Material used

You will need a piece of wire about 1 metre long. Any type of wire will do but wire of 0.8–1.2 mm in diameter will be easiest to handle.

How to make and play

1. Wind this wire around a pipe of suitable diameter, or if a pipe is not available, some bottle neck will serve the same purpose. Leaving a short piece on both ends of the wire, wind the entire length of wire firmly around the pipe.
2. Loosen the coiled wire by slightly unwinding both ends and remove the coil.
3. Pull at both ends. The coil will be transformed into a spiral.

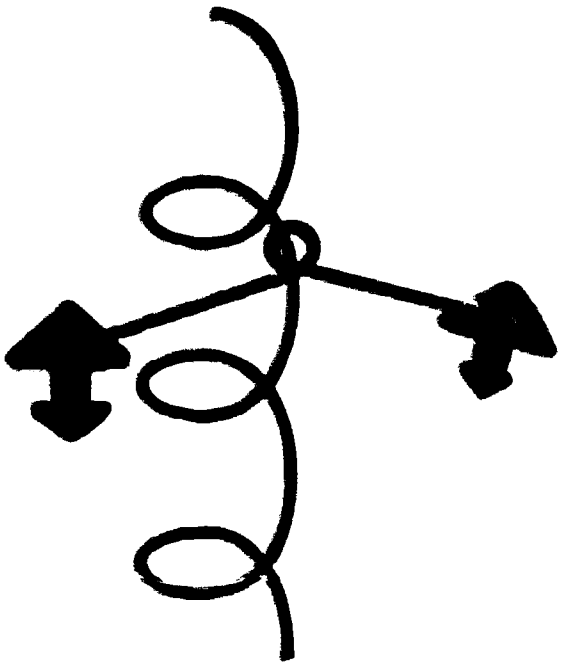


Twisted piece of wire

Wrap the wire around a bottleneck.

Mobile Toy Using Wire

4. Cut a separate piece of wire, about 10cm. long. Twist this once, as shown in the illustration, and thread it onto the spiral wire.
5. Fix some kind of weights on both ends of the twisted wire piece and the spinner of the toy is ready.



6. Hold the spiral wire upright, using both hands, and the threaded piece of wire (the spinner) will spin downward.
7. Reverse positions of both hands and the spinner will spiral downward again. This motion can be repeated any number of times.

Possible modifications

This toy can be enjoyed in several different ways depending on how it is made.

1. The curves of the spiral can be altered depending on the way in which the coil is pulled. If, for example, the same spiral is extended longer this will make the spinner turn faster as well as make the drop faster.
2. A thicker (or thinner) pipe used to make the spiral coil will also affect the movement of the spinner.
3. The length of the arms of the spinner, the angle between them and the attached weights will also affect its movement.
4. Any sort of picture can be drawn and cut out by children themselves to use as paper counter-weights for the spinner. Butterflies, aeroplanes, cars, etc. can be attached as counter-weights.

5. Use a longer piece of wire and make the spiral longer. Make this into a ring by connecting both ends of the wire with solder and shape it into a continuous spiral. Thread a piece of twisted wire beforehand just as in the other illustration. Using both hands to rotate the spiral, the loose piece can be made to spin continuously.

Educational objectives

1. To become familiar with wire as work material.

Many lower grade children are often not familiar with the characteristics of wire and may tend to think that it can be tied like string.

2. To discover the significance of balance.

In order to ensure a smooth downward spin, it is important not only to make a smooth, even spiral, but also to make sure that the length of the arms of the spinner are symmetrical and the two counterweights equal. It is perhaps better not to mention this point from the start, but to let children work freely until they discover it on their own.

3. By spinning repeatedly and observing the phenomenon of a weighted spinner that always spins downwards, to create a concept of the idea of gravity.

Originally, there is a similar toy with the simple idea of a downward spiraling object which is made of paper.Paper that is about the thickness of drawing paper is cut and folded. Unfold it and release it, and the piece of paper will spin as it falls. One aim of introducing this kind of a toy is to make children aware that a similar toy can be made from other materials which are readily available. An effort should be made to show a variety of examples and help children experience a wide range of ideas.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Narikazu Ohsumi, NIER, Tokyo, Japan.

Sheet 29

A BOAT

Level : Pre-school and primary

Subject area : Craft and basic science

Brief description

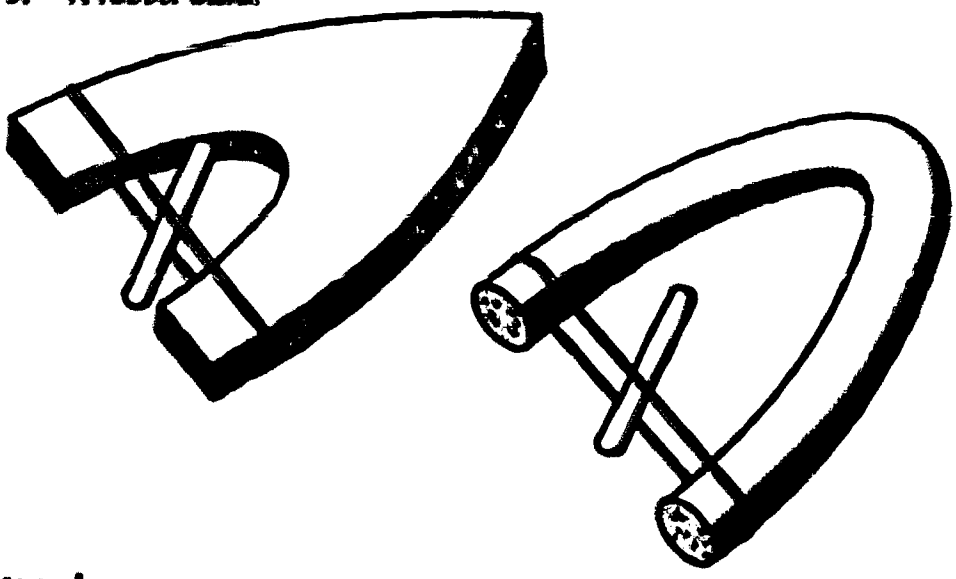
This is an improvised wooden boat pushed by a "propeller"

Objective

To provide children an opportunity to play with a self-made toy from no-cost materials.

Materials needed

1. A piece of plywood cut into the shape of a frog, or a bamboo stem about 30 cm. long bent in the middle to form an angle.
2. A flat stick about 1 cm x 6 cm wide, and 1 – 2 mm thick (an ice-cream stick would do)
3. A rubber band.



How to make

1. Insert the ice-cream stick in between the two threads of the rubber band, and wind it backward, twisting the rubber band.
2. Put the whole thing on the surface of the water and let the twisted rubber band release its energy moving the boat forward.

Source Inventory of Low-cost Instructional Materials, Games and Toys, prepared by Dr. Pruang Kumut; Department of Educational Technology; Faculty of Education, Srinakarinwirot University, Bangkok.

Sheet 20

BAMBOO FAN

Level : Pre-school and primary
Subject area : Craft and basic science

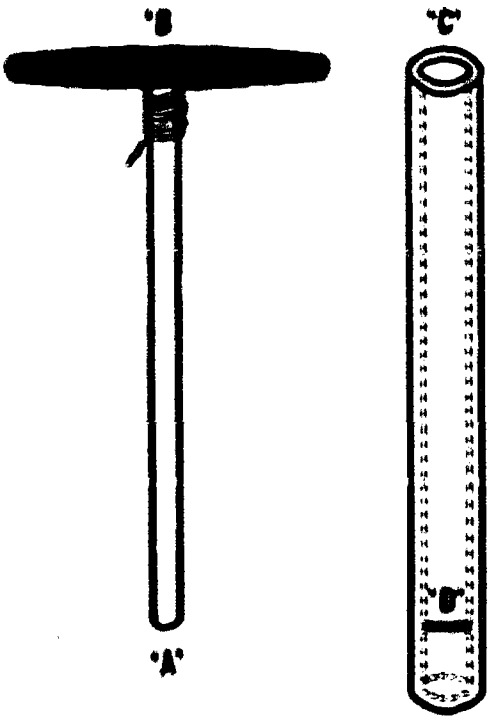
Brief description

This is a simple fan which can be rotated with a thread.

Materials needed

Bamboo, Pin (nail), Thread, Razor Blade, Plywood.

How to make



1. Take a bamboo stick "A" about 25 to 30 cm long
2. Make fan blades out of bamboo or plywood piece "B" which is about 10 cm long. Fix a thin nail through the centre of blade "B" to the stick "A".
3. Tie a thread about 30 – 35 cm long to the nail.
4. Take a tube (another bamboo piece "C", a little longer than "A" which is hollow and inside which the stick "A" can easily go.)
5. Tap the bottom part of the tube "C" by a piece "D"

How to use

It becomes a toy when the thread is wrapped around the top part of the stick "A", then "A" is inserted into "C" and the thread is pulled. The blade rotates like a fan.

Possible modifications

If the blade is made of twisted metal like a propeller, it will fly away when the thread is pulled.

Source: Inventory of Low-cost materials/games, developed by the Dept. of Teaching Aids, NCERT, India.

Sheet 31

PAPER WINDMILL

Level : Pre-school and primary
Subject area : Craft and play activities

Brief description

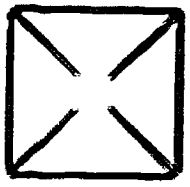
This is a self-made toy which can be made easily from a piece of paper and a stick or a pencil with an eraser at its end.

Materials needed

1. A square sheet of paper, 15 x 15 cm
2. A bamboo stick or a pencil with rubber eraser at its end
3. A pin and a pair of scissors.

How to make

1. Take a piece of coloured construction paper, about 15 cm. square.
2. Cut diagonally straight through each corner to within 2 cm. of the centre.
3. Pick up the end of each of the four alternate half-corners with a straight pin.
4. After you have the four half-corners on the pin, stick the pin through the exact centre of the paper and mount the wind wheel at the end of a bamboo stick or against some flat surface where the wind will make it whirl. The rubber eraser top end of a pencil is a good spot on which to stick the paper windmill.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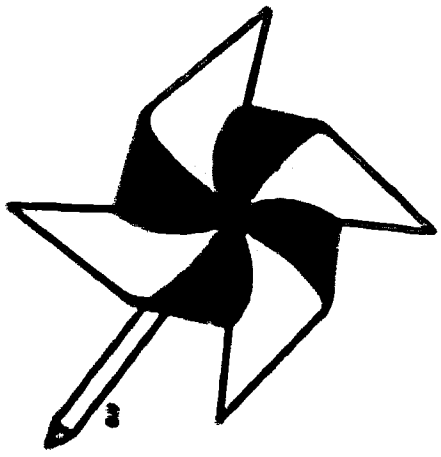
2


3

5. To add variety to the windmill making, let the children use white paper and paint various designs on the square before it is pinned into shape.

Source: An Inventory of Low-cost/Simple Educational Materials, Games, and Toys in the Philippines.

SPINNING DISC WITH THREAD

Level : Pre-school and primary
Subject area : Play activities and basic science

Brief description

A simple toy consisting of a disc and a piece of thread which children like to make by themselves and play with.

Objectives

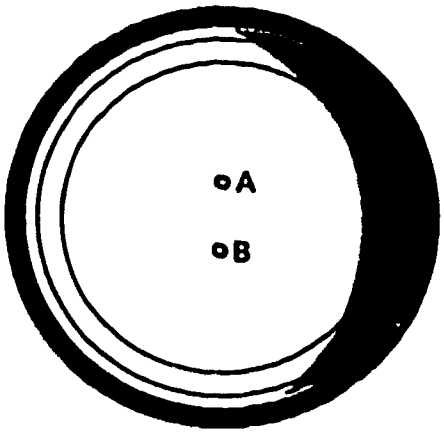
To provide an opportunity for children to make their own toy from no-cost materials.

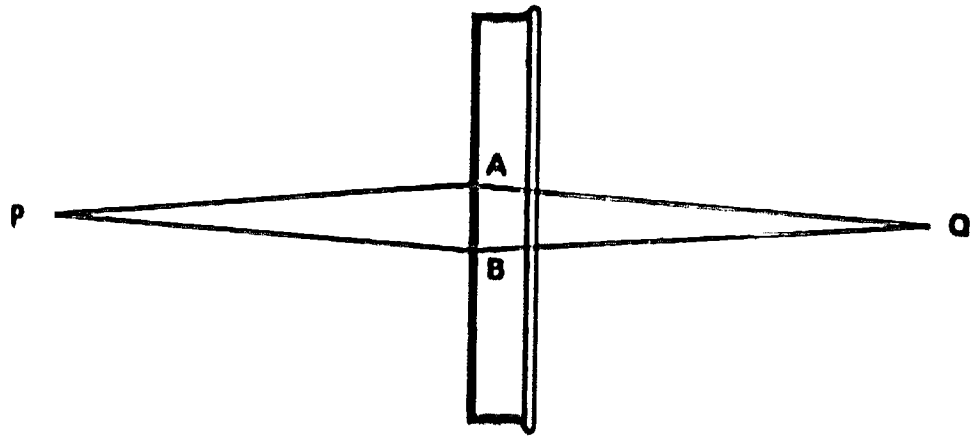
Materials needed

1. Boot-polish tin lid;
2. A piece of thread, about ½ metre long.

How to make

1. Take a discarded lid of a boot-polish tin, and make two holes A and B, about 1 cm apart.
2. Take two pieces of strong string, 25 to 30 cm long and thread them through the two holes of the circular disc.
3. Tie the strings at the two ends P and Q.





How to play

1. By rotating the disk, the thread gets twisted.
2. Pulling the two ends P and Q by two hands makes the disc spin, releasing the twist and then twisting the thread further in the opposite direction.
3. Before the disc stops spinning, pull the threads again, spinning the disc in the opposite direction again. Pulling and releasing the string continuously makes the disc spin faster and faster.

Source: Inventory of Low-cost materials/games, developed by the Department of Teaching Aids, NCERT, India.

PAPER LOOPER

Level : Pre-school and primary
Subject area : Craft and play activities

Brief description

There is a commercially available wire-coil toy called the "Tomboy". It descends staircase-type slopes on its own by turning over and over. It is quite a lot of fun to watch. The toy described below, made from paper, is a resemblance of the "Tomboy". It is made by cutting out square-shaped or round-shaped loops from paper and pasting the pieces together. Its special feature is that it turns over as it goes down a slope, rather than a staircase. Since its movement resembles that of a looper, this toy is called a 'Paper Looper".

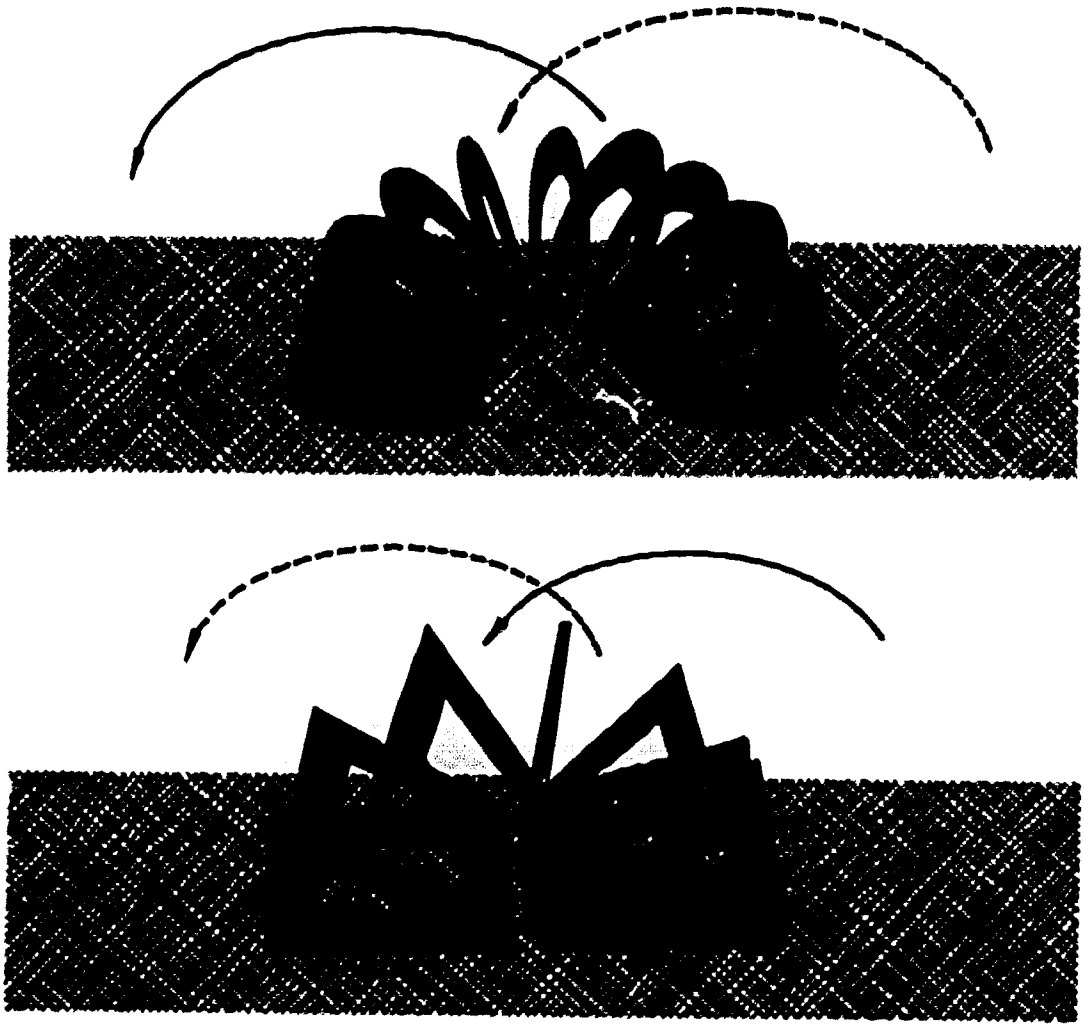


Figure 1 Round and square paper loopers

Materials needed

1. Paper
2. Scissors and
3. Glue

How to make

As seen in Fig. 1, it is possible to make both a round paper looper and a square one. The two important points to remember when making this toy are to choose the right kind of paper, and to have patience while fixing it together.

A. Round looper

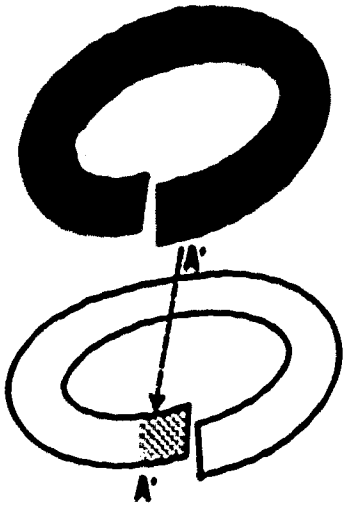


Figure 2

1. Choose suitable paper. It is better to choose paper slightly thinner than drawing paper. In Japan, postcards issued by the post office are just of the right thickness, as is old calendar paper.
2. To make the round looper, draw two concentric circles, one smaller than the other, using a compass.

   The outer circle could be about 5·6 cm, in diameter and the inner circle 4·5 cm.
3. Cut a ring which should be slit in one place, as shown in Fig. 2
4. Paste point A of the first ring to point A^1 on the second ring so that the two rings pile up one on top of the other.
5. Cut out at least 20 of these rings and paste them together in the same way.
6. When the glue is dry, the series of rings are attached into one long strip, as shown in Fig. 3

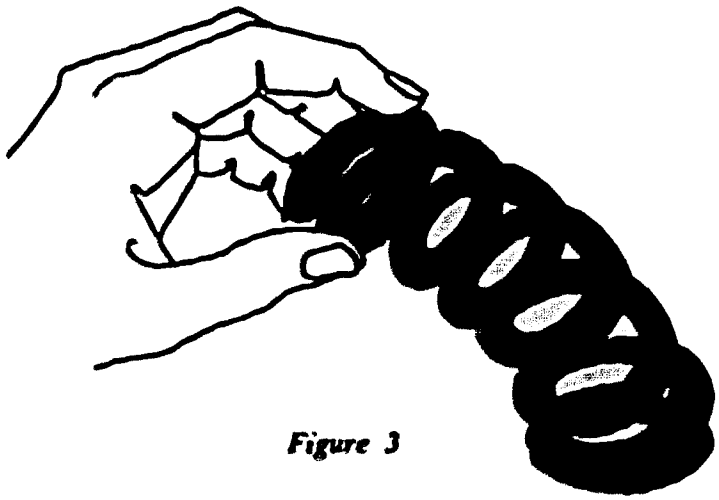


Figure 3

Be careful so that the glue does not go over the edges, and wipe off any excess glue. If one is not careful in this, the rings will stick together and will not come out as one long series of rings as in Fig. 3.

B. Square looper

1. Cut 80 to 100 strips of paper about one centimetre in width.
2. Then cut these strips in a standard length, such as 5 or 7 cm.
3. Paste these strips together in order as shown in Figure 4.
4. Pile up about 20 layers.

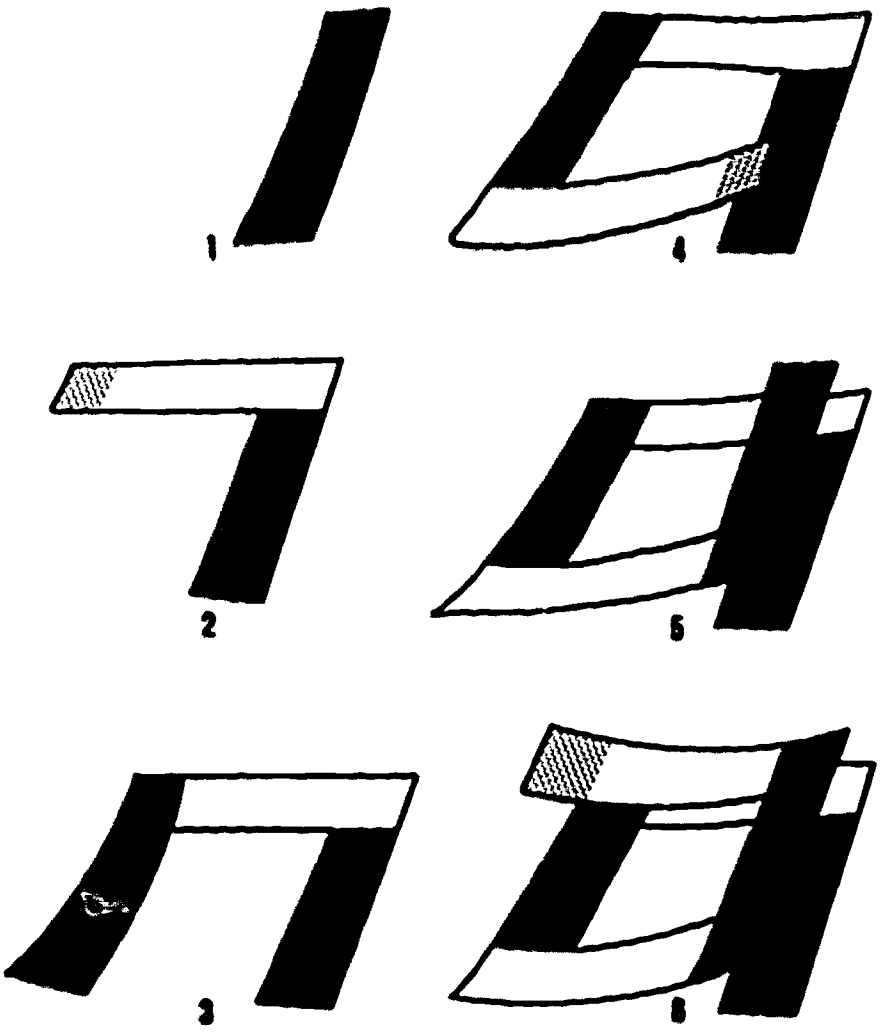


Figure 4 How to make the square looper.

How to play

1. For both shapes, let the glue dry completely before testing. If it is tested as soon as it is made, the glued ends tend to come apart. One important factor in making this toy is to use suitable glue.
2. If possible, paste sand paper on both ends of the looper. This prevents slipping.
3. Place the looper on an inclined surface and pull its upper part to start it moving.

Source: Case study of Simple Low-cost Teaching Materials, Games and Toys, prepared by Narikazu Ohsumi, NIER, Tokyo, Japan.

SIMPLE CONSTRUCTION SET

Level : Pre-school and primary
Subject area : Play activities

Brief description

This is a game using match sticks and bicycle valve tubes (or looped rubber bands) to build three dimensional shapes.

Objectives

1. To give children practical experience in producing three dimensional shapes such as cubes, prisms, and pyramids.
2. Assembling these simple elements and using them to make some more complicated shapes or to make some imaginative toys, in the form of a house, a table, a chair, etc.

Materials needed

1. Match sticks
2. Razor blade
3. Babul thorn
4. Bicycle valve rubber or nylon tube.

How to make

1. Cut the valve rubber or nylon tube into 1 cm long pieces.
2. First make a joint of two sticks inserting them into the tube.
3. Pierce a hole with a babul thorn in the centre of the valve tube joining the two sticks.
4. Now insert a third matchstick into the valve tube through this hole perpendicularly to the other two. A joint of three sticks is thus made (Figure 1).

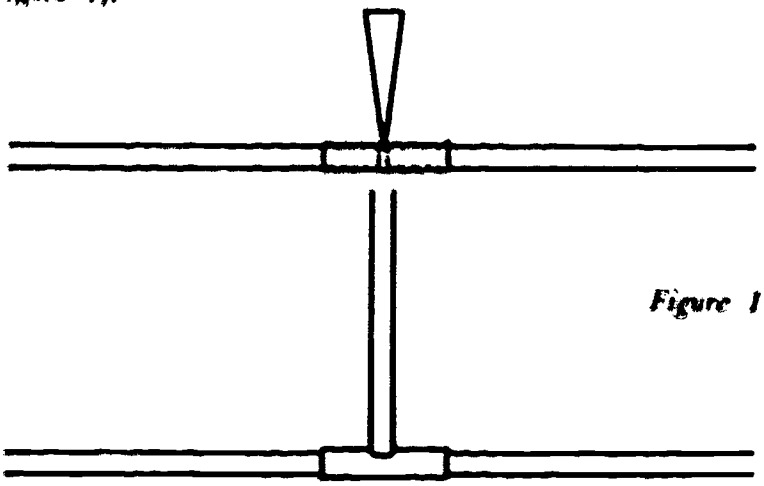


Figure 1

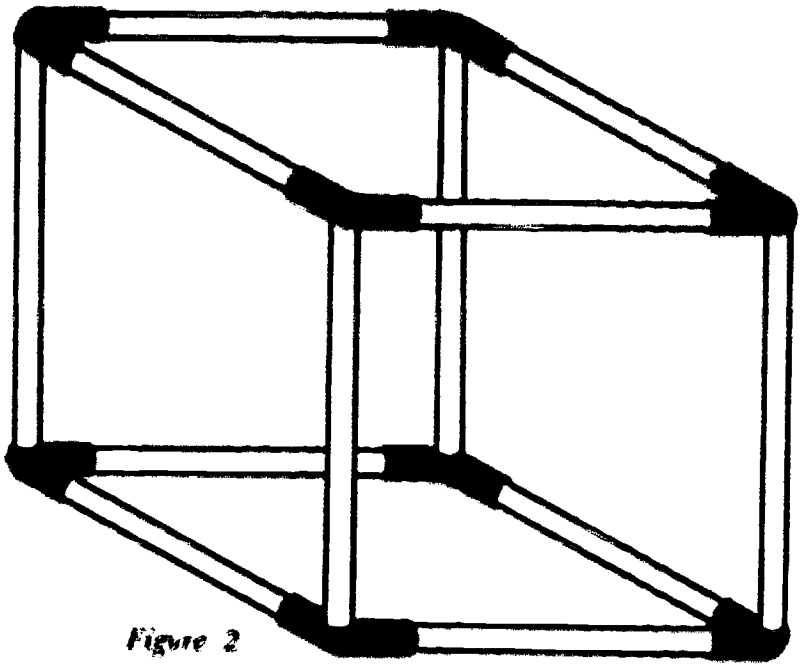


Figure 2

5. Shapes of cubes, prisms, pyramids, houses etc. can be made by children in the same manner (Fig. 2).

Possible modifications

If rubber or nylon valve tubes are not available, the match sticks can be joined using looped rubber bands.

Source: Inventory of Low-cost materials/games, developed by the Department of Teaching Aids, NCERT, India.

GEOMETRIC BOARD

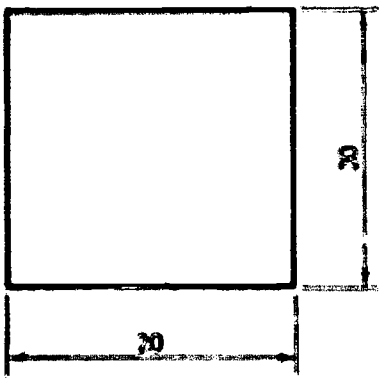
Level : Primary
Subject area : Craft and basic mathematics

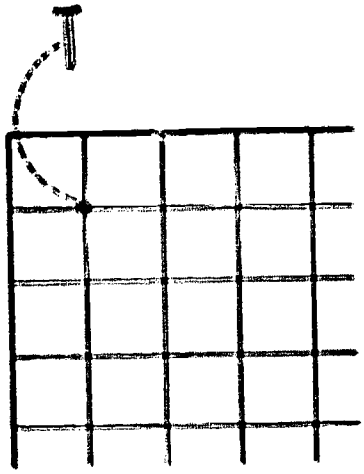
Brief description

This is a plain wooden board with equally-spaced nails hammered onto it. A rubber band can be hooked over the nails so as to produce any desired form.

Educational objectives

This board is useful for children in creating various shapes and forms on their own and for practice in calculating their respective areas.





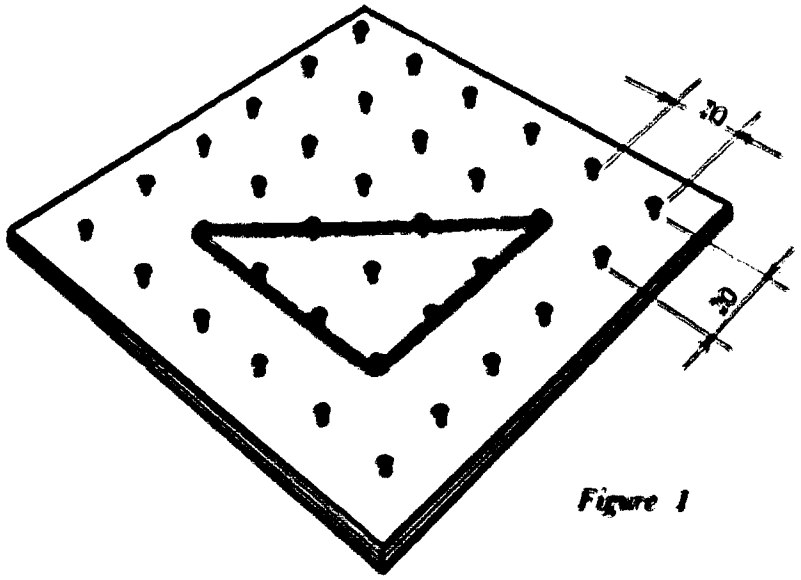


Figure 1

Materials used

1. A square shaped wooden board at least 8mm thick and about 20cm x 20cm in size so that it will hold a fair number of nails.
2. 36 nails, preferably with rounded heads, which are safer.

How to make

1. Mark off the board carefully by drawing a grid with several parallel lines, 20mm apart crossing with a similar grid at right angles, and hammer in the nails at the crossing points.
2. Hammer the nails at an even height. Be careful that the sharp ends do not protrude through the board, but make sure they are hammered in firmly enough so that they will not loosen when a rubber band is hooked over them.
3. Take a rubber band that is long enough to form various shapes on the board.

How to use and play

1. *Making shapes*

Children will be able to form any shape they want: triangles, squares, parallelograms, polygons, trapezium and need not be limited to the standard shapes.

Any child can easily make polygon on this board. They can compare a large square to a small square or a large triangle to a small triangle and see the relationships. It is advisable to provide them with sheets of grid paper so that they can copy and record each shape they make on the board. Examples of such drawings are shown in Figures 2, 3 and 4.

2. *Calculating surface areas of various figures*

In calculating the surface area of figures on this board, count every small square bordered by four nails as one unit of surface area. This could be the basic rule for some calculations. For instance, the area of the square in Fig. 2 will equal 9 units, or in Fig. 3 the area will be 45 units.

The surface area, (S), of the shapes made on a geometric board can also be calculated with the following formula:

$S = B/2 + T - 1$, where

B = number of nails which the rubber bands is touching

T = number of nails enclosed and not touching the rubber band

For instance for Fig. 2, B = 12 and T = 4. Therefore, S for Fig. 2 is

$S = 12/2 + 4 - 1$ or $S = 9$

In the same way, the shape in Fig. 3 can be shown to have half the area of that in Fig. 2, or S = 4.5. For Fig. 4, the calculation will prove that it is also 9, or the same as Fig. 2.

Children will be able to confirm that their calculations are equal to the sums obtained by counting the number of nails on the geometric board. The above examples are showing simple polygons, but once the basic rules are taught, children

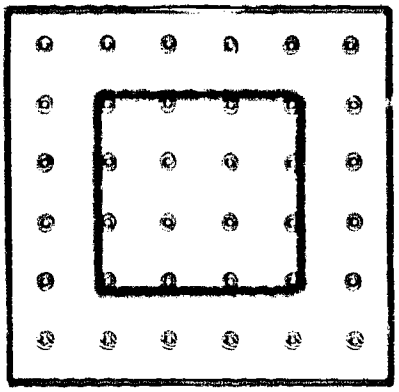


Figure 2

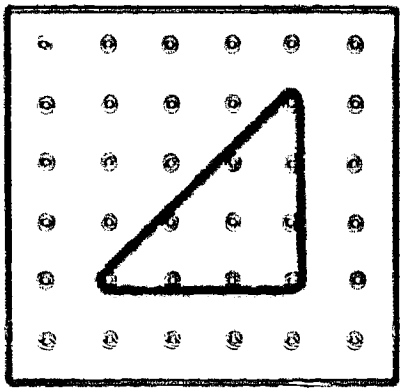


Figure 3

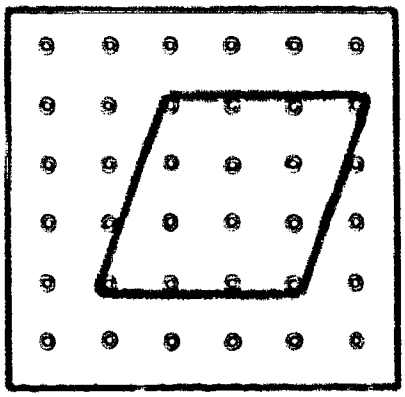


Figure 4

will think up the most intricate shapes and often surprise the teacher with their extraordinary examples.

Possible modifications

In this project, the choice of materials can be quite flexible. For instance, pre-made peg-boards which already have holes in them may be used. In this case the holes are made very evenly. Old golf tees can be used as pegs.

With this type of ready-made board, children can insert pegs only into holes which they want and then hook a rubber band around them to obtain the desired shape. In this case the pegs can be removed and stored separately which will save space and make storing easier.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Narikazu Ohsumi, NIER, Tokyo, Japan.

WORD BUILDING MATCHBOX TRAIN

Level : Pre-school and primary
Subject area : Learning alphabet and spelling

Brief description

This simple toy requires a number of empty discarded matchboxes marked with a large size letter each. When attached to one another, they may form various words.

Materials needed

1. A few empty matchboxes
2. Paper
3. Felt pen or Crayon
4. Scissors, and
5. Glue

How to make

1. Cut plain paper into rectangular pieces with the size of the top side of a matchbox.
2. Draw one letter on each piece of paper and glue it onto a matchbox.

How to play

Let the pupils arrange the matchboxes so as to build the desired word and make a "train" by attaching the matchboxes together.

Matchbox train

Source: Bangladesh Education Extension and Research Institute Report of a National Workshop on Educational Technology.

SPINNING COIN

Level : Primary
Subject area : Play activity and basic science

Brief description

This spinning coin is a toy that children in the lower elementary grades will enjoy playing with. Explanations of the ruling theoretical principles would belong to college-level physics. Therefore the purpose is not to understand the ruling principles; rather, it is for children to see whose coin can spin the longest.

Materials needed

1. A few old discarded coins
2. Bits of sticky clay
3. A hand drill.

How to make

Make one part of the coin heavier than the other. This can be achieved either by sticking equally heavy clay bits symmetrically on both sides of the coin off-centre (fig. 1), or by drilling a large hole off-centre through the coin using a hand drill (Fig. 2).

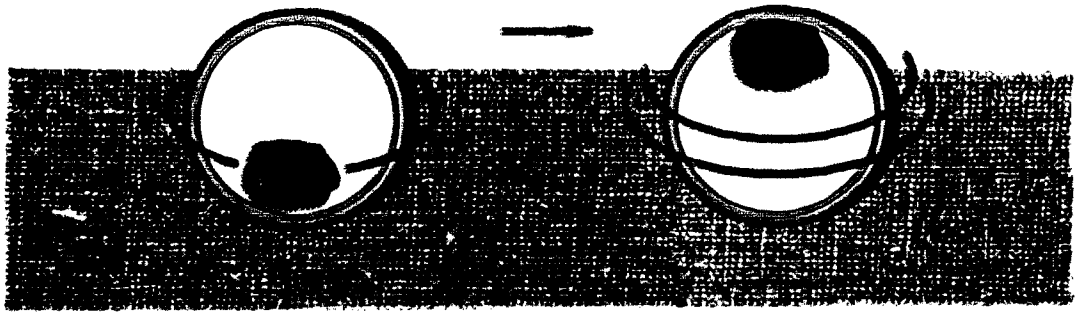


Figure 1 Clay bits stuck on both sides of coin.

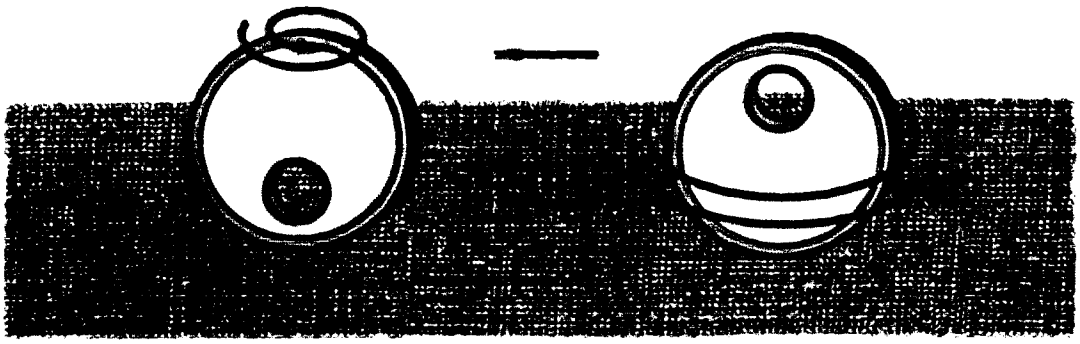


Figure 2 Coin with a hole.

How to play

1. Position the coin on its edge in vertical position so that its heavier part is on one side, or on the top. Keep it in this position on a smooth surface (cement surface, wooden floor or table top) by pressing the top with one finger.
2. Give the coin a fast, strong flick with a finger of your other hand to make it spin.
3. Observe how the spinning coin readjusts itself so that its lighter part moves downwards towards the bottom, while its heavier part moves upwards towards the top.

Possible modification

In place of a coin, this experiment many be conducted with a piece of wire, which is shaped as flat off-centre spiral, as shown in Fig. 3.

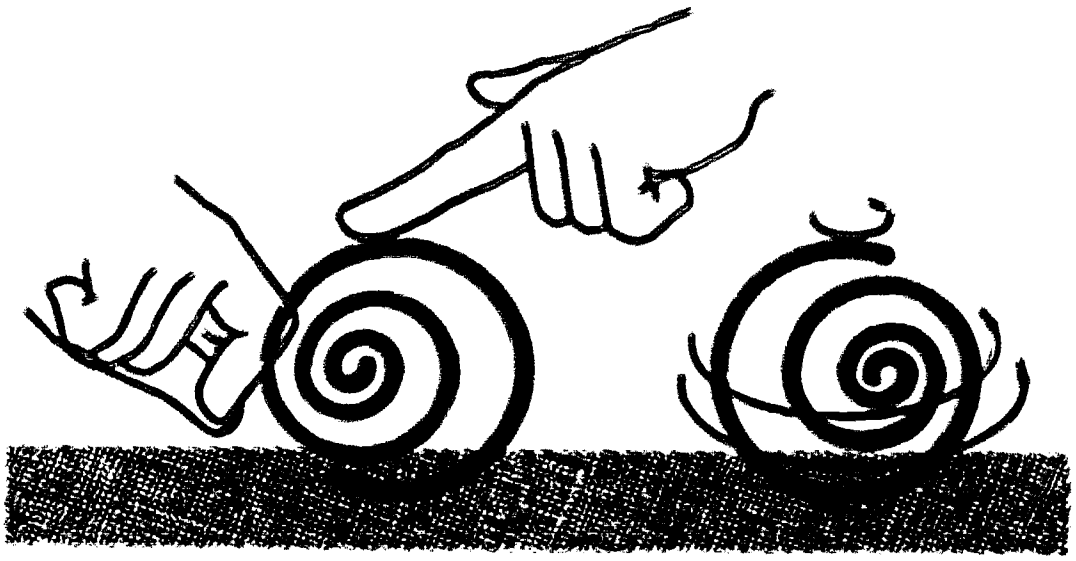


Figure 3 Spinning Wire.

Source: Case study of simple Low-cost Teaching Materials, Games and Toys, prepared by Narikazu Ohnuma, NIER, Tokyo, Japan.

Level : Primary
Subject area : Basic science

SELF-MADE COMPASS

Brief description

This is a cheap self-made compass using needles which have to be magnetized.

Objectives

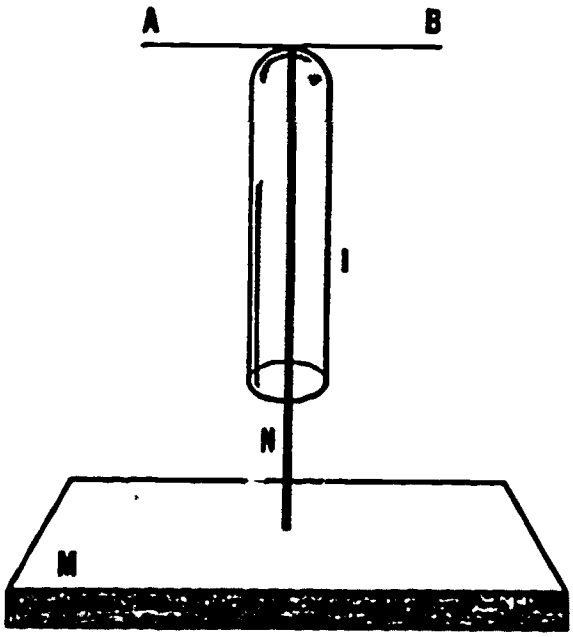
To demonstrate the magnetic poles with a cheap compass.

Materials needed

1. Magnet for magnetization
2. Needle
3. Bicycle spoke
4. Wooden block
5. Small test tube, or the top part broken off an ampule
6. Glue

How to make

1. Take a needle and magnetize it by stroking with a permanent magnet.
2. Fix the needle AB with wax or glue (Epoxy glue) to the top part of a broken off ampule, or a test tube (I).



3. Put the test tube on a vertically pointed needle (N) or bicycle spoke, mounted on a wooden base (M), so that the needle AB is free to rotate in a horizontal plane about the vertical needle N as an axis. (The needle N can be also fixed on an empty match box M).

How to use

1. The needle AB rests in a north-south direction due to the earth's magnetic field.
2. It shows attraction and repulsion when some other magnetic object is brought near to it.
3. Its sensitivity can be equal to that of an ordinary compass.

Possible modification

A self-made compass could be produced more easily if the magnetized needle is oiled, or placed on a thin plastic sheet, and floated in a dish of water.

Source: Inventory of Low-cost material/games, developed by the Department of Teaching Aids, NCERT, India.

MULTIPLE REFLECTION

Level : Primary and lower secondary
Subject area : Craft and basic science

Brief description

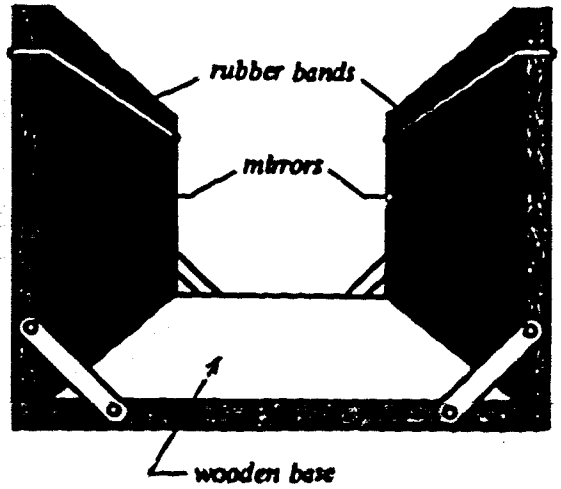
This is a set of two parallel mirrors facing each other with the effect of producing multiple reflection of any object placed between them.

Materials needed

Two plane mirrors

A wooden support for the mirrors

How to make



Attach two mirrors vertically to the opposite ends of the wooden support, perpendicular to the base and facing parallel to each other, as shown in the figure, using rubber bands to attach the mirrors.

How to use

Place an object between the two parallel mirrors and observe its multiple image. Move the object closer to one of the mirrors and observe the result.

Source: Bangladesh Education Extension and Research Institute-Report of a National Workshop on Educational Technology.

KALEIDOSCOPE

Level : Primary and lower secondary

Subject area : Craft and basic science

Brief description

This is a kaleidoscope which uses mirrors. One model needs two mirrors and the other needs three.

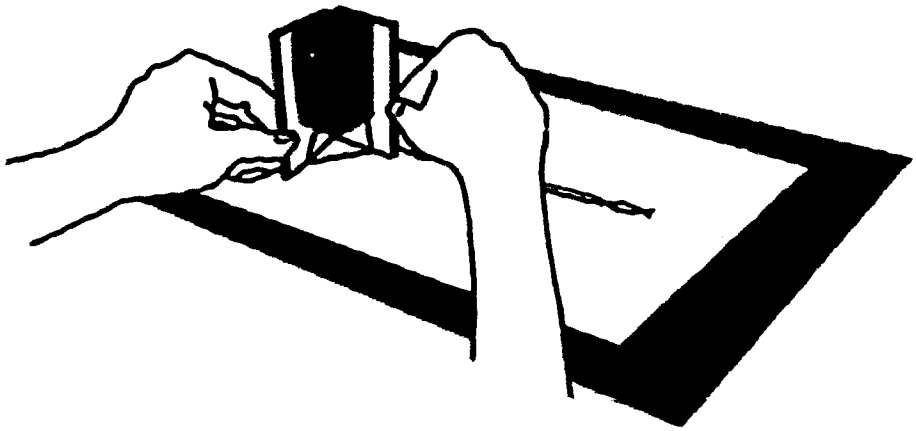


Figure 1 A Kaleidoscope using 2 mirrors

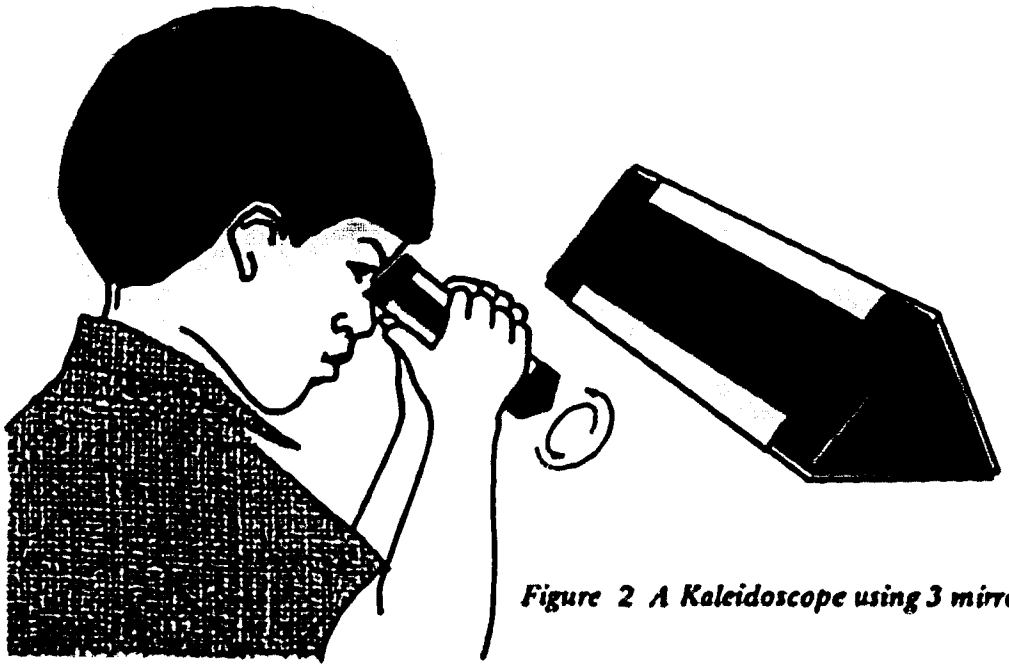


Figure 2 A Kaleidoscope using 3 mirrors.

Materials needed

1. Two square-shaped mirrors for the first model and three rectangular mirrors for the second model. Glass mirrors are dangerous for children to handle and are difficult to cut. They can be substituted with glass slides used for biology experiments; pasting black paper onto the back of the slides and using them in place of mirrors.
2. Adhesive tape.

How to make

A. Two-mirror Kaleidoscope

1. Prepare pieces of a size easy for children to handle; about 5 x 5cm.
2. Using some adhesive tape connect the 2 mirrors together so that they open up like a book. This way the angle between the two mirrors can be freely adjusted.

B. Three-mirror Kaleidoscope

1. Prepare 3 rectangular mirrors of equal size, e.g. 3 x 10 cm.
2. Fix the three mirrors together so that their shorter sides form an equilateral triangle.
3. Secure the sides of the prism firmly with adhesive tape.
4. Decorate the outside with some attractive paper.

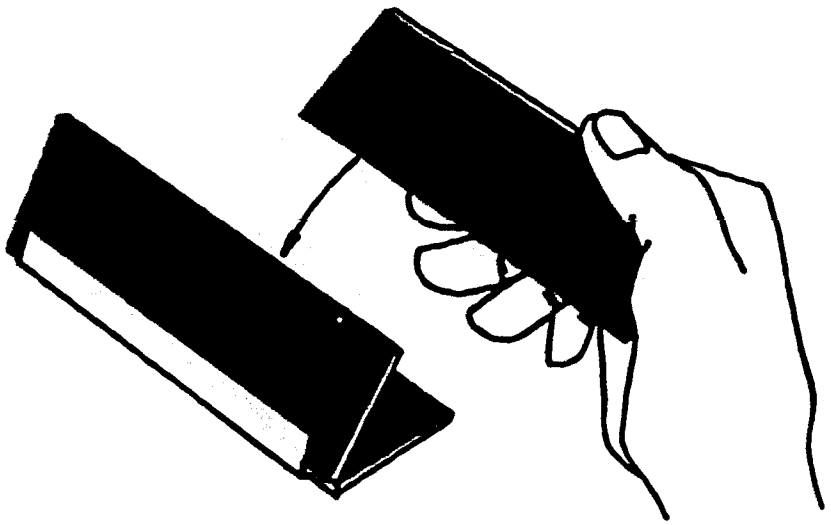


Figure 3 shows how to make a Kaleidoscope using 3 mirrors.

How to use

A. The 2-mirror Kaleidoscope

1. Draw a series of waves across a piece of paper. They can be of any length or size.
2. Draw another set of waves onto the first so that the crests and troughs of the second set of waves are a mirror image of the first set. Using a

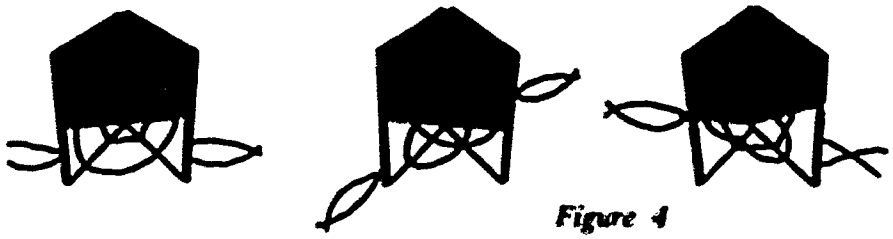


Figure 4

different-coloured pencil for this second set would make the drawing looking more attractive. Lay the paper flat on the table.

3. Set the 2-mirror kaleidoscope upright like an open book onto the paper with the waves (Fig 4).
4. Slowly move it to the left or to the right along the set of waves. Most interesting designs will be reflected onto the mirrors. Children will often be delighted to play with this toy.
5. Try drawing different designs onto the paper. Let children copy the patterns reflected on the kaleidoscope that they find especially attractive.

B. The 3-mirror Kaleidoscope

1. Hold the kaleidoscope up to one eye and turn it slowly. The reflection through the 3-way mirror will be a breath-taking view. Any object, like an open book on the table, or even the pattern on the ground will create the most surprising images for children to observe.

Educational objectives

1. This project attracts children's interest towards characteristics of the mirrors and light, both of which are part of our daily lives.
2. Kaleidoscopes are often used in drawing and design classes to help children to produce complex design patterns which they would be unable to create on their own.
3. The Kaleidoscopes can also serve as a good teaching aid when learning about various figures in geometry and makes the lesson very interesting.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Narikazu Ohsumi, NIER, Tokyo, Japan.

Level : Primary and lower secondary

SIMPLE PERISCOPE

Subject area : Craft and basic science combined with play activities

Brief description

This is a simple periscope made of milk cartons and plastic mirrors.

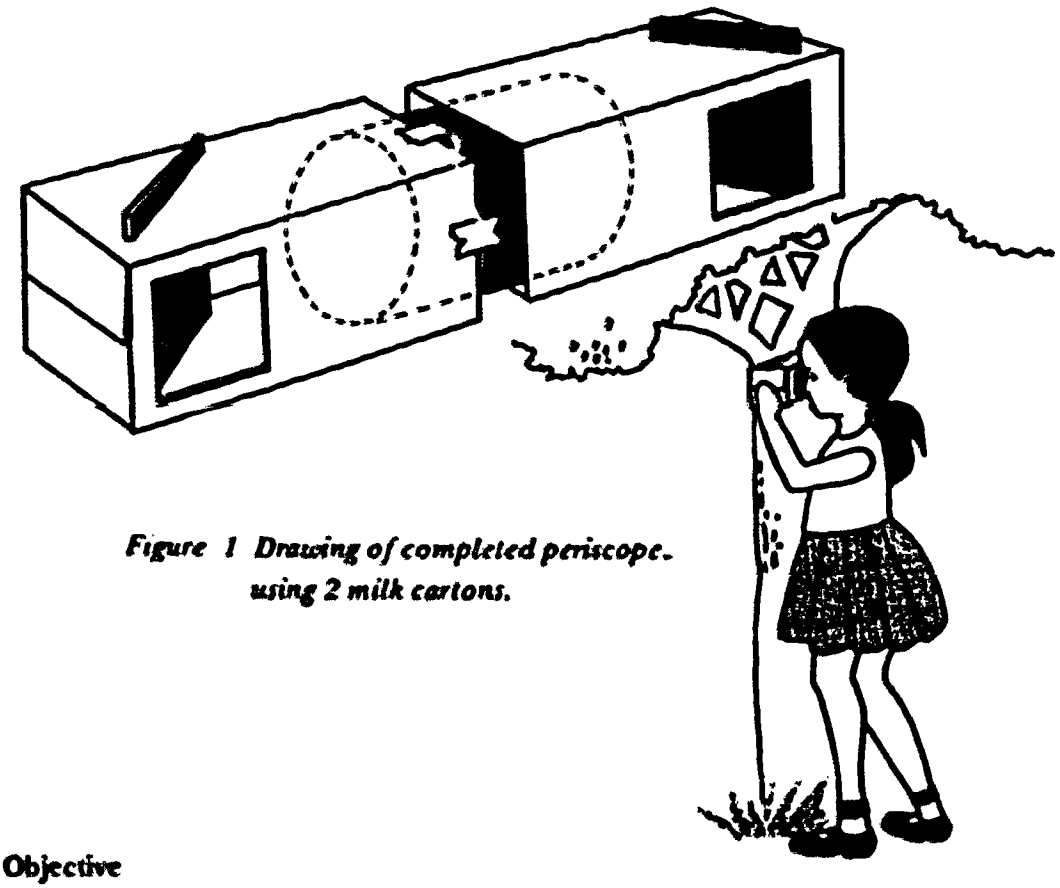


Figure 1 Drawing of completed periscope using 2 milk cartons.

Objective

To produce a toy for observing things from a hiding place by using inexpensive, discarded materials.

Materials needed

1. Two empty milk cartons
2. A sheet of thin cardboard or drawing paper
3. Two mirrors

How to make

1. Take two large milk cartons which hold about 1 litre, and cut off the upper ends.
2. Cut a square shaped window opening close to the other ends of each milk carton.
3. Make a slit so that you can place a mirror at a 45° angle next to each window (Fig. 2).
4. Roll up a piece of thin cardboard or drawing paper and make a cylinder that will fit inside the first carton. Insert one end of it inside the milk carton, fix it with adhesive tape. Make it so that the other carton will rotate smoothly around it.
5. Insert a mirror into each slit and the periscope is complete (Fig. 3).

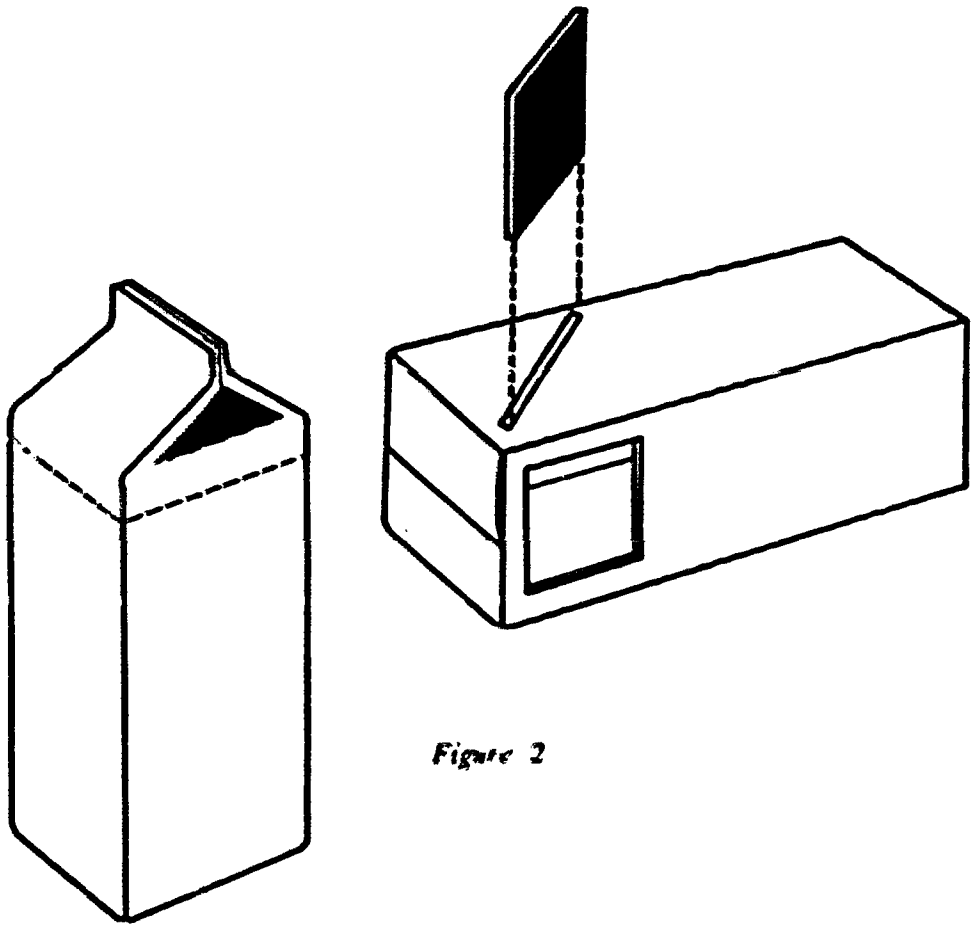


Figure 2

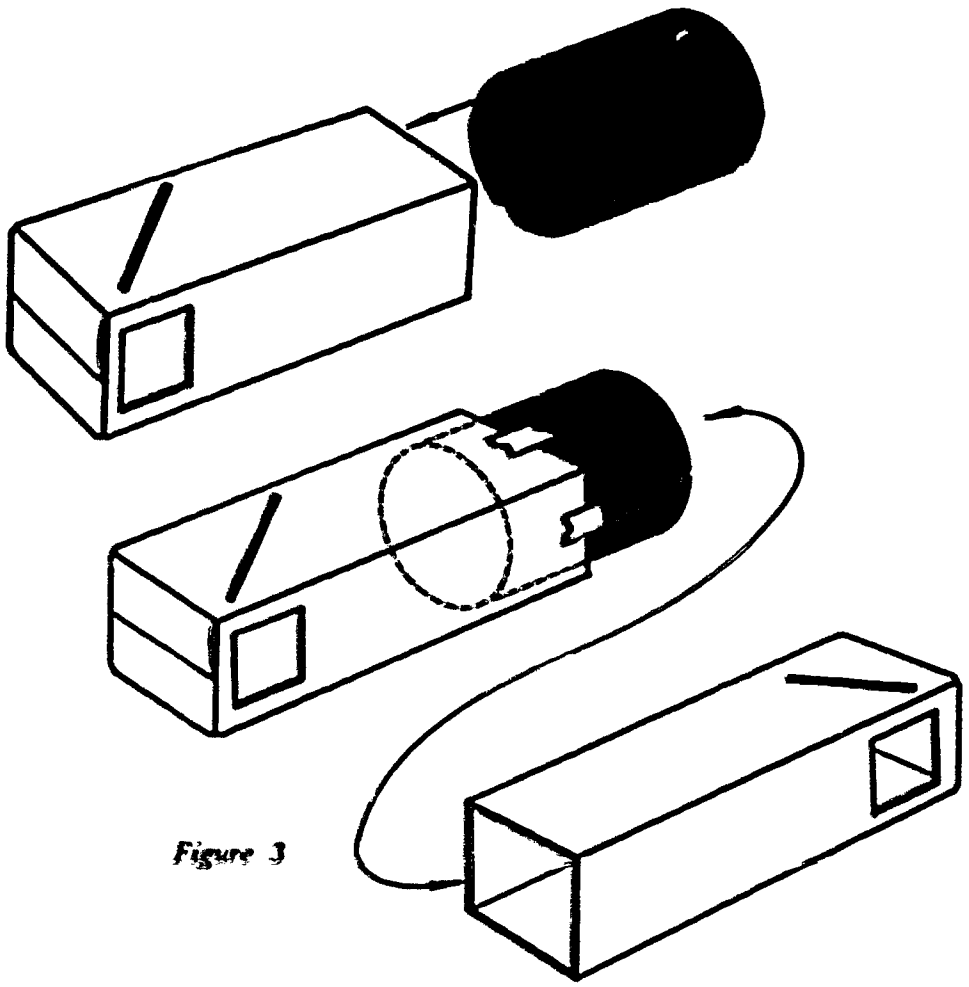


Figure 3

How to use and play

Look through one window and rotate the other one. The view inside will keep changing.

The way things look through the periscope when it is held vertically will be very different from these when it is held horizontally. Children become absorbed in how things look from under the table or behind other objects in the room or outdoors.

Children will most likely create different kinds of periscopes from the material they are given. For example, they may construct a longer one or one that can be extended, or others which have a bend.

Plastic mirrors can be cut into desired shapes and sizes by a cutter-knife, for plastic objects and are much safer to handle than glass mirrors.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Narikazu Ohsumi, NIER, Tokyo, Japan.

Level : Secondary
Subject area : Physics

MODEL DEMONSTRATING TRANSFER OF MOMENTUM

Brief description

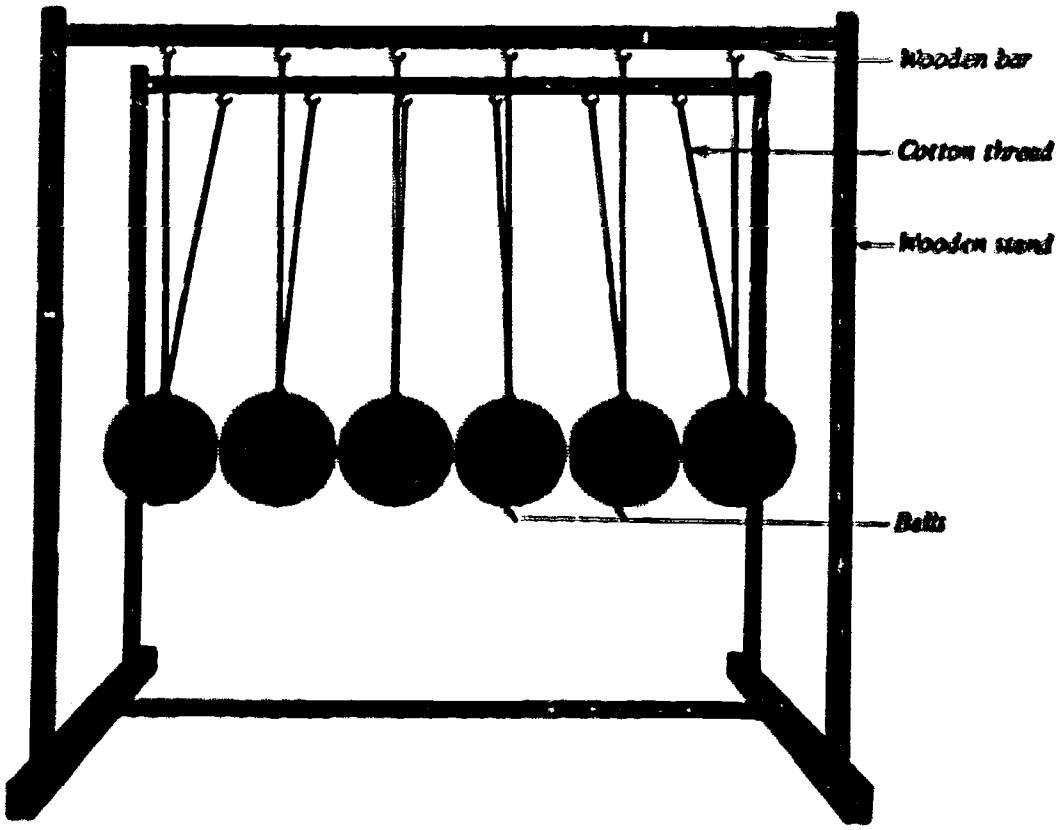
This model consists of six (or more) heavy wooden balls with equal weight, which are suspended slightly touching each other on two strings each as shown in the Figure. The last ball is pulled away from the others; when released it knocks the rest of balls, causing a swinging motion and the last ball at the opposite side swings further than the other balls. If two balls are pulled out and released on one side, two will separate on the other side.

Materials needed

1. Wooden stand
2. Cotton thread
3. Six wooden balls of the same size
4. 18 hooks

How to make

1. Make a frame consisting of four wooden stands, two horizontal base bars and two upper bars as shown in the Figure.



2. Fix the hooks on each of the six balls and on the upper horizontal bars so that thread can be fastened to them to suspend the balls in one line. The hooks which are fixed on each bar are spaced at a distance equal to the diameter of the ball so that each pair of the hooks on the two bars becomes parallel to the other.

3. Then hang up each ball to the two bars by the thread so that all the balls remain at equal height.

Source: Bangladesh Education Extension and Research Institute-Report of a National Workshop on Educational Technology.

Sheet 43

Level : Primary
Subject area : Crafts

CARDBOARD BIRD

Brief description

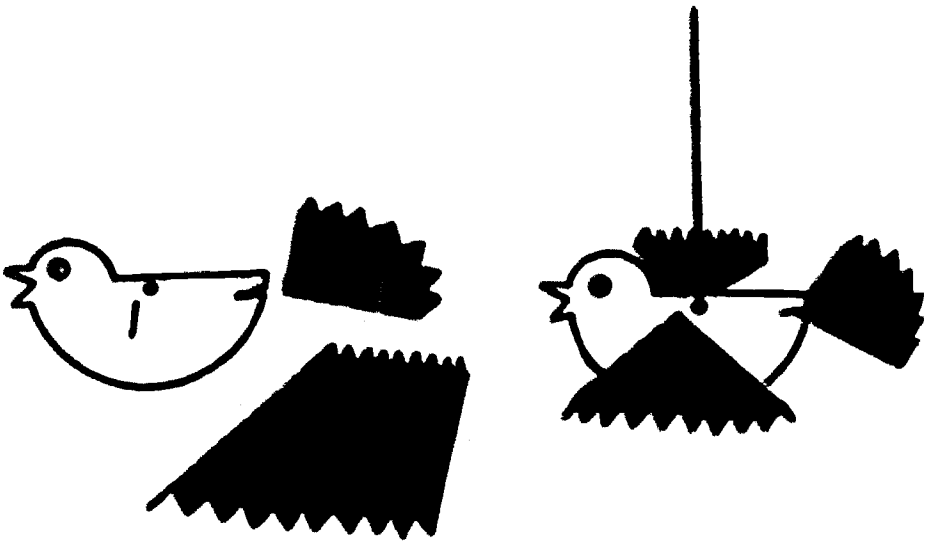
This is a self made paper , for decoration, which develops children's skills and creativity.

Materials needed

1. Paper
2. Crayons or water colours
3. String
4. Needle
5. A sharp paper cutter
6. A pair of scissors.

How to make

1. Cut out the body and head of a bird from cardboard.
2. Colour both sides of the body with crayon and paint the eyes with bright colours on both sides of the head.
3. Cut a slit through the body near the shoulders for the wings.
4. A small slit at the rear will allow for the tail to be slipped into place and glued into position.
5. The coloured wings can be made of coloured construction paper or tinted stationery and folded in bellows-fashion in 1 cm. folds.



6. Slip the wings through the wing slit.
7. Cut the tail from the same kind of paper as the wings, in a V shape.
8. Fold in two or three folds on each side toward the point of the V.
9. Glue the tail in position.
10. Punch a hole at the back of the cardboardboard bird and thread a piece of string for hanging.
11. Now the bird is ready to hang in an open window or at the porch. Watch it "fly" with the wind.

Source: An Inventory of Low-cost/Simple Educational Materials, Games, and Toys in the Philippines

TRADITIONAL DECORATIVE ART

Level : Primary and lower secondary
Subject area : Arts and crafts

Brief description

Simple but delicate craft practice is useful for the development of manual and artistic skills through the production of a variety of decorative materials by using tender palm leaves, sometimes in combination with the green mature leaves.

Objectives

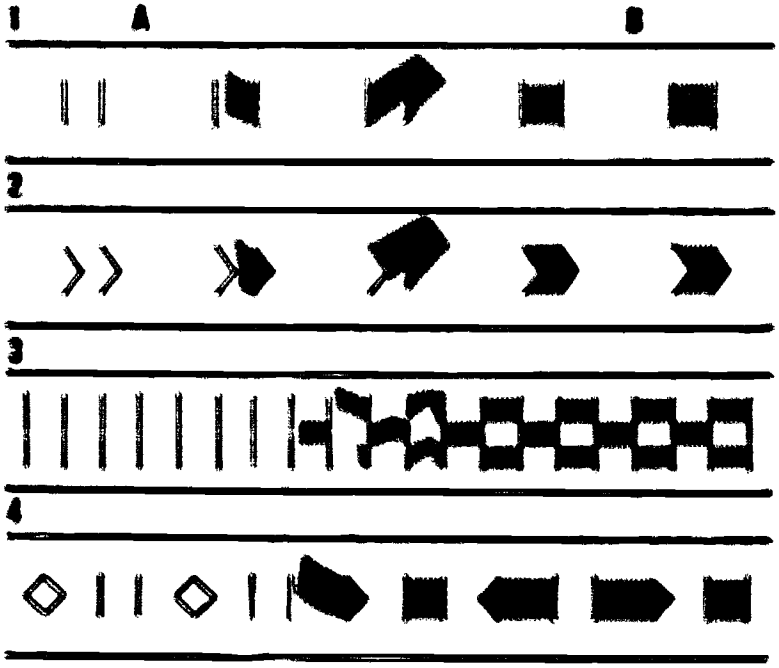
1. To develop manual and artistic, creative skills.
2. To produce decorative materials from no-cost material.

Materials needed

1. Strips of tender (cream-yellow) coconut leaf.
2. Mature (green) leaves of coconut palm.

How to make

1. Figures 1, 2, 3 and 4 show simple patterns in which a strip of coconut leaf (in Figure 1 – green strip and in Figures 2, 3 and 4 tender strips) could be converted into a decorated "band" which may be used for various decorative designs. The fine cuts shown on these "base bands" are cut

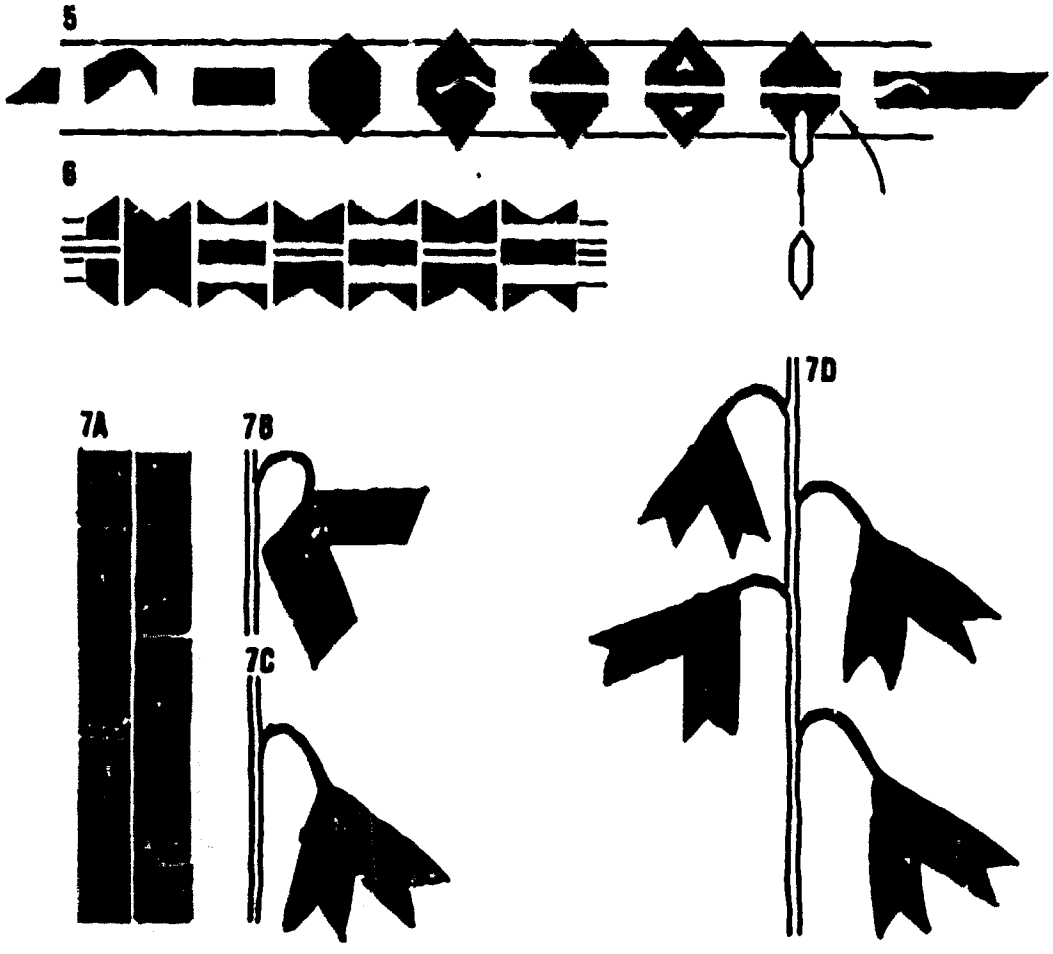


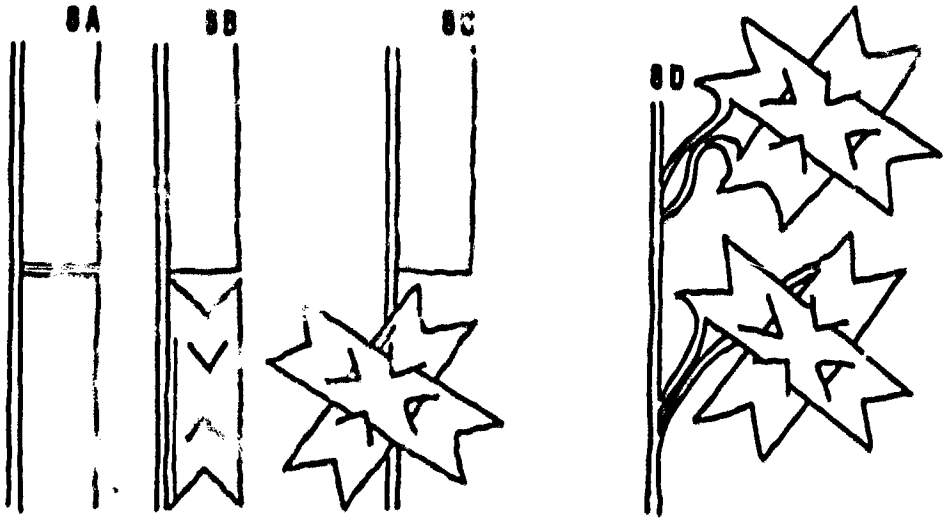
with a sharp knife. The strip may be carefully folded length-wise into two (without splitting the strip) and cut slits perpendicularly or diagonally to the central folded part. Figure 1 shows how a narrow strip of tender leaf passes through the slits. In the other figures a strip of tender leaf passes through the slits.

Possible modifications

Figures 5 and 6 show some possible methods to increase the effect through more complicated designs by using additional slits and pieces of coconut leaves with different shapes to insert into the "base band". The 'base band' shown in Fig. 6 is a complete leaf with the rib and additional shapes are intervowen to beautify the design. Figure 7 shows the stages in making a floral decoration from a coconut leaf: (A) open the leaf and cut the slits as shown (alternatively on the two sides). (B) Unfold each strip and bend as shown and fix it with an 'overlapping loop' (c) to complete the 'flower'. (D) Make flowers starting from the base of the leaf towards the tip so as to produce an 'inforescence' of alternate 'florets'.

Drawing 8 is another style of an 'inflorescence'. Follow all steps carefully.





Note

Numerou decorative patterns and ornaments can be made using coconut leaves in conj nction with other auxilliary materials such as banana-stems. Many such creations may provide decorations for various functions, ceremonies and festivals, both religious and national.

Source: Inventory of Low-cost Simple Materials Games and Toys, prepared by P.B. Dayasiry, School Science Equipment Design Unit; Curriculum Development Centre, Sri Lanka.

LOW-COST "ORIGAMI OF SRI LANKA"

Level : Primary and lower secondary
Subject area : Crafts

Brief description

This traditional craft is using the tender (cream-yellow colour) leaves of coconut palm for producing a variety of shapes resembling various objects, insects, animals, etc. The strips of palm leaf can produce numerous toys of extraordinary beauty and original design.

Objectives

1. To develop the manual skills of the young children through the rewarding exercise of producing an article for entertainment and play at no-cost.
2. To promote creative imaginative thinking.

Materials needed

Tender (Cream-yellow colour) leaves of the coconut palm.

How to make

Example 1. A Swallow

1. Take two strips of palm leaf (without midrib) of almost equal width and proceed as shown in Figure 1.

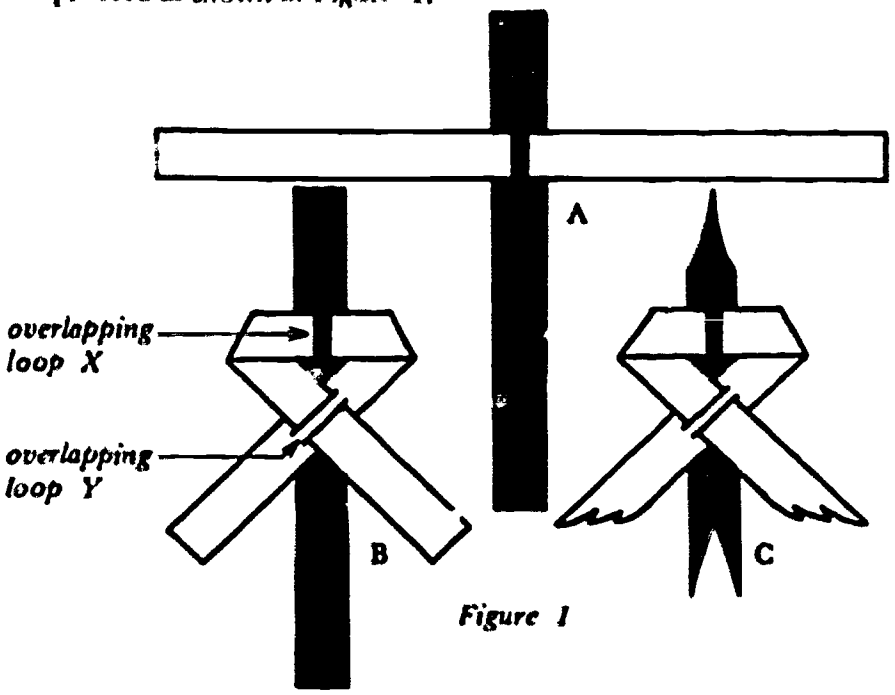


Figure 1

2. Cut the shapes of wings and tail using a pair of scissors. Overlapping-loop strips 'X' and 'Y' could be simply torn using finger pressure (however the length of the 'loop' should be not longer than the width of the strip that passes through it).

Example II. A Mini Windmill (Fan)

Take two strips of palm leaf each about 20cm long and proceed as illustrated in Figure 2 below to complete the design.

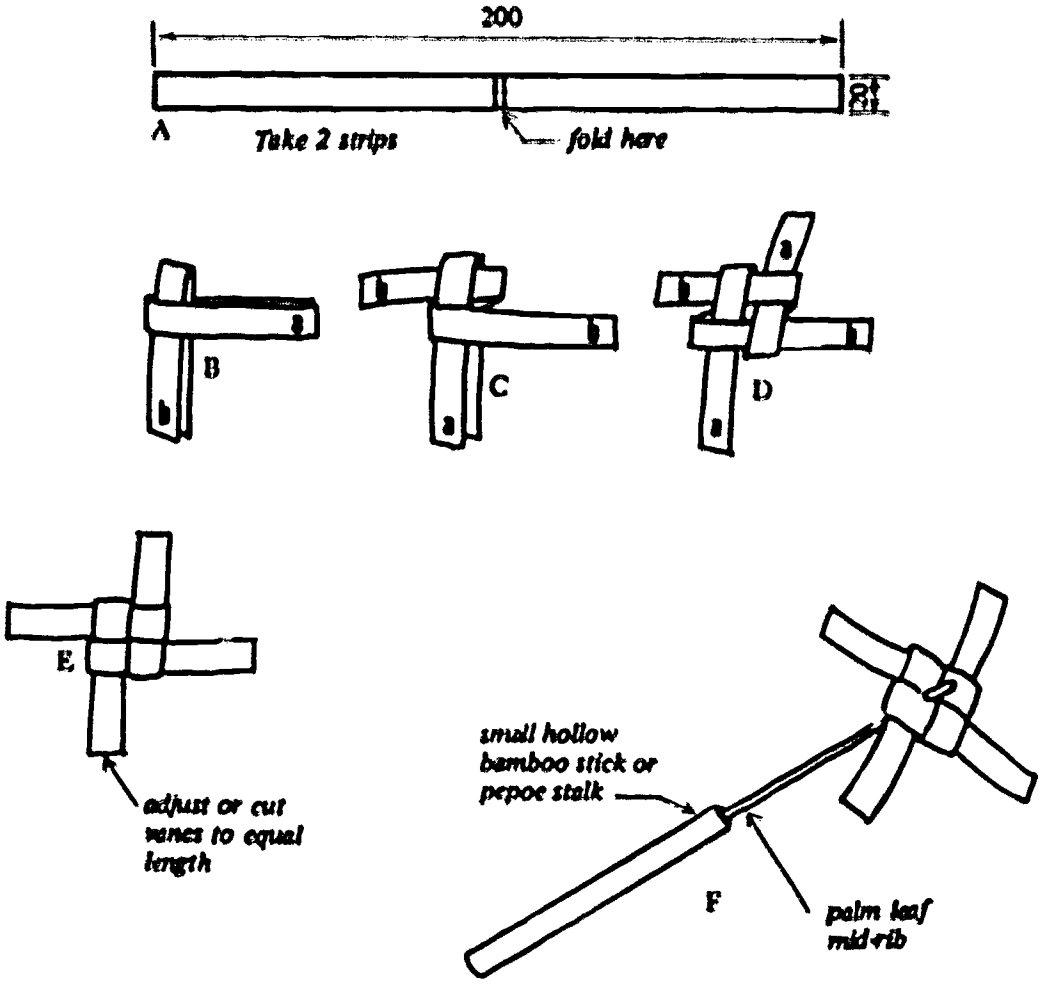


Figure 2

Example III A Butterfly (Beetle)

Take two long strips of palm leaf and proceed as shown in Figure 3.

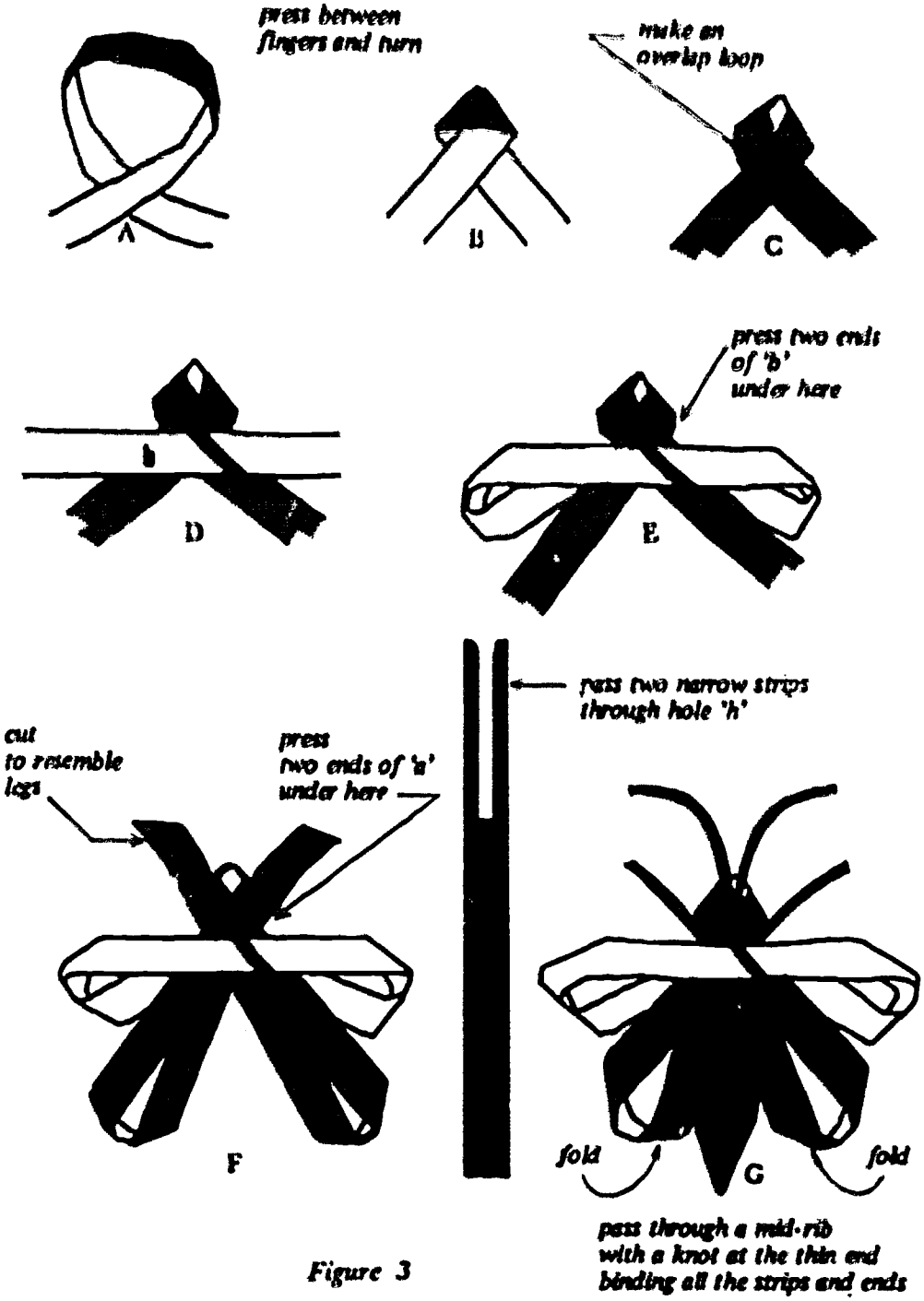


Figure 3

Example II' – A Parrot

1. T wo strips of palm leaf (about 2cm wide) and proceed as shown in st 'A' to 'D' (Figure 4)
2. o the ends coming out from each corner of the box. To bring the two ends at each corner still closer to each other make overlapping loops as shown in stage 'D' at both corners.
3. Produce a similar but smaller shape from strips about 1 cm wide and complete the 'head' (stage 'F') as the earlier 'body' already made (stage 'E')
4. Now cut the shape of the beak at one corner of the head (from two ends coming out from one corner) and invert it over one corner of the larger body and pass the remaining two ends of the head through one corner of the larger body which has to be cut to a shorter length (see arrow in stages 'E' and 'F') and fix it as shown in stage 'G'
5. Pull all ends tight and cut wings and tail to a required shape and complete the parrot.

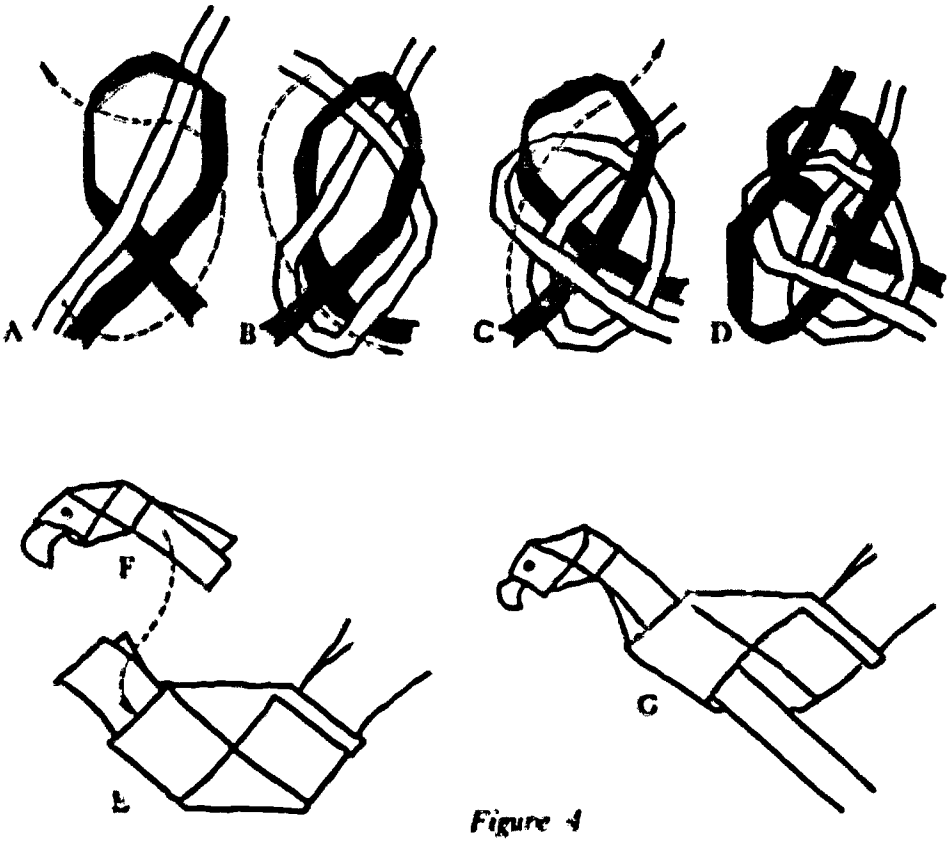
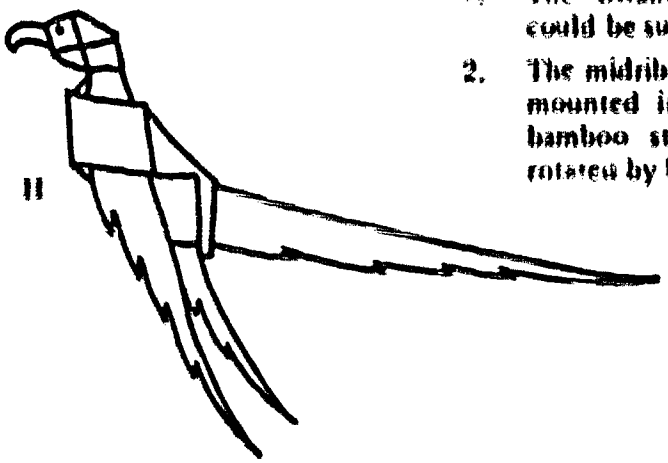


Figure 4

How to use



1. The Swallow, Beetle and the Parrot could be suspended at the end of the rib.
2. The midrib of the windmill (fan) may be mounted inside the bore of a narrow bamboo stick or a papaya stalk and rotated by blowing on it.

Source: Inventory of Low-cost Simple Materials Games and Toys, prepared by P.B. Dayasiri, School Science Equipment Design Unit; Curriculum Development Centre, Sri Lanka.

DECORATIVE ARTWORK USING FEATHERS

Level : Primary
Subject area : Crafts and language

Brief description

Feathered artwork is a multi-purpose device with unlimited possibilities for use, depending upon the ingenuity of the teacher. It can be produced at no cost.

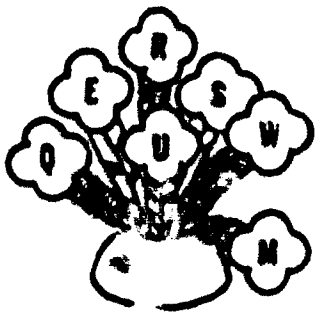
Objectives

To develop various skills in reading, pronounciation and numeral computation

Materials needed

1. Tail or wing feathers (as many as needed)
2. Scraps of cardboard or coloured paper
3. The shell of young coconut fruit to hold the feathers
4. Adhesive tape

How to make



1. Select the needed number of feathers.
2. Cut flower petals out of scraps of cardboard or coloured paper.
3. Write letters of the alphabet on one side of the flowers (one letter on each flower).
4. Tape the back side of a flower to the tip of a feather.
5. Arrange the flowers in an ark shape with the coconut shell as a holder.

How to use

1. This device may be used in a relay game for vocabulary building. The players draw a feather, then identify the letter. Words that start with the letter are given. The team that can give the most number of words is the winner.
2. Instead of letters and building words, numbers may be written on the flowers and used for calculation exercises, depending upon the objective of the lesson.

Possible modifications

1. Coconut/buri midribs cut into the desired length may be used instead of feathers.
2. The coconut shell holder may be substituted by a jar or an icecream cup perforated at the bottom, so as to hold the feathers.
3. Use numbers instead of letters and use for arithmetic games.

Source: National Workshop on Educational Technology with special Reference to Development of Low-cost Educational Materials, Philippines.

MAGUL GETAE

Level : Lower secondary
Subject area : Crafts

Brief description

A set of rectangular wooden blocks of uniform cross section but having different lengths and shapes (12 pieces), to be assembled together to a predetermined shape 'knot' by interlocking the pieces.

Objectives

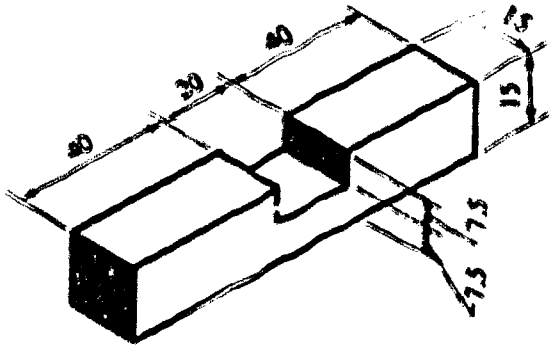
1. To develop the concept of three dimensional thinking.
2. To encourage intelligent and logical reasoning and concentration when solving real-life problems, with due attention towards possible alternatives and their effect.

Materials needed

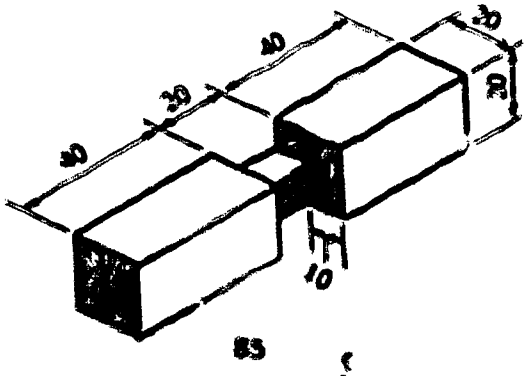
1. Six wooden blocks 20mm x 20mm x 100mm
2. Six wooden blocks 20mm x 20mm x 150mm

How to make

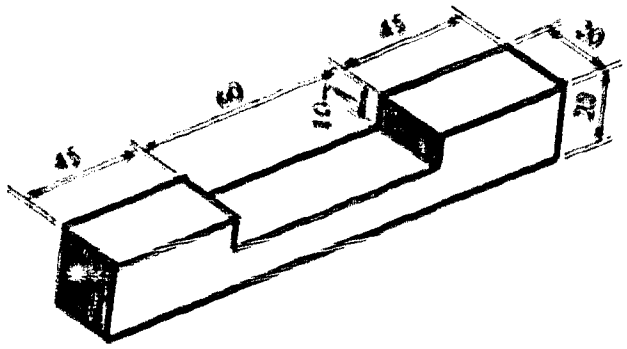
1. Cut the small blocks of wood to the shape shown below.



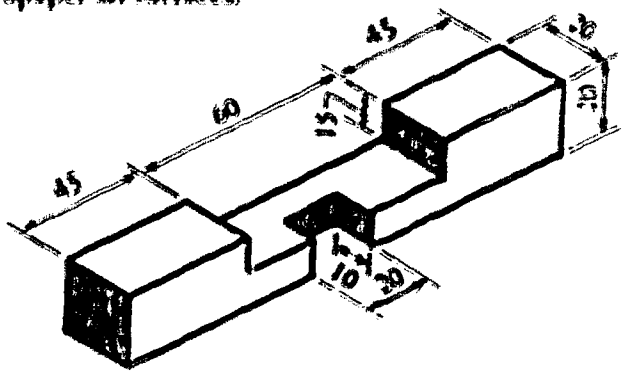
2. Of these six blocks select two and cut to the shape shown below.



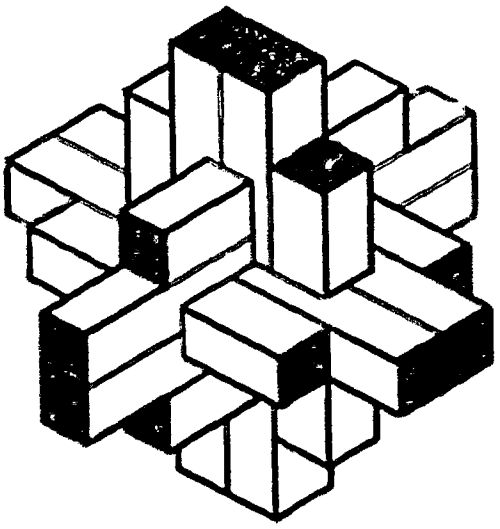
3. Select five longer blocks and cut to the shape shown below.



4. Select two blocks from the above and cut further as shown.
5. Sandpaper all surfaces.



How to use



1. Put all the pieces together to form the 'knot' shown in the illustration by interlocking the pieces. The final 'knot' should be symmetrical on all three planes and properly fixed.
2. Dismantling the 'knot' and putting back the pieces will be an equally challenging exercise.
3. Once mastered, this could be performed even when blindfolded.

Source: Inventory of Low-cost simple materials games and toys, prepared by P.B. Dayasiry, School Science Equipment Design Unit, Curriculum Development Centre, Sri Lanka.

PULSE METER MADE FROM A MATCHSTICK AND THUMBTACK

Level : All levels
Subject area : Science, biology

Brief description

By using one matchstick and a thumbtack, it is possible to make a device to demonstrate the vibrations of someone's pulse and make it easy for others to observe.

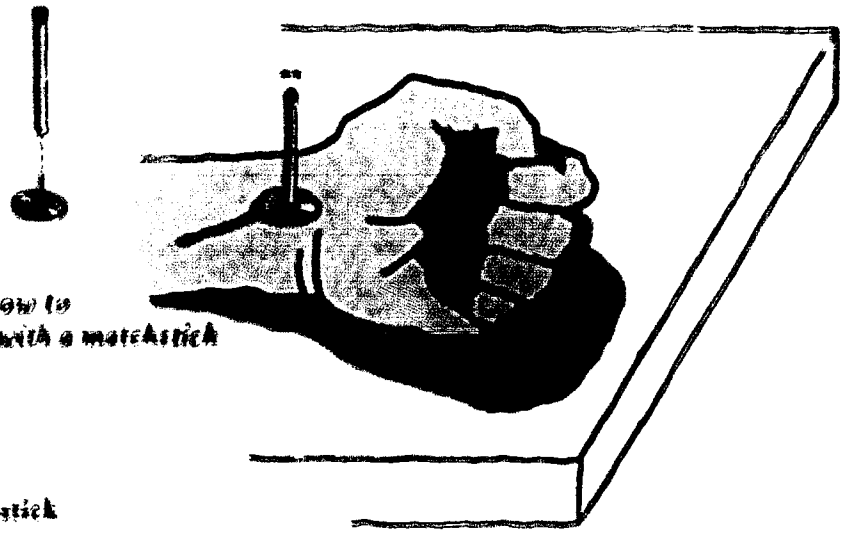


Figure 1 Shows how to measure the pulse with a matchstick and a thumbtack.

Materials needed

1. A matchstick
2. A tiny thumbtack

How to make

As can be seen in Figure 1, this is a very simple device. It is possible to make a a pulse-measuring device simply by pushing a thumbtack carefully into a matchstick.

How to use and play

1. Feel the wrist to find the spot where the pulse can be strongly felt.
2. Stabilize the wrist by placing it on a desk or other solid surface. Place the head of the thumbtack on that spot with the matchstick in a vertical position. The upper end of the matchstick will begin to move in accordance with the pulse.
3. First, measure and record the pulse for one minute. Then, run in place for a minute or two and measure the pulse in the same way afterwards. It can be seen that there is a difference between the pulse count under normal circumstances and after running. Further, after five or six minutes rest, measure the pulse again and confirm that it has returned to normal.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Narikazu Ohsuga, NIER, Tokyo, Japan.

Sheet 49

EXPERIMENT WITH SOAPY WATER

Level : All levels
Subject area : Science

Brief description

Almost everybody has had the experience of playing with soapy water, as a youngster. This experiment aims at observing some interesting phenomena which soap bubbles possess through the use of a simple, hand-made tool.

Materials needed

A piece of flexible wire

A piece of string (cotton thread)

How to make

1. Cut a piece of wire about 40cm long. Any available piece will do, but wire of 0.6 to 1 mm diameter will work best
2. Bend the wire and make a frame as shown in Figure 1.
3. Next, take some cotton thread and make a loop. The loop should be small enough to just fit within the wire frame.
4. Tie a piece of string at two opposite points on the loop, attach each loose end onto the wire frame. Make sure the string is not tight but a little loose.

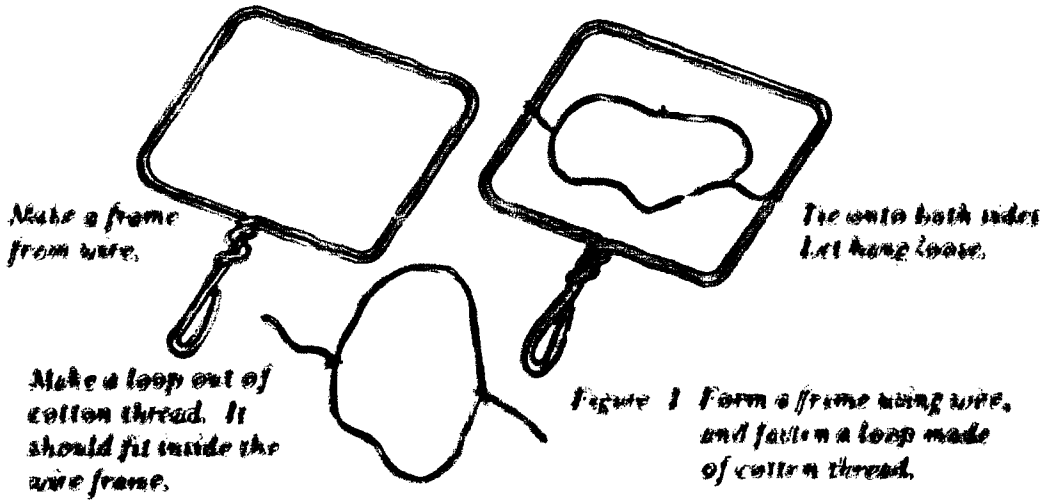


Figure 1 Form a frame using wire, and fasten a loop made of cotton thread.

Objectives

1. To have fun with an experiment using a self-made toy to be used as a tool for observation of certain phenomena.

   Similar to other toys made of wire, this is very simple to make. It is important for children to familiarize themselves with science experiments by making their own tools and making observations on some phenomena.

2. Observers will probably discover the surface tension in a film of soap as they watch the cotton loop shape itself into a perfect circle. At the same time, this phenomenon will be practical proof of the fact that among all possible shapes that can be formed out of a given circumference, the circle will take [illegible] greatest surface area.

3. Playing with soap bubbles is an another game enjoyed by younger children which can also be scientific. This experiment should be regarded as one experiment which has developed from playing with bubbles. Children can experience the transition from mere play into the level of scientific experimentation.

How to use and observe

1. Prepare some soapy water in a wash basin or in a pot using some soap and water. You need only enough to immerse the wire frame.

2. Immerse the wire frame in the soapy water and then gently lift it out. A thin film of soapy water will form [illegible] frame.

3. Take a pencil or use your fingers [illegible] the part of the film that has formed inside the loop of cotton [illegible]. The point of this experiment is to observe what shape the loop will take at this stage.

4. As shown in Figure 2, the part of the film which has popped will form a nice circle. Even if the attached strings are jogged, the loop will always return to the shape of a circle when released.

5. This illustrates how a film of soap is pulling from all sides, shaping the loop into a circle.

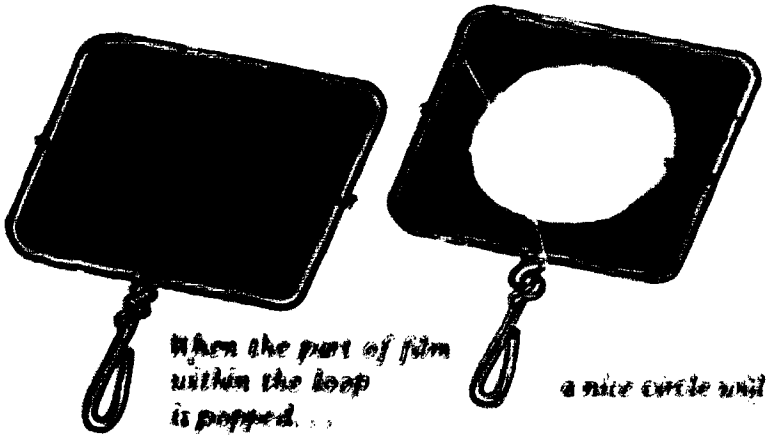


Figure 2 Soak the wire frame in soap water and gently lift it. A thin film of soap will form across the frame.

Source: Case study of simple low-cost teaching materials, games and toys, prepared by Naokazu Ohsumi, NIER, Tokyo, Japan.

SOLAR SPECTRUM

Level : All levels
Subject area : Science

Brief descritpion

The solar spectrum can be demonstrated with a simple experiment in which a plain mirror is dipped at an angle in a glass with clean water and turned around in the sunshine.

Materials needed

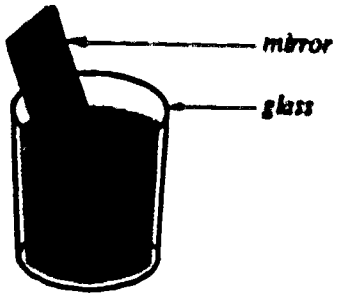
1. Water glass
2. Plane mirror

How to make

1. Place a plane mirror in the water glass at an angle with the bottom of the glass.
2. Add water in the glass and place it in the sun.

How to use

Rotate the glass towards the direction of the sun and observe the spectrum produced.



Source: Bangladesh Education Extension and Research Institute-Report of a National Workshop on Educational Technology, 1980.

LOW COST LENGTH MEASUREMENT DEVICES

Level : Primary
Subject area : Basic science

Objectives

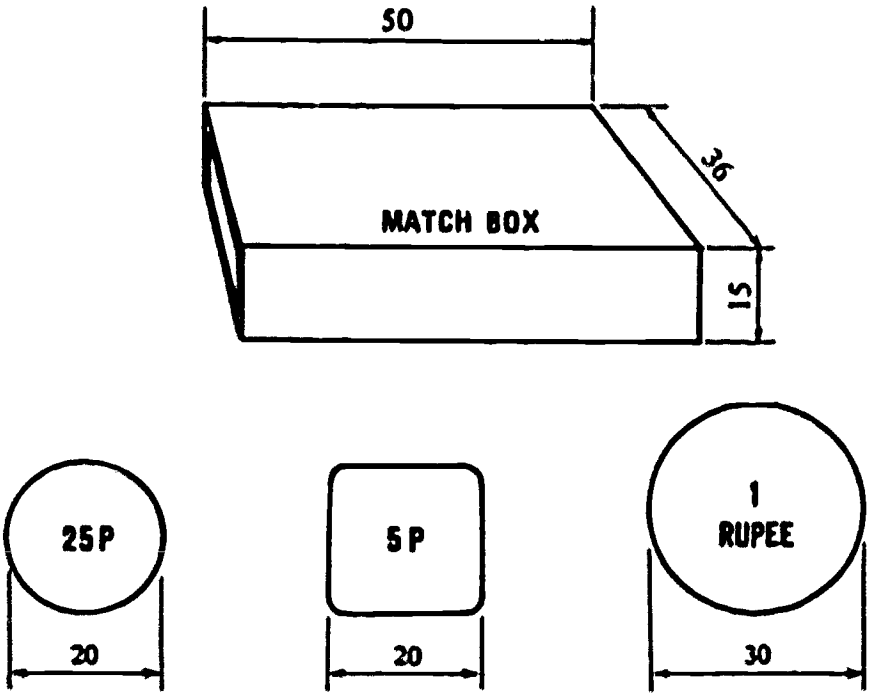
To improve the child's concept of length and its measurement by using easily avaliable common items from its immediate environment.

Materials needed

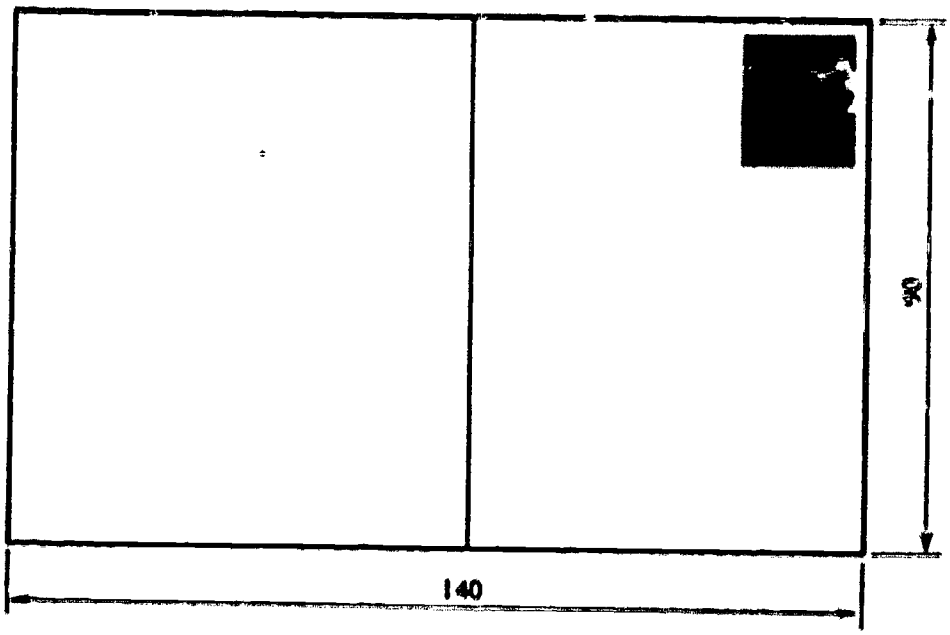
1. Coins
2. Matchboxes
3. Post cards
4. Bricks, tiles, etc., each of which has a standard dimension

How to use

1. Determine the exact measurements of selected items. Objects like a matchbox, coins, bricks, post cards etc, have standard size in many countries. Find out the length of these objects with a measuring scale.



2. Now you can find the length of any longer object or distance with the help of some of these objects. e.g. the length of the pencil can be determined with coins or a matchbox. A measuring scale is always essential for determining the length of the object to be used as a measuring device.



3. Exercises of determining the number of bricks required to cover a small platform, or the size of paper needed for packaging of a number of match-boxes can provide meaningful learning experiences.

Source: Inventory of low-cost materials/games, developed by the Department of Teaching Aids, NCERT, India.

A SIMPLE WATER CLOCK

Level : All levels
Subject area : Science

Brief description

This is an old tin with a hole at the bottom filled with water up to a certain level so as to contain sufficient water which will drop within a specified time.

Materials needed

1. An old tin
2. Water
3. A hammer and nail (for making a hole)

How to make

1. Make a hole in the bottom of the tin.
2. Fill the tin with water, and measure the time it takes for the water to drop through the hole.
3. Adjust the volume of the water in the tin, until it takes exactly 1 minute for the tin to empty and mark the water level scratching with a nail.
4. Other tins with holes of different sizes, can be calibrated for different durations of time.

Source: Bangladesh Education Extension and Research Institute – Report of a National Workshop on Educational Technology.

VOLUME MEASURING CYLINDER

Level : All levels
Subject area : Science

Brief description

This is a transparent container (empty glass or plastic discarded bottle or jar), which is calibrated (marked) by the students.

Objectives

To make a volume measuring cylinder from easily available no-cost materials.

Materials needed

1. A spoon, a match box or little empty plastic medicine pill box, whose volume is known or can be easily determined
2. An empty jar or cylinder
3. A paper calibrating strip, to be marked by the students

How to make

1. Take the inside drawer 'D' of a match box; dip it in oil; dry it in the sun. It now becomes waterproof. The drawer can now be used as a standard for measurement of volume. Most match boxes from India have an approximate volume of 20 cubic centimetres (Figure 1).

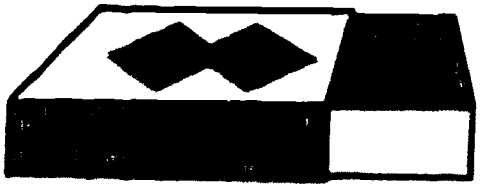


Figure 1

2. In place of the match box drawer, a little empty pill box, whose volume is already known, can be used.
3. Stick a piece of paper along the measuring cylinder.
4. Pour the contents of the matchbox drawer or the pill box and mark on the strip of paper a horizontal line against the level of the water.
5. Repeat this process until the strip of paper is calibrated, then empty the jar which becames a volume measuring cylinder (Figure 2).

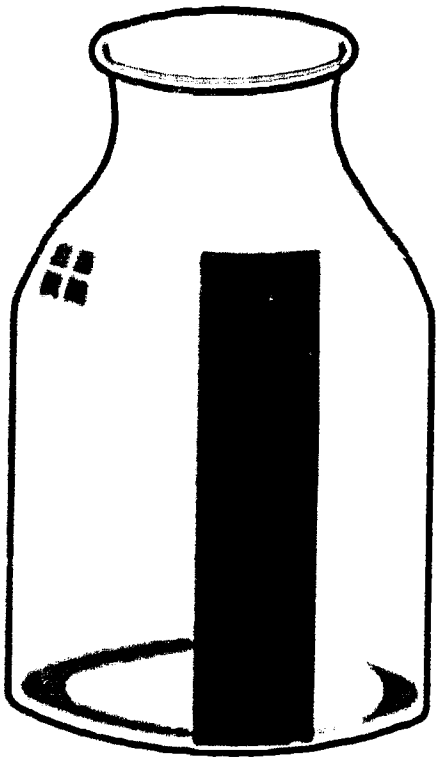


Figure 2

How to use

1. The volume of any other smaller jar, bottle and other containers can be found out by filling them with water and then emptying them in the measuring cylinder.
2. If the calibration is known to the users, the total volume can easily be calculated in cubic centimetres.

Source: Inventory of Low-cost materials/games, developed by the Dept. of Teaching Aids, NCERT, India.

Sheet 54

BEAM BALANCE

Level : Primary and lower secondary
Subject area : Mathematics and science

Brief description

A simple balance which could be made from scrap plywood and timber. Useful for practical weighing activities at all levels of the primary school. Its use is mainly determined by the requirements of the syllabus in mathematics and science.

Objectives

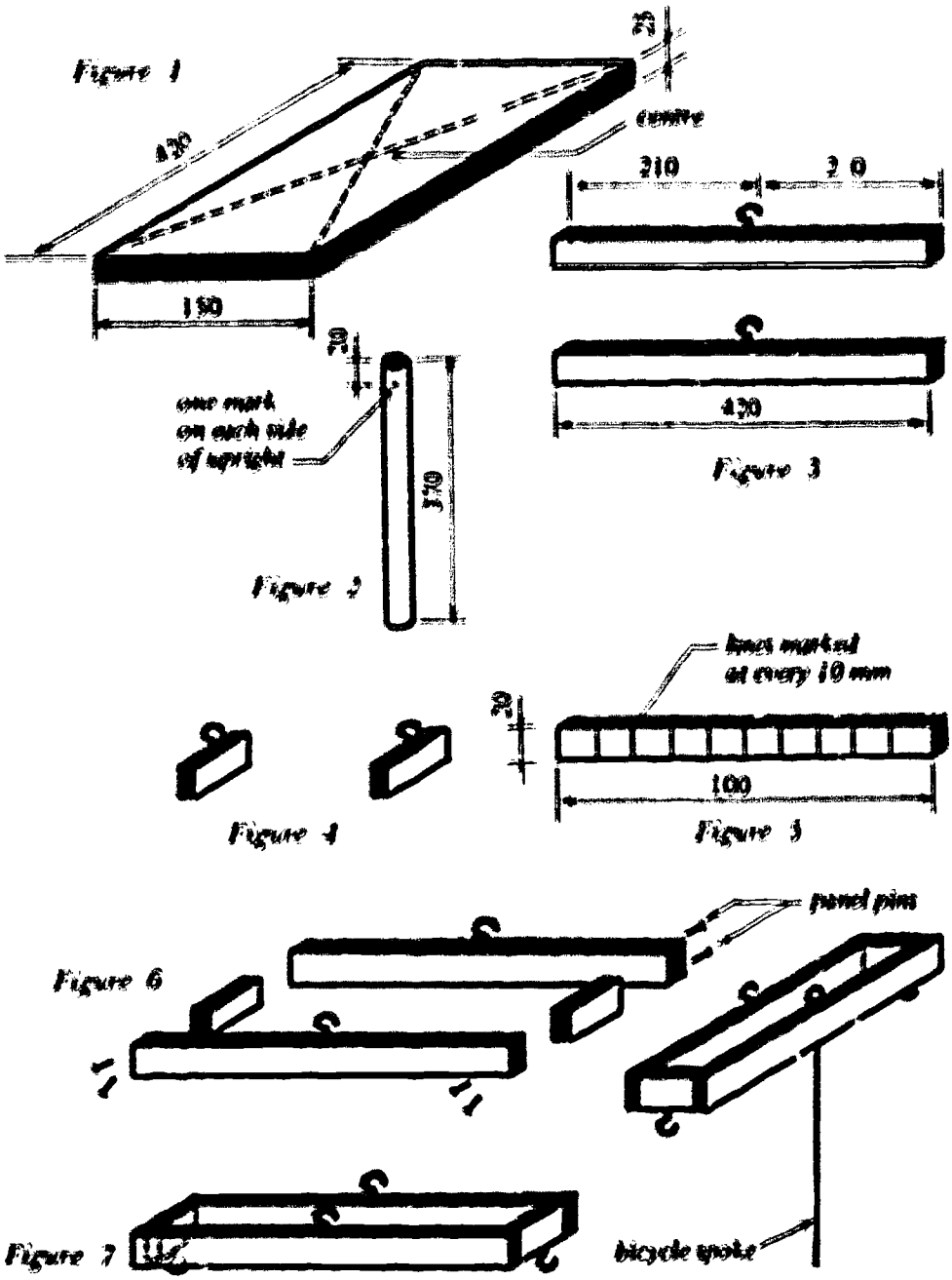
1. Through practical experience pupils will discover the principles of balance and will learn to use the terms heavy, light, heavier than, lighter than.
2. By using standard weights from 10 g to 1 kg in practical activities the pupils will find the weights of common objects.

Materials needed

1. 6 Small cup-hooks about 25 mm long, (Figures 7 and 8)
2. 1 Screw 20mm x 8 gauge (Figure 10)
3. Panel pins or small nails 20mm long, (Figure 6) wood glue (optional)
4. 1 Piece of timber material with dimensions: 420mm x 150mm x 25mm (Figure 3)
5. 2 Pieces of 3-ply plywood with dimensions. 420mm x 20mm (Figure 3)
6. 1 Piece of dowel timber or a broom handle 370mm long and about 20mm in diameter (Figure 8)
7. 2 Pieces of 3-ply plywood with dimensions: 40mm x 20mm (Figure 4)
8. 1 Piece 3-ply plywood with dimensions: 100mm x 20mm (Figure 5)
9. 2 tin lids approximately 120mm in diameter (Figure 13), nylon fishing line or strong thread or string (2 metres long), (Figure 13)
10. Bicycle spoke or coconut leaf spine (300mm long, Figure 7)
11. Cross-cut saw, screw driver, hammer, brace and 20mm bit

How to make

1. Cut the base board from the timber and mark the centre point by crossing diagonal lines (Figure 1). Use the brace and 20mm bit and drill a hole 20mm deep at the centre point.
2. Cut the desired length of dowel or broom handle for the vertical stand, mark two points opposite to one another, 20mm down from the top (Figure 2).
3. Cut two strips of 3-ply plywood 420mm long and 20mm wide. On the top edge of each, mark the centre point (210mm from each end). Use



a hammer and panel pin to make a hole at these points and screw a cup-hook into each. Make another hole immediately below the cup-hook on one beam only (Figure 3).

4. Cut two pieces of 5-ply plywood 40mm long and 20mm wide. These are the beam fasteners. Make a central mark on each piece. Make holes and screw in cup-hooks as described in step 3 (Figure 4).

5. Cut one piece of 5-ply plywood 100mm long and 20mm wide. Mark vertical lines at 10mm intervals across the width (Figure 5). This is the scale.

6. Using 8 panel pins and glue, join the two parts of the beam together using the two beam fasteners as shown in Figure 6. Insert the bicycle spoke or coconut leaf rib in the remaining hole. The complete beam should look as shown in Figure 7.
7. Make holes and screw in cup-hooks where marked on the vertical stand.
8. Insert the stand into the baseboard with the cup-hooks perpendicular to the length of the baseboard.
9. Using a 20mm, 8 gauge screw and glue, fasten the stand firmly into place from the underside of the baseboard.
10. Attach the scale as shown in Figure 11 by nailing it to the upright at the central mark.
11. Hang the beam, as shown in Figure 12.

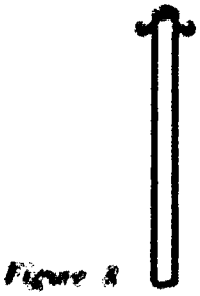


Figure 8

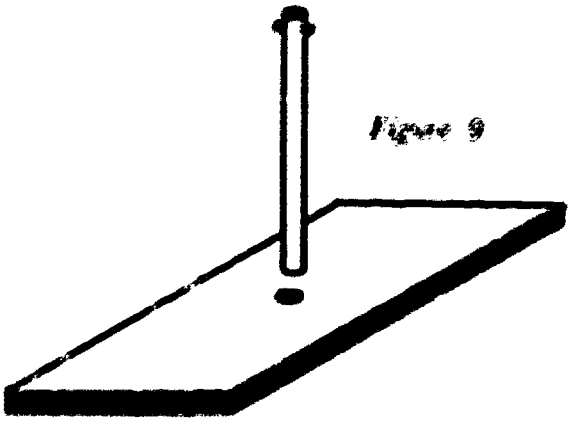


Figure 9

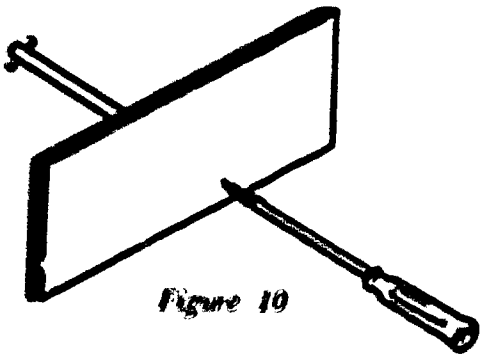


Figure 10

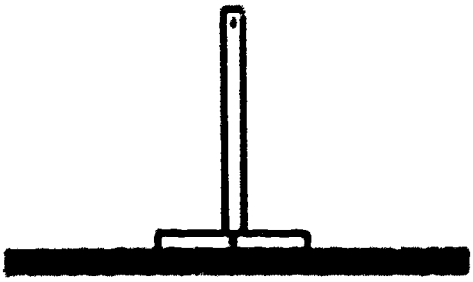


Figure 11

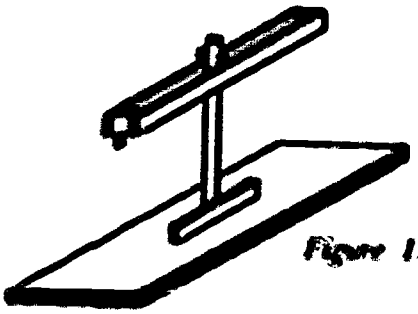


Figure 12

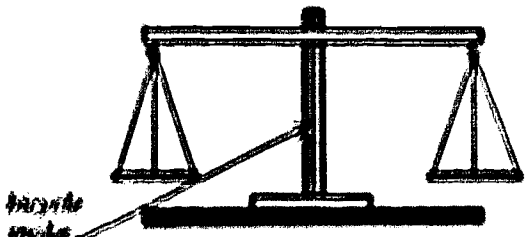


Figure 13

12. Using the hammer and a nail, make 3 evenly spaced holes in the edge of each tin lid and thread the strings as shown in Figure 13. Each string should be 250mm long. These are the trays for weighing. Hang the trays.

How to use

1. Let the students weigh various objects and make comparisons. Ask them: Which is heavy? Which is light? Is this heavier or lighter than that? How much heavier is this than that? (Let them use the scale).
2. Find some locally available objects that can be given an approximate metric weight and kept in the classroom: e.g. the duster, a clam shell, a nut, a stone, a half coconut shell full of sand, etc.

   These can be used for weighing exercises at lower levels when metric weights are not available.
3. Use the balance and cardboard coins in the classroom "shop" for exercises in measuring, weighing and "Selling" by weight e.g. 1 kg of clay costs K5,00. Weigh out 500g of clay. How much does it cost?

Source: Prepared by Production Centre for Educational Materials, Port Moresby, Papua New Guinea.

RAZOR CUTTER

Level : All levels
Subject area : All subjects

Brief description

The razor cutter can be made from pieces of discarded steel banding used for strapping wooden crates, a razor blade and two fastening screws and nuts. It is suggested for teachers' use only.

Objectives

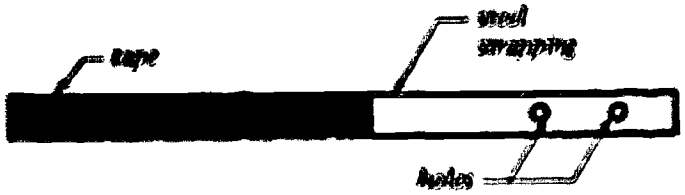
To provide a suitable cutting instrument for making teaching aids from paper, cardboard, plastic sheets etc.

Materials needed

1. Two discarded pieces of steel banding, 15 cm long
2. Razor blade
3. Two screws and nuts 10 mm long and 4 mm diameter

How to make

1. Fasten part 'A' of the pieces of steel banding together with tape (insulating tape, cellotape, or sticking plaster will do).
2. Punch or drill two holes with diameter 5mm, in the other end 'C'. These holes should be at a proper distance apart, corresponding to the holes of the razor blade.
3. Insert the blade 'B' between the two metal pieces.
4. Insert the screws through the holes and fasten the nuts.



How to use

The razor cutter may be used for cutting paper, cardboard, plastic sheets and other materials into the desired shape, using template contours or preliminary drawn outline of the pattern.

Source: Education Resource Centres Newsletter No. 2 – published by Department of Education, Papua New Guinea.

MINI CINEMA

Level : All levels
Subject area : Story telling and creative expression

Brief description

This is a device illustrating sequential events of a story in stages which may be presented to an audience of pupils by using a flexible strip of drawings simply by pulling a string (No electric power supply is required).

Objectives

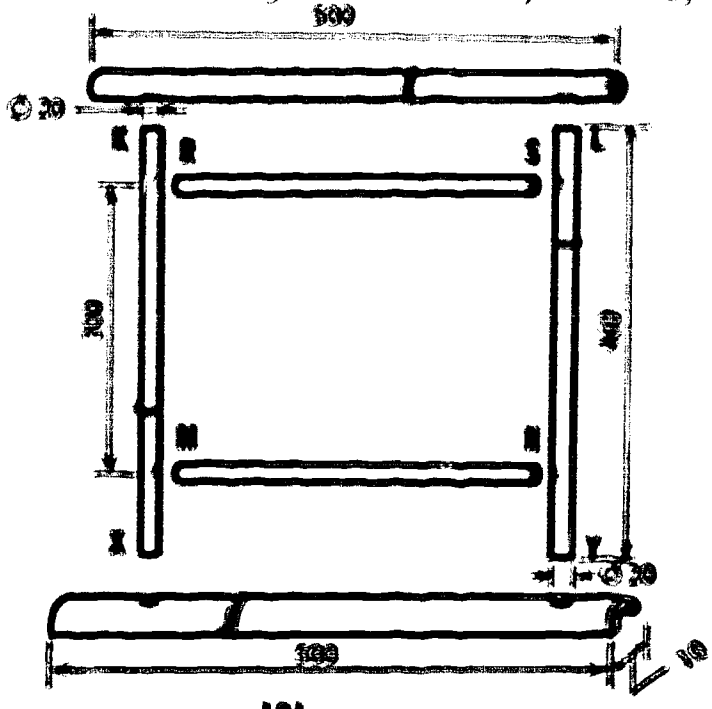
1. To illustrate in stages, the successive events of a story.
2. To encourage children to prepare their own 'story telling' strips, making their own drawings.

Materials needed

1. Bamboo stick
2. Blank writing paper
3. String
4. Panel pins, 20 mm
5. A piece of cardboard

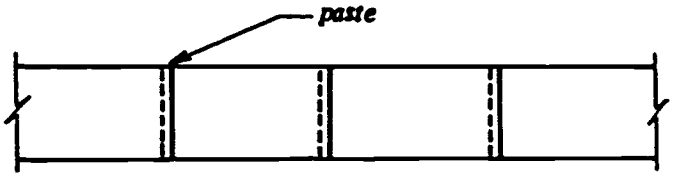
How to make

1. Prepare the components of the device from bamboo according to the dimensions shown in the figure. The holes may be made by sewing two

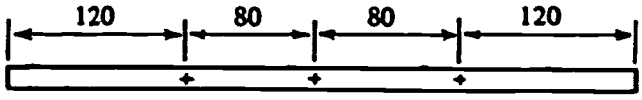


cuts across the bamboo (at the proper points) and removing the unwanted pieces with a chisel. Assemble the components using some glue to fix them together as shown in the figure.

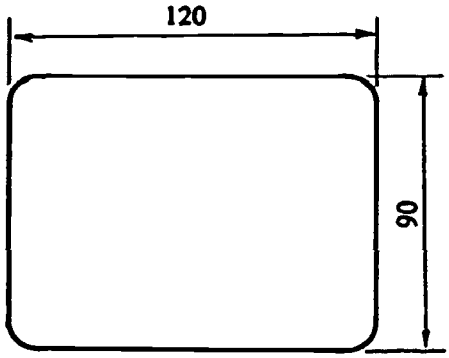
2. Paste sheets of paper so as to form a long strip.



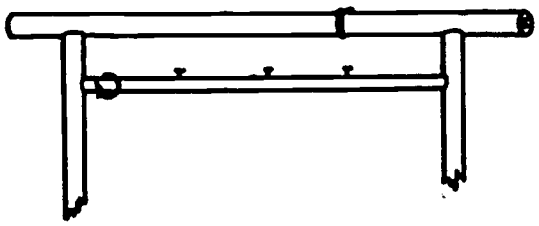
3. Fix 3 panel pins on each horizontal bamboo crossbar ('MN' and 'RS') according to the measurements shown below



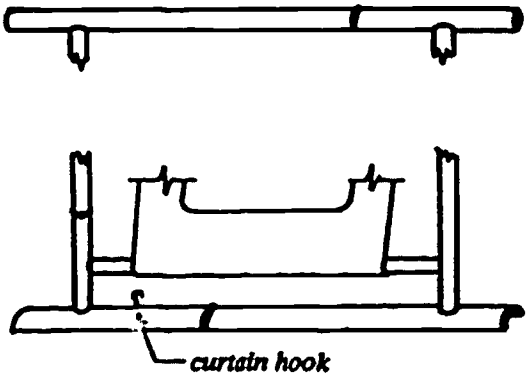
4. Fix another panel pin 50 mm away from the ends, marked 'R' and 'S'.
5. Draw 'frames' along the paper film-strip for the pictures of the scenes.



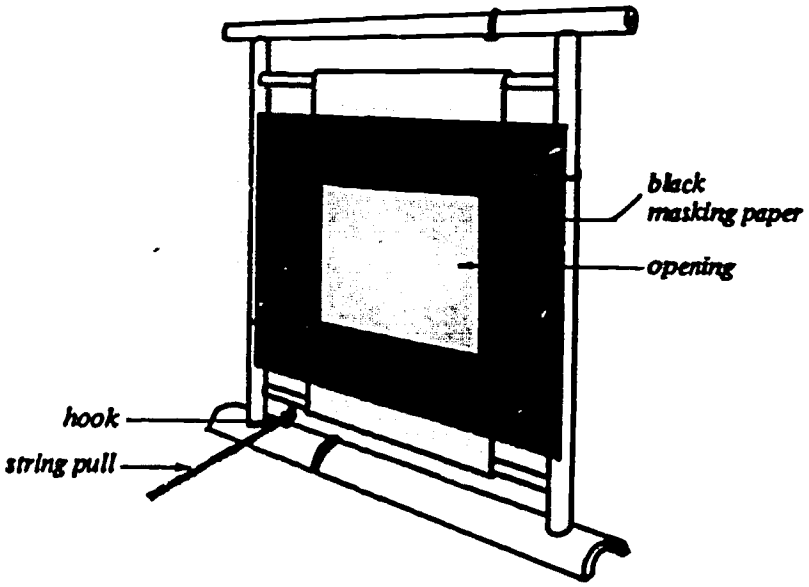
6. Draw the various illustrations for each stage of the story in successive frames.
7. Attach the end of the string to the panel pin (described in point 4 above) and wind the string around the rod in such direction that when pulled, the strip will move as desired.



8. Attach the 'end' of the 'film' to rod 'MN' and wrap the film around by turning the rod 'MN'.



9. Fix a hook on the 'base piece' as shown.
10. Once the whole film is wound around the rod 'MN', attach the other en of the film to the rod 'RS'.
11. Take a piece of cardboard 400 x 300 mm and cut an opening equal i size to the size of the frames of the strip and attach it to the vertic supports so that each frame can be seen through the opening on th cardboard screen.
12. Poke the free end of the string through the curtain hook on the base.



How to use

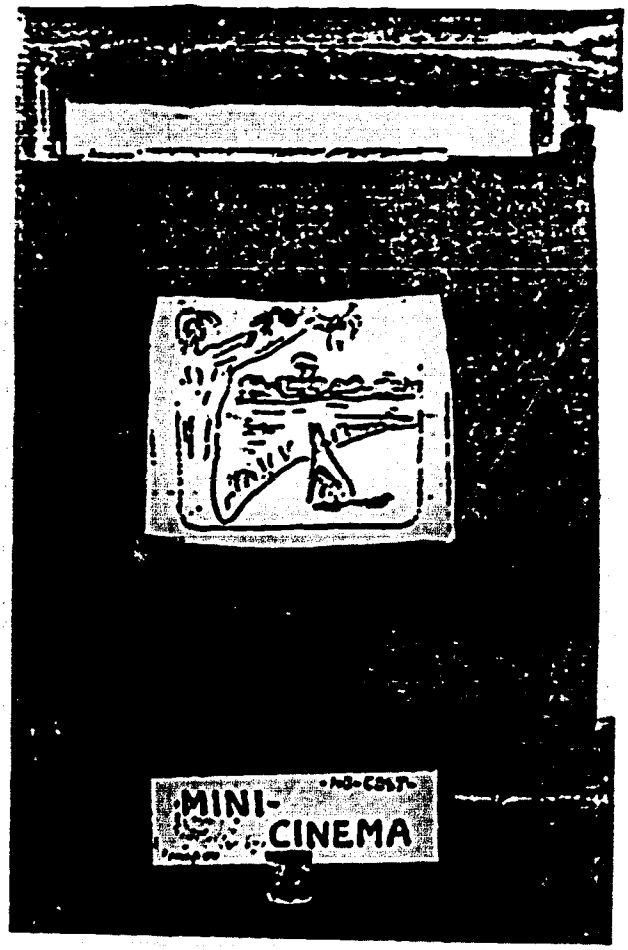
In story telling, advance each frame by pulling the string as much as nece sary, holding the upper cross-bar with the other hand.

Note: P.V.C. tubing or suitable wooden rods may be used to make the frame in place of bamboo.

The mini-cinema may be used to show various diagrams related to various steps in a lesson.

The children may be asked to produce their own strips and show them to the class.

Source: Inventory of Low-cost Simple Materials, Games and Toys, prepared by P.B. Dayasiri, School Science Equipment Design Unit; Curriculum Development Centre, Sri Lanka.



SMALL DISPLAY BOARD

Level : All levels
Subject area : All subjects

Brief description

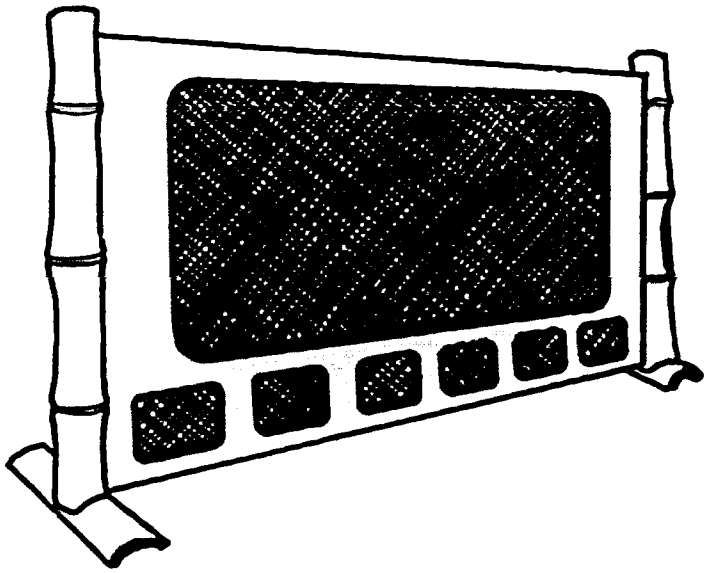
This is a multi-purpose teaching aid which can be used in teaching all subjects.

Educational objectives

To facilitate learning through illustrating the subject matter, as well as for vocabulary building, sentence structure or grammar.

Materials needed

1. Bamboo
2. Nails
3. Thin cardboard
4. Poster paint
5. Chisel
6. Hammer
7. Saw
8. Ornamental bamboo plant
9. Pieces of cloth
10. Human hair



How to make

1. Cut off the two posts and three horizontal bars from a piece of bamboo. The height and width is at the discretion of the maker.
2. Bore holes in the posts to insert the horizontal bars. Cut two pieces of the thin cardboard for the front and back cover. Cut the opening of the front cover. Cut also some holes to form 'pockets'. Nail the back and front covers to the posts. Prepare the posters and the words to be attached to the posters.

How to use

This display board is a multi-purpose teaching aid, and it can be used whenever some demonstration of visuals is needed.

Possible modifications

Various materials may be used, for example plywood, or mat can be used in place of the thin cardboard.

Bark of abaca (banana-like fibre plant) can be used instead of thin cardboard to write the words to be matched to the posters.

Coconut tree bark can be also used.

Source: National Workshop on Educational Technology with Special Reference to Development of Low-cost Educational Materials, Philippines.

PROJECTION SCREEN

Level : All levels
Subject area : All subjects

Objectives

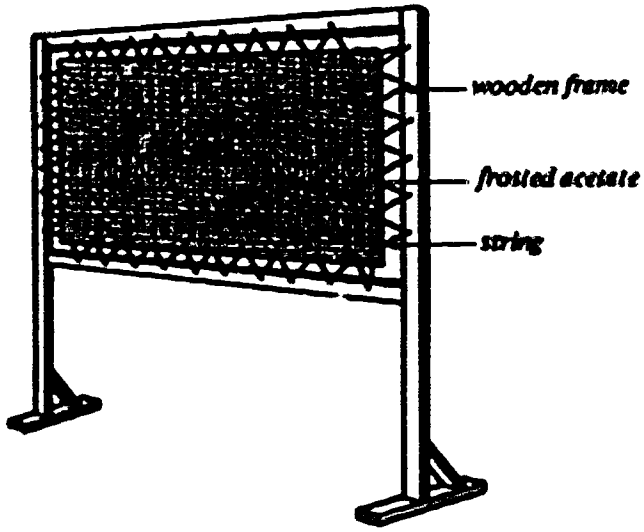
1. To replace an expensive projection screen.
2. To have the same quality as the expensive one.

Materials needed

1. Frosted acetate, size 70 x 80 cm
2. 1 sheet of cardboard or a poster
3. 30 metres of nylon rope
4. Timber material

How to make

1. Staple the frosted acetate onto a rectangular piece of cardboard.
2. Frame the frosted acetate in a wooden frame which is little bigger than the acetate sheet. Attach legs to the frame.
3. Make holes at the rims of the screen and on the four sides of the wooden frame.
4. Thread the nylon rope and fix it firmly.



How to use

1. Before using it, position the screen in an appropriate place in the room so as not to interfere with other activities, and align the projector at a proper distance from the screen so that the projected image should fill the whole screen area without distortion, and the projector should not obstruct the view of the viewers.

2. If the projector and the screen have to be removed from their places, mark their proper positions for efficient use when needed, without wasting time for re-alignment.

Possible modification

In place of frosted acetate sheet a white matte paint applied on plywood would be cheaper or easier to obtain.

Source: "Instruction Sheet for Low-cost Educational Materials" prepared by Educational Innovation and Technology Centre, Department of Teacher Education, Bangkok.

A RAIN CYCLE MODEL

Level : Primary and lower secondary
Subject area : Science

Brief description

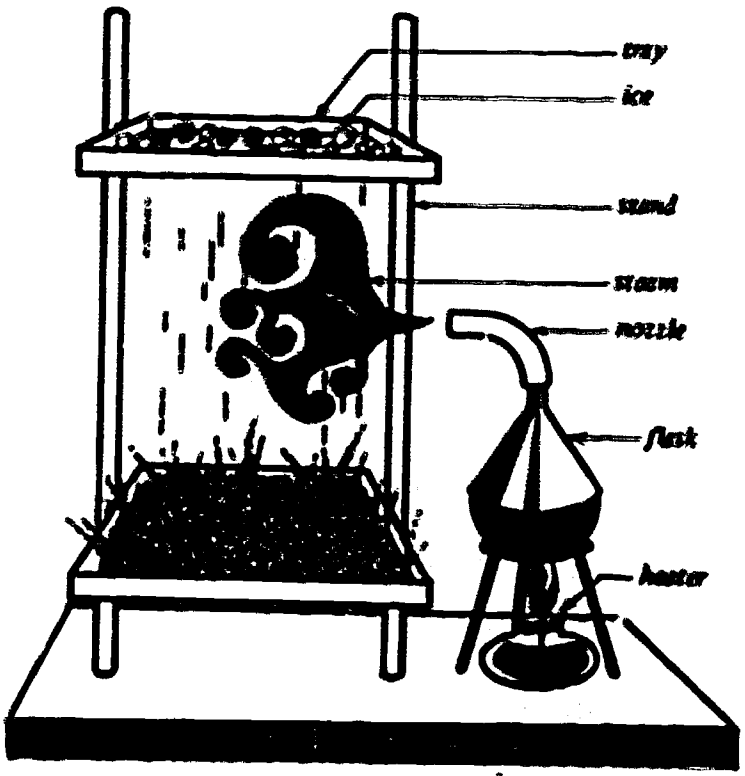
This is a simple way of demonstrating how a flow of steam condenses when it contacts a cool surface and produces "rain drops".

Materials needed

1. Spirit lamp or electric heater
2. Container fixed above the heater
3. Funnel filed to the container
4. Flexible plastic tube fitting to the funnel
5. Shallow metal tray with ice cubes, supported by a stand
6. Tray with plant seedlings

How to make

1. Place the tray with plant seedlings on the table.
2. Place the metal tray with ice cubes about 35 to 40 cm above the tray with the seedlings and supported by a stand.



3. Place the container containing water over a source of heat near to the seedlings, so that the funnel and the flexible plastic tube will direct the steam towards the upper tray with ice cubes.
4. Explain to the students that the steam resembles the natural evaporation of water from the earth towards the cooler upper layers of clouds in the atmosphere.
5. The condensation of the steam produces "raindrops" which fall over the lower tray with plant seedlings, like rain.

Source: Bangladesh Education Extension and Research Institute – Report of a National Workshop on Educational Technology.

SIMPLE CURRENT INDICATOR

Level : Secondary
Subject area : Science

Brief description

Where an expensive gavanometer is not available this simple current indicator could be used for detecting small electric currents and their directions, and similar (qualitative) observations in junior secondary science lessons.

Objectives

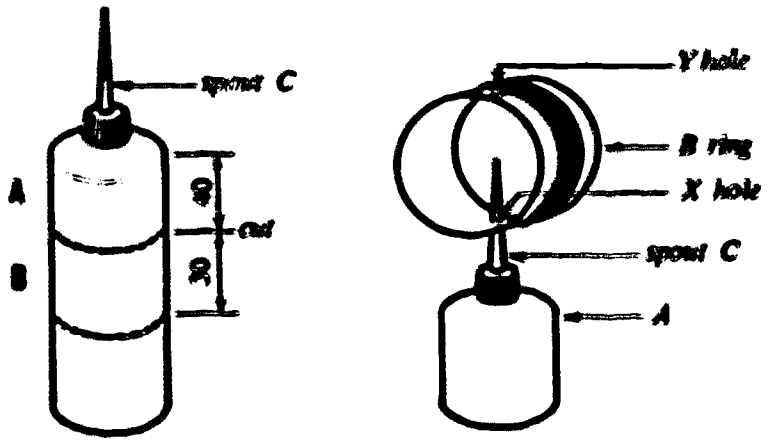
1. To utilize discarded materials or low-cost materials for making a current indicator useful in many teaching-learning situations.
2. To illustrate to the pupils how to equip their 'homelabs' with a low-cost apparatus.

Materials needed

1. Discarded plastic oil can with spout and with cylindrical shape, about 40 mm in diameter)
2. Empty ink-bottle filled with sand
3. Two discarded ballpoint pens
4. Eyelet (male half)
5. Three needles
6. Copper wire D.C.C 28-30 S.W.G.

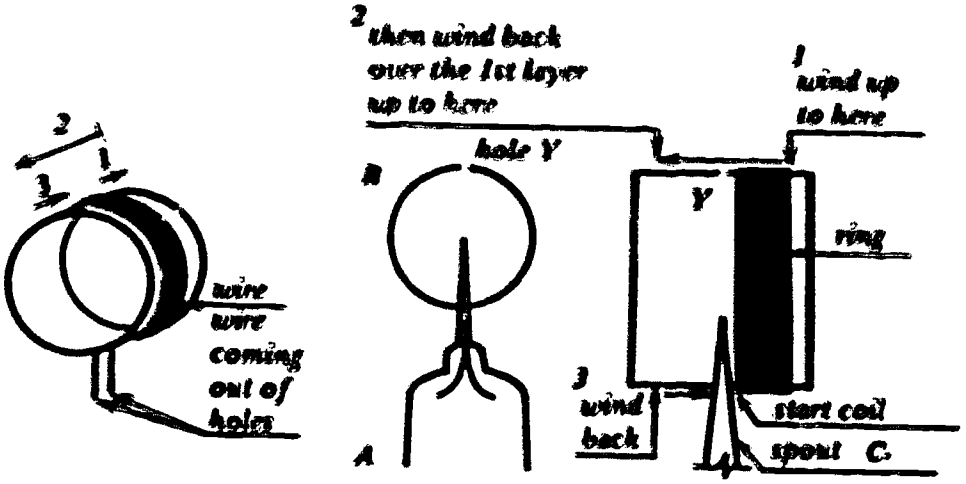
How to make

1. Cut from the plastic oil can the two portions 'A' and 'B' as shown in the diagram.

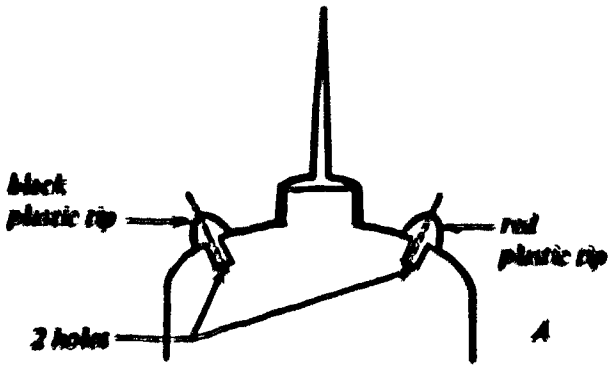


2. Remove the spout 'C' from piece 'A' and make a hole at the centre of the plastic ring 'B' so as to allow the spout 'C' to pass through half way (as shown in the diagram).

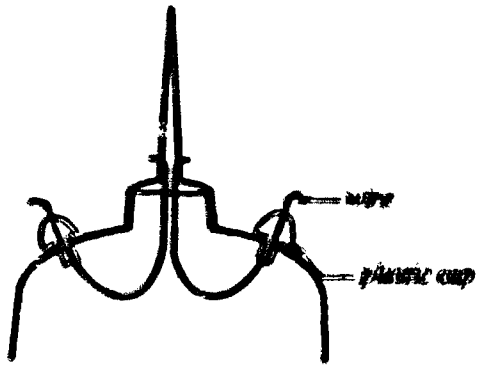
3. Pass one end of the copper wire through a hole 'X' made on the spout just below the ring 'B' and wind a coil around 'B' (about 20 turns) towards one edge and then back towards the centre and across to the other edge of the ring (about 40 turns) and back to the centre (about 20 turns) and pass the other end of the wire through another hole 'Y' made on the opposite side of the spout (at the same level of the hole 'X', winding the coil in the same direction).



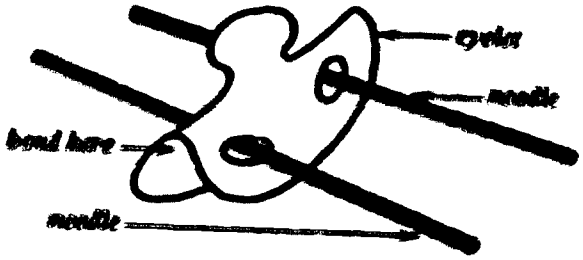
4. Screw the spout to the piece 'A', make two holes on the upper surface of the piece 'A', (about 25 mm apart from each other) just big enough to take the coloured plastic cap of an empty ball point pen.



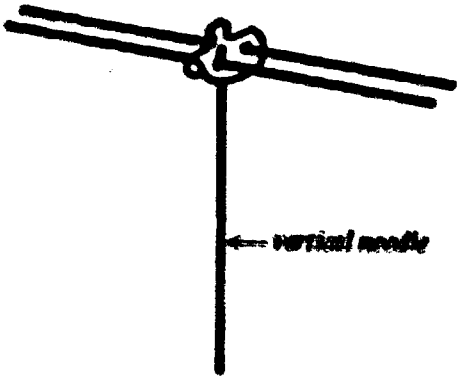
5. Pierce the bottoms of the plastic caps with a hot-pointed needle and pass one end of the coil through this hole in the plastic cap (from inside) and the other end of the wire through the hole of the other coloured cap. Fix the two coloured-tips into the two holes already made on the piece A using some glue (see diagram).



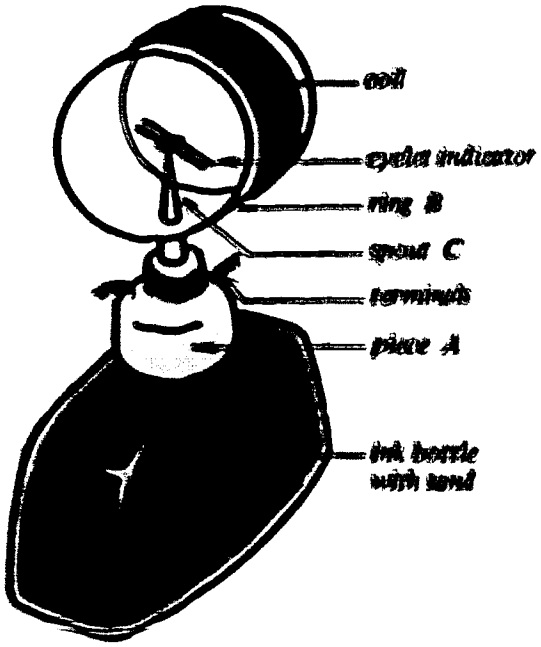
6. Take the 'male half' of the eyelet and carefully bend the base disc downwards from both sides so that each flap has two thread holes symetrically positioned on each side (see diagram) through which two needles can be inserted.



7. Insert two magnetized needles through the holes as shown in the diagram so that the eyelet is properly balanced and free to rotate when placed on a third, vertical needle, as shown.



8. Assemble the complete current indicator as shown (place the eyelet with needles on the top of the vertical 3rd needle so that it is fitted to the tip of the spout on the top of the ink bottle filled with sand.



How to use

1. Place the assembly on the table with the indicator needles freely pivoting on the vertical needle. Turn the unit so that the axis of the coil is perpendicular to the indicator needles (at rest).
2. Now connect the two terminals 'C' to a source of electric current (small current) whose direction is to be determined or whose magnitude is to be compared. For determining direction always use first a standard source (a battery) to determine polarity.

Source: Inventory of Low-cost simple materials, games and toys, prepared by P.B. Dayasiri, School Science Equipment Design Unit, Curriculum Development Centre, Sri Lanka.

BULB HOLDER

Level : All levels
Subject area : Science

Brief description

This is a simple flash-light bulb holder.

Objective

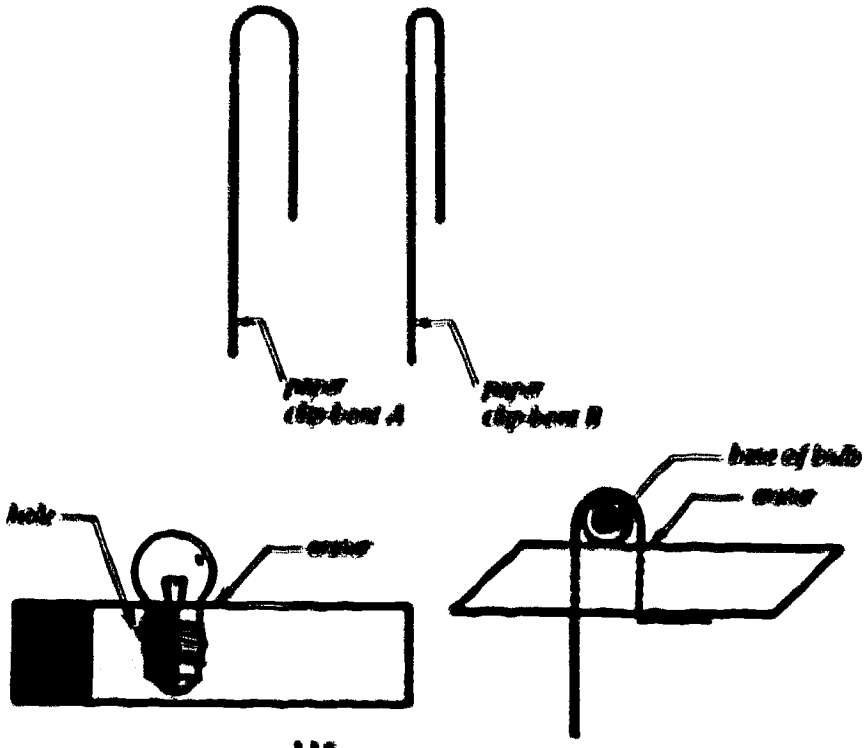
1. To provide to teachers as well as to pupils a good example of improvised techniques in basic science lessons.
2. To produce a flashlight bulb holder for various experiments, made from easily available materials.

Materials needed

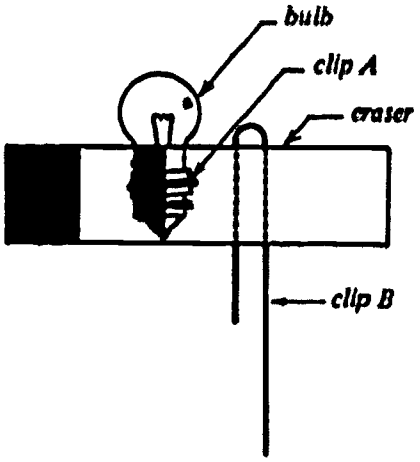
1. A rectangular eraser
2. Two paper clips

How to make

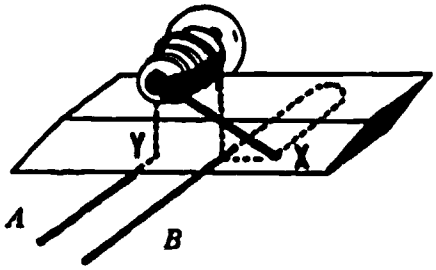
1. Straighten the two paper clips.
2. Bend one end of a straightened clip 'A' around the socket of a flashlight bulb as shown in the diagram.
3. Bend the other clip 'B' into an narrow U-shape with one arm about 20mm shorter than the other (see the diagram).

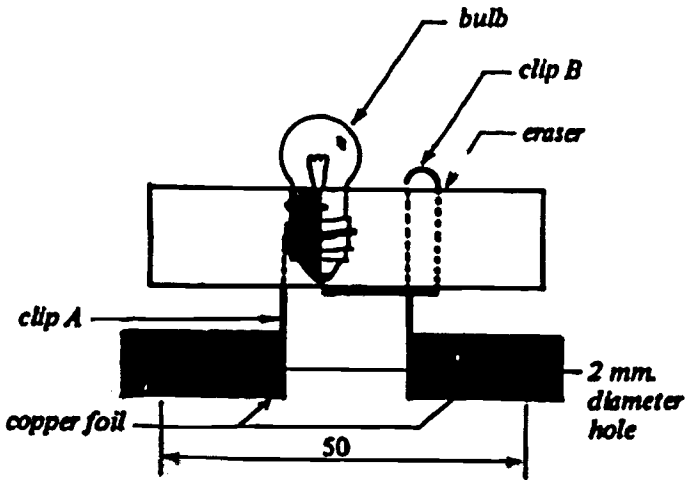


4. Place the socket of a flashlight bulb across the middle of the eraser and make 2 holes in the eraser on either side of the socket with a punch or an awl.
5. Pass the longer arm of the clip 'A' through the hole and press hard into the eraser so that the socket of the bulb is held by the wire-loop (see the diagram).



6. Make two holes in the eraser from one side and pass the other wire loop 'B' as shown in the diagram.





7. Bend the longer arm of 'B' at point 'X' towards the centre terminal of the bulb and make a small bend so as to make a good contact with the terminal.
8. Make a bend 'Y' in the longer end of loop 'A' making it parallel to the free end of loop 'B'.

How to use

1. Screw a bulb into the loop on the eraser.
2. Connect the two free ends of the two paper clips to a low-voltage supply.
3. If the holder is to be used on a simple circuit-board, solder two strips of copper foil each 30mm x 50mm in size to the two terminals of the holder and punch two holes as shown in the drawing.

Source: Inventory of Low-cost Simple Materials, Games and Toys, prepared by P.B. Dayasiri, School Science Equipment Design Unit; Curriculum Development Centre, Sri Lanka.

APEID PUBLICATIONS RELATING TO EDUCATIONAL TECHNOLOGY

1. *Making and using low-cost educational materials: report of a Sub-regional Workshop. 1979*
2. *Report of the First Asian Seminar on Educational Technology. 1980* [1]
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4. *Production and utilization of educational broadcasting programmes: report. 1980*
5. *APEID Inventory: Low-cost educational materials: how to make, how to use, how to adapt. Vol. I. 1980*
6. *Report of the Second Asian Seminar on Educational Technology. 1981* [1]
7. *Low-cost educational materials: report of a Sub-regional Workshop. 1981**
8. *APEID Inventory of Educational Innovations in Asia and the Pacific, EIA Nos. 131-144 (on educational broadcasting). 1981*
9. *Report of a Sub-regional Course on Educational Broadcasting. 1982**
10. *APEID Inventory: Low-cost educational materials: how to make, how to use, how to adapt. Vol. II. 1982*
11. *Low-cost educational materials: a synthesis study. 1982**
12. *Guidelines for repackaging multi-media resources. 1982**
13. *Minicourse approach: what it is and how it works. 1982**
14. *Report of the Third Asian Seminar on Educational Technology. 1982* [1]
15. *Low-cost aids for elementary science teaching in Asia and the Pacific. 1982* [2]
16. *Report of the First Asian Seminar on Educational Technology (third cycle of APEID). 1983* [1]
17. *Report of a Study Group Meeting on Applicability of Advanced Technologies to Educational Development. 1983*
18. *Report of the Second Asian Seminar on Educational Technology (third cycle of APEID). 1984* [1]

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1 Published and available from: Japan Council of Educational Technology Centres, c/o Japanese National Commission for Unesco, 2-2 Kasumigaseki-Sanchome, Chiyoda-ku, Tokyo, Japan

2 Published and available from: National Institute for Educational Research, 6-5-22 Shimomeguro, Meguro-ku, Tokyo, Japan

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