UNIT 12 READING PICTURES – RELATING 2D WITH 3D

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12.1 INTRODUCTION

Spatial abilities consist of the ability to understand, interpret and model the visual world. Also included is the ability to communicate this information effectively through various representations. In the previous unit we have talked about the spatial abilities children usually have. We have given examples of children interacting with the space around them and exploring it in many different ways, so as to make sense of whatever happens and lies around them.

In this unit we consider the ability of children to read two-dimensional representations of the visual world. In Sec.12.2 we look at ways in which young children react to pictures. We also consider the implications of what we find for us teachers.

In Sec.12.3 we particularly look at examples from the textbooks of older children. We find that children often get very wrong messages from such pictures and diagrams. We bring out some of the factors responsible for the kinds of erroneous ideas that they give to children.

In Sec. 12.4 we look at the other area that is neglected in the school, namely, developing in the children the confidence to represent in 2D what they see in 3D. The ability to recognise different spatial properties of objects helps in this. We talk about how recognising symmetry in an object or groups of objects helps in creating this visualisation.

'D' stands for dimension.

Finally, in Sec. 12.5, we shall suggest some activities to help children develop the abilities we discuss in the unit. These tasks are meant to be opportunities for children to read, analyse and/or create meaningful 2D representations of the 3D world around them.

Objectives

After studying this unit, you should be able to

- identify problems that children face when reading pictures;
- identify the misconceptions children can get about phenomena and processes due to diagrams in their textbooks;
- explain the problems children face when representing the world around them through drawings;

- explain why children need to recognise properties like symmetry in an object or groups of objects;
- suggest and try out activities to help children develop the ability to read and visualise 3D in 2D.

12.2 HOW DO CHILDREN READ PICTURES?

In the previous unit we spoke about how far children's spatial abilities are developed. Included in these abilities is the ability to read pictures of the world around us. How far do children of various ages have this ability? In this section we shall try and answer this question.

A child begins to interact with pictures fairly early. Children from different backgrounds interact with different kinds of pictures. Some see pictures on calendars, some see them on hoardings, some see lots of them in magazines, newspapers and books. All of us see how the attention of children is arrested by colour pictures. Some kids have more opportunity than others do for interacting with pictures and seeing photographs of people around them. Some may actually be involved in the process of seeing these photographs taken. Many of them also have access to television, a medium that has moving pictures. Therefore, on the whole, all children do read pictures, some more than others. But, the question is: does a child read a picture like an adult does?

How does a child look at a picture — altogether, or in pieces? Does a 3-year-old pick up from a picture the same information as her parent or older sibling does? We often find children looking at hoardings on the street outside cinema halls and even looking at the covers of pictures in bookshops. What is interesting is the way they share what they see in the picture with their friends, trying to find a meaning to whatever is shown in the picture. If you overhear this, or talk to children reading pictures, you may find that they do not make the same connections as you or other adults do. What a child finds important may be very different from what you may consider important in the picture. She usually tries to relate the picture to her world and see herself in it. You must have seen very young children trying to identify women in pictures with their mothers, or other people with their siblings, or animals with their pets.

This is not the only aspect of young children reading pictures. They may also look at a series of related pictures and not connect them. Consider the following example about this, involving Fig.1, which was narrated to me by a friend.

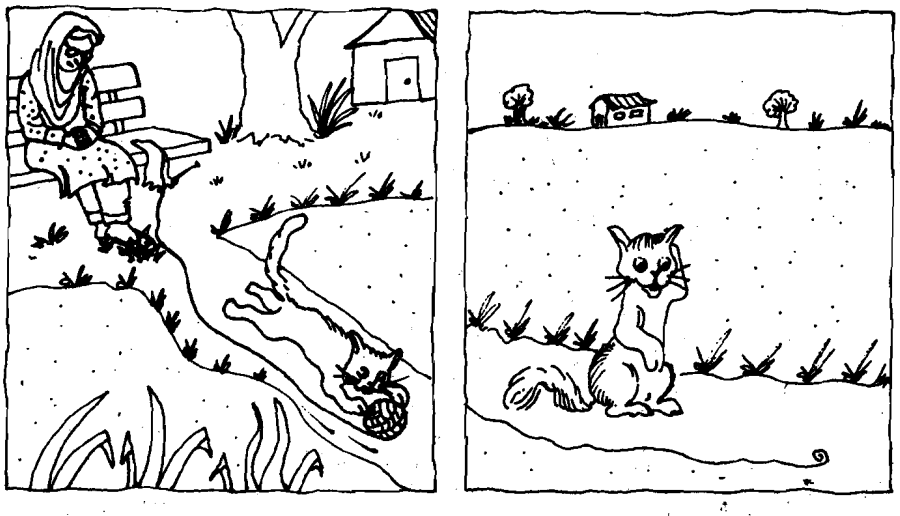

Fig. 1

Example 1: Madhu was telling her 3-year-old son a story from a picture book. Each page of the book had a picture and a couple of sentences on it. The story (and the pictures) were about a cat and a girl. After finalising the story, Madhu was flipping over the pages of the book with the child. Suddenly her son pointed at the cat in two of the pictures (see Fig. 1) and asked, "Which of these is bigger?" My friend told him that both the pictures were of the same cat. But the child seems not to have accepted this because a few days later he asked his mother whether the cat on the cover page was bigger than the cats inside!

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What does this example tell us? For one, the child sees the cat on each page as different. He also does not realise that the size of the picture is not necessarily reflecting the size of the cat. What more? Think about this while trying the following exercises.

E1) Sit with a young child and take her through a picture book. Talk to her to find out if she can make out the continuity in the characters present in the pictures. What other difficulties did this child have in understanding the story?

E2) What lesson does Example 1 have for us teachers?

We often use pictures in order to help children understand a story. Most books for children are filled with pictures with the understanding that the child will look at the pictures, get interested in the book and understand the flow of the story. When we begin teaching them to count, we do it with many pictures and symbols. But, we need to ask ourselves whether very young children do read pictures. Also, if they do, then what kind of information are they extracting from the pictures? Regarding this matter, consider the following instance.

Example 2: A 2-1/2-year-old child was reading a storybook with his father. The storybook had a picture (see Fig. 2), which the child looked at and said, "The dog is bigger than the elephant." As an afterthought, she added, "Isn't it so? ... And how is this elephant standing on top of the house. The house will break."

In the same book there was also a picture of a parrot shown from fairly close. When she came to it, she asked, "Which is bigger? This parrot or the elephant?"

Fig. 2

When the father was narrating these incidents to a friend, he added, "My daughter had seen real elephants many times and had been fascinated by them. She knew that an elephant is bigger than a dog. She also knew that a bird or a dog can easily go under an elephant or sit on the back of the elephant without causing it any trouble. But she did not relate the pictures to the real animals. This was about four years ago. Now, of course, she can easily read all these pictures the way the author meant them to be read.

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What does the example above tell us about the child's understanding of a picture as a representation of reality? Does she understand about proportion and perspective in pictures? It appears that she was not able to relate the objects drawn to the real objects, which were familiar to her also.

Regarding perspective, she did not realise the convention that an object closer to the viewer in a picture would be bigger than an object meant to be further away. This understanding comes gradually.

As children grow, they gradually learn to draw out information from the pictures as the illustrators meant them to. This process, of course, requires that the child be given adequate exposure and opportunity to develop ease in comprehending and extracting information from pictures. The child slowly realises that pictures have a proportion that relate to the actual size of the objects drawn, and that the size depends upon the perspective also. (Of course, some pictures, called **caricatures**, are drawn without proper proportion in order to exaggerate and emphasise certain features and focus attention on certain specific points (see Fig. 3).

Fig.3: A caricature

Since a picture is a depiction of 3D images on a 2D surface, a lot of information about these images gets lost in this process. This information has to be reconstructed when looking at the picture, which requires a knowledge of conventions used for representing it. So when a child is looking at a picture, she needs to learn and use, for example, the convention that what is shown towards the upper part of the picture could be something that is hanging in the sky or could be something behind the objects drawn further below. She also needs to understand that the objects that are nearer the viewer are bigger and the objects that are farther away are smaller. In brief, she needs to understand that **pictures are only representations of reality**, which are constructed using some basic rules and conventions.

To help children understand and become familiar with these rules, we need to give them many opportunities to look at a variety of pictures and talk about them. We should encourage them to periodically share their understanding and ideas about pictures with us and with their peers. This also requires them to listen to the meaning others have found in the pictures.

Think about what you have just read, and try an exercise .

E3) Do the following activity with a very young child (say, a 3-year-old), a Class 5 child and a Class 10 child.
Show the children a picture of a scene that all three would be familiar with. Ask them to explain what they see in the picture. Bring out the differences you note in their 'reading' of the picture.

A child's ability to read pictures is also reflected in what she draws. If you ask a 6-year-old to draw, you would find that her drawings do not reflect appropriate proportions. She would begin by drawing what is uppermost in her mind at that time. As the drawing proceeds, each added object becomes smaller and smaller. For instance, in drawing the map in Fig. 4, the child had drawn a big letterbox, because this was important to her.

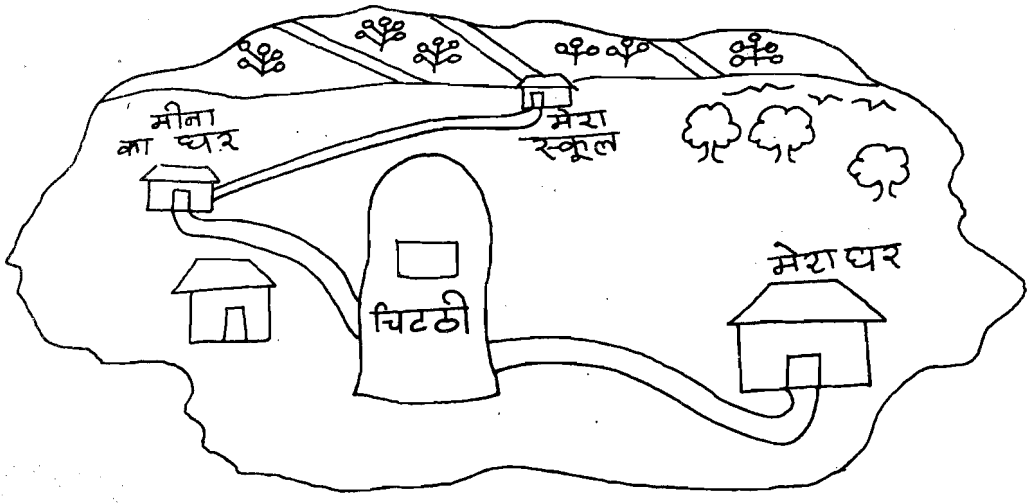

Fig. 4: A child's map of her locality

This subjectivity in drawing pictures is also sometimes reflected in reading them. For instance, a friend told me that her 4-year-old child, while looking through a storybook, complained that the tiger was not made big enough. The argument was that the tiger is the strongest of all animals and hence it should be the biggest!

Children in early primary classes, if asked to draw a picture of their street or the room they are staying in, tend to keep themselves at the centre. This is the egocentricism that we mentioned in Unit 11. Regarding this matter, we conducted a study in a school in which the children were asked to draw their classroom. Some of them began with the teacher's desk, making that the biggest object in the classroom. Many others made their own desks much bigger than the other desks in the classroom. In drawing the pictures, the children represented the legs of desks and tables in all kinds of ways. They made things that were small but important to them much bigger than their size required (see Fig. 5).

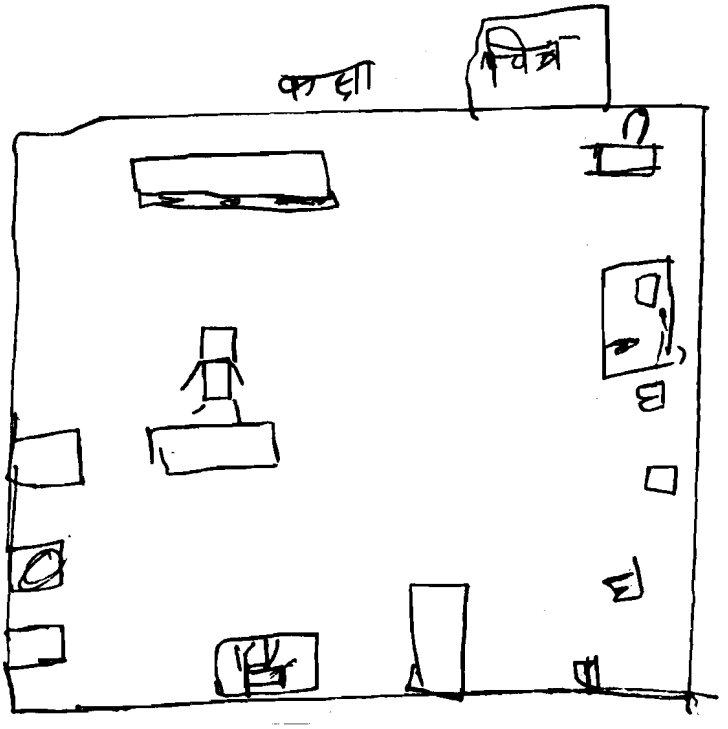

Fig. 5: A child's representation of her classroom

Try this exercise now.

E4) Ask a group of children between the ages of 9 and 12 to draw a room or a building. Look at the pictures drawn and the manner in which they have used proportions in them. What conclusions can you reach from these drawings?

The discussion above indicates that children need to learn how to read and draw pictures in a way that they can meaningfully exchange ideas with others. These abilities develop gradually only with repeated opportunities of sharing what they have drawn with others, talking about the picture and what it conveys to them. Unfortunately, there is very little space in the curriculum for such activities. Where do we give children an opportunity and a challenge to represent what they see in a way that communicates appropriate information to others? Of course, we do use a lot of pictures in our textbooks and on the boards because this is an important mode of communicating information. But, are they really communicating to the children what we are trying to teach? We shall look at this question in the next section.

12.3 WHAT MESSAGES ARE THE PICTURES CONVEYING?

Let us consider some examples of pictures supplementing the text material, and what the children extract from them.

12.3.1 The Seasons

To start with, let us consider the text material used for teaching children about the seasons. A typical textbook shows a picture of the earth orbiting the sun. The picture also indicates the position a certain hemisphere has summer, and when it has winter (see Fig. 6).

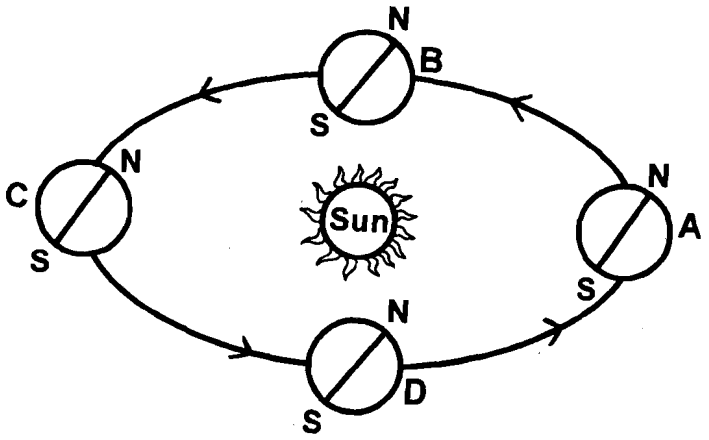

Fig.6: A textbook picture showing positions of the earth around the sun

As you can see from the figure, the orbit of the earth is shown to be elliptic. The earth is shown at four positions — at both ends of the major and minor axes of the ellipse. The exaggerated difference between the major and minor axes is probably intended to show the children explicitly that the orbit of the earth is elliptic. In actual fact, the size of the two axes is nearly the same, that is, the orbit is nearly a circle.

The picture used, unfortunately, misinforms more than it helps in building any understanding for the child. A common inference that children draw from the picture is that summer occurs when the earth is closest to the sun. This could be because they relate the heat and cold of summer and winter to being closer and farther away from a fireplace.

It is not just the children who draw such inferences. Many of us draw similar conclusions and construct our own explanations from such pictures. You may have realised that the pictures drawn in the textbooks do not take into account the relative distances involved. The fact that the orbit is nearly a circle is ignored.

We also forget that if the distance of the sun and the earth is as in the picture, the earth cannot be more than a dot and the sun a bit more than a big dot. The book illustrators and writers overlook these aspects too. Nowhere is the child given the opportunity to visualise the relative sizes and distances. And, visuals have such a strong impact that the child or the teachers form their understanding of the relative sizes from them.

The exercises below may help you in further realising the care required in creating pictures in the text. You may also realise the need for making the children conscious of actual relative proportions when using pictures.

E5) Ask children between Classes 7 to 9 to visualise the sun if the earth is the size of a pea. What kind of images did they come up with? Also ask them why the temperature is different in June and December. What were their reasons for arriving at their answers?

E6) List two other concepts which require a visualisation in three-dimensional space. Give illustrations to bring out the kind of difficulties children face in dealing with them.

The primary school textbooks also carry diagrams that depict a process or certain relationships. Let us see one such example.

12.3.2 Processes Through Pictures

The usual textbook uses diagrams to convey information about a process very often. For instance, they explain about the life cycles of living beings, the food chain in the plant and animal world, or a production process in industry with the help of such pictures. However, if you ask children to read such pictures, don't be surprised by their answers. In fact, try this as an exercise.

E7) Take a Class 4 or 5 Environmental Studies textbook. Pick a picture, or a series of pictures, representing a process. Examine it for the information it conveys to you. Find out from some children who are using the book what the picture means to them. Note down the differences, if any, between the two 'understandings'.

Let us, consider what one study told us about what a picture of the life cycle meant to some children. Groups of children from Class 5, 8 and 9 were separately asked to look at Fig. 7.

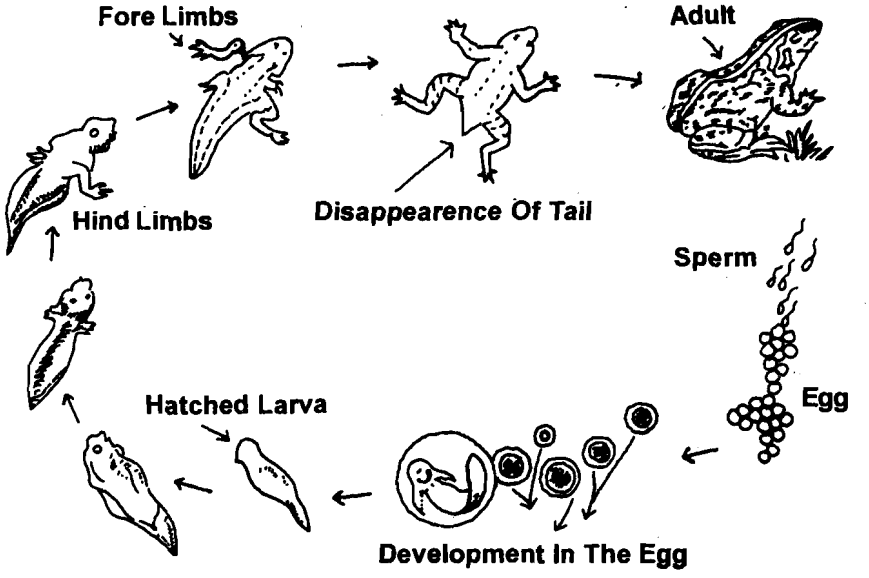

Fig 7: The life cycle of a frog

In response to questions regarding the size of a frog's eggs, the answers from children varied from a few centimetres in diameter, to showing a small gap between the thumb and the forefinger. One of the Class 4 children looked at the picture of the eggs and called them bubbles, but corrected himself later. Children of Class 8 and 9 were able to recognise the sperm and the eggs in the picture, while younger children could not make any sense out of these. Many children said that

the larva is formed by the fusion of many eggs. Some children were convinced that 5 eggs make one larva and 5 larva give a frog.

There were many other such misconceptions. Many of them could have been corrected by talking to the children about the picture. In fact, when the teacher began asking a few simple questions, the children were led to realise that a frog's egg can't be seen with the naked eye.

For another example of misinformation through diagrams, consider children's reactions to Fig. 8. This shows the food chain between plant food, herbivores and carnivores.

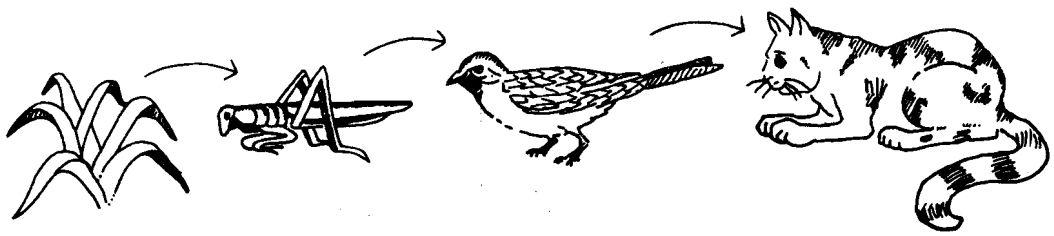

Fig 8 : A food chain

The picture is accompanied by text describing it. However, this is not enough for the child to answer, for instance, how many herbivores are required for carnivores like big cats to survive in the jungle. Similarly, the amount of foliage needed for supporting that many herbivores does not come out from the picture or the text. When children from Classes 4 to 10 were shown this picture, many of them were of the opinion that one forest can only have one lion and one lioness. They had some notion of the amount of meat a lion required for one feed, but they had no idea of the proportion needed to keep the population balance. While children were able to talk about many kinds of food chains and give examples, they had problems in speaking about the numbers required for an ecological balance. The food chain picture gave them the feeling that each animal required only one other animal for survival. From the picture, it is clear that the relative proportions of different plant and animal life were not taken into consideration while drawing it.

Another aspect of these process pictures and depiction of cycles of events is the arrows used in them. What do these arrows mean to a child? Do they indicate the direction in which the pictures have to be seen? Do they indicate that the things in the earlier picture get transformed to those in the next picture? Arrows in a single picture can mean several things. These 'different understandings' are not true only of children. The conventions are culture-dependent, a fact that comes out beautifully in the following example reported in the Sewa Mandir Newsletter.

Example 3: A group of urban people went to a village for a project regarding visual communication. They showed several pictures to the villagers, and asked for their reactions to the pictures. They also asked the villagers to read the picture shown in Fig.9.

There were no immediate replies. After quite a bit of discussion in one group, one of them said, "This one seems to be a man hoeing, this one is planting, ..., this one is harvesting the crop". "Fine!", said a surveyor, "So, what are these things (*pointing to the arrows in between*)?" The villagers looked at each other, discussed a bit more, and one of them finally said, "Must be water pipes for the field."

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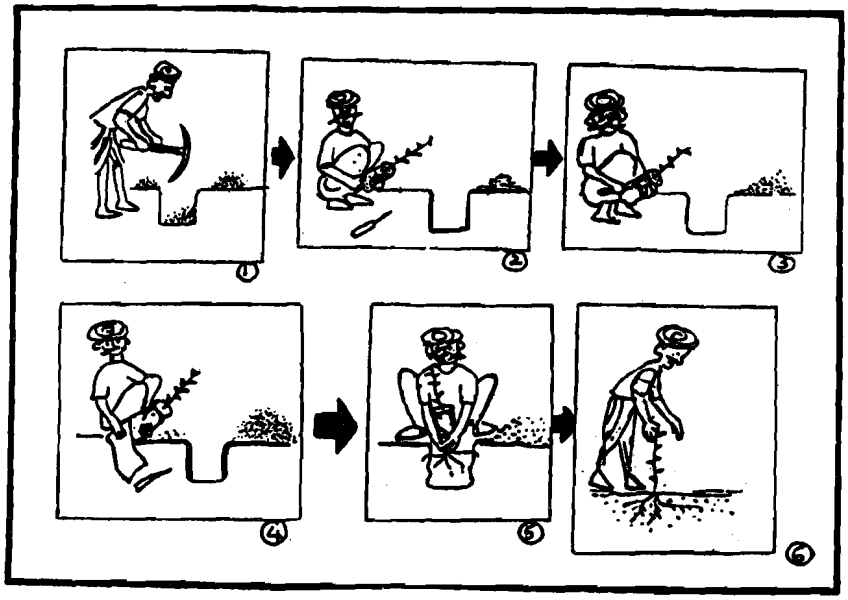


Fig.9: A process diagram

To summarise, the pictures drawn in such diagrams are often of things that the child has never seen. There is no indication to the child about the convention used while relating different objects in a picture — their sizes, positions, etc. This is particularly important because the pictures have been simplified and are only schematic representations. For them to be useful as a source for communicating information, we need to develop the ability in children to understand such representations. Here is an exercise about this matter.

E8) Ask some Class 5 and some Class 8 children to represent a process of some local industry, say making bricks. Ask them to explain their diagrams, including the conventions they have used. What observations can you read in the difference, if any, in the abilities of the two groups of children regarding this matter?

E9) Give 3 implications of what you have studied in this section for you as a teacher.

You have just observed some problems children face when they try to 'read' pictures. Let us see some examples of how children try to represent the world around them in 2D.

Fig.10 : A child's drawing

12.4 CHILDREN'S DRAWINGS

Let's begin this section with a look at a drawing by a child (Fig. 10). We may not find this and other such drawings very meaningful. We may feel that they do not convey anything. However, for the child these lines can carry fairly elaborate meanings. But if these meanings are to be communicated to others, the children need to learn some picture-related conventions. They also need to be able to discern some spatial properties like symmetry in objects or groups of objects.

How does an understanding of this property help? Suppose you are asked to look at any object from one position, and draw it from various sides. For instance, let us consider a ball. If you were to draw it, you would find that it looks the same from any point equidistant from it in any direction. This is because you realise that any line through the centre of the ball is an axis of symmetry, that is, a ball has

See Unit 19 for a detailed discussion on rotational and reflection symmetry.

infinitely many axes of symmetry. In fact, it has infinitely many planes of symmetry too.

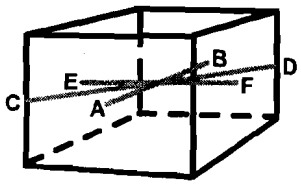


Fig.11: A cube

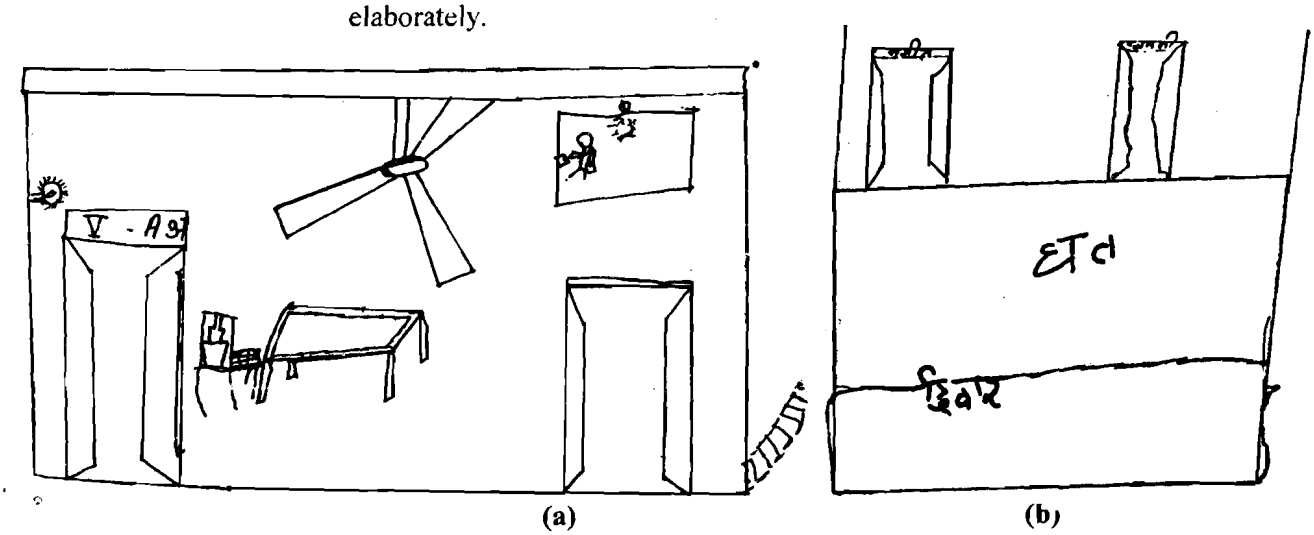
Now suppose you place a cube-shaped box a couple of paces away from yourself (standing facing A in Fig.11), and draw it. Next, suppose you want to draw it as if you are looking at it two paces behind B in the figure. What is the difference between the two pictures? Similarly, if you draw the box, looking at it from behind C, will it be different from drawing it when standing behind D? Do you need to draw all four pictures, or can you make a prediction about two of them after drawing only two pictures? In fact, you can, because the cube has **rotational symmetry** with respect to the line EF, as well as with respect to AB and CD. In fact, you can find many other axes of rotational symmetry.

Fig.12: An irregularly shaped object

Now, suppose you are asked to visualise the stone shown in Fig.12 from different positions. Could you use symmetry to help you? You would actually get different views from different positions since this has no reflectional or rotational symmetry about any plane or line.

So, drawing objects will be an easier task for you if you can find some symmetry in it. The same is true for children. However, the school curriculum does not realise that visualising and utilising the property of symmetry is an important area of development for children.

There are several other spatial properties that are useful for visualisation of the world around us. The school curriculum does not have place for many of these. Consequently, the ability to represent 3D in 2D is very under-developed in older children also. This comes through from the following task given to children of Class 5. They were asked to draw pictures of the classroom as it would appear to them, if they looked at it from the top. The pictures (an example is shown in Fig.13) clearly show the struggle of children to visualise what an object would look like from a position which is different from where it is usually seen. The issues involved can be seen more clearly from the picture of the table and the objects placed on it. The implications of the pictures in terms of proportions of different objects as well as the nature of the shapes, bring out the process the children are going through. If you look at their attempts, we find that the children have drawn benches in different shapes. The same children, when asked to draw the picture of the classroom from the front, were able to do much better. Even here, the ratios and proportions of pictures drawn were not factual —for instance, the doors and windows were made comparatively bigger with designs on them shown elaborately.



(a) (b)

Fig.13: A Class 5 child's visualisation of her classroom (a) from the top, (b) from the front.

Why don't you try these exercises now?

E10) Ask a group of children to draw a picture of their houses as they would appear from the top, and then draw them from the front. Analyse the pictures in terms of which elements are highlighted in them and which are completely overlooked. Study the proportions used for different components in the picture also. What does this analysis reveal to you about their spatial sense?

E11) Why do we need to develop in children the ability to recognise symmetry?

So far we have given several examples to show something that all of us would agree on by now — that many children are not ready to draw or read pictures the way we would like them to. So, how can we remedy the situation. Let's talk of that now.

12.5 WHAT WE CAN DO WITH CHILDREN

It is not difficult to think of tasks that would help a child sharpen her ability to read and draw pictures. For example, consider the following tasks.

TASK 1: Children could be divided into groups, and each group given a picture showing a variety of objects and/or a variety of events taking place. Of course, all the objects and actions should be familiar to the children. Each group could look at the pictures they have, and discuss among themselves which objects they can see in the picture, what is happening in the picture, what are the farthest things from a particular object, which of them is in front, which is behind, which is above something or below something, etc. Each group could then describe whatever they see in the picture to the rest of the children. While the children are looking at the pictures, the teacher could sit with each group turn by turn and help them look carefully at the picture they have. She could prod them to talk about it, and familiarise them with several space related words.

If all the children have the same picture, the class could play a game to develop their spatial sense and language. In the game one group asks a question which has to be answered by another group. For example, the question could be "What is the thing that is behind a tree and in front of the building?"

TASK 2: You could have a series of pictures that describe a process broken up into different stages, for example, the life cycle of a plant. The children could be asked to organise and arrange these pictures in a meaningful order such that the connection between one picture with the other is clear. If this is a group activity, they may like to discuss the pictures with each other. However, **each child** should be required to articulate the reason for the specific order in which she places the pictures. It is this articulation that will help her clarify her understanding.

TASK 3: You could collect or make a chart of a series of pictures that are related to each other in some way. These pictures need not display the same action. Nor do they need to have nearly identical items in all respects. Children divided into groups can be asked to look at these series of pictures and think of a story connecting all of them. The children should be free to add from their imagination. However, the stories should be such that the importance of the pictures and the children's interpretation for each are brought out in them.

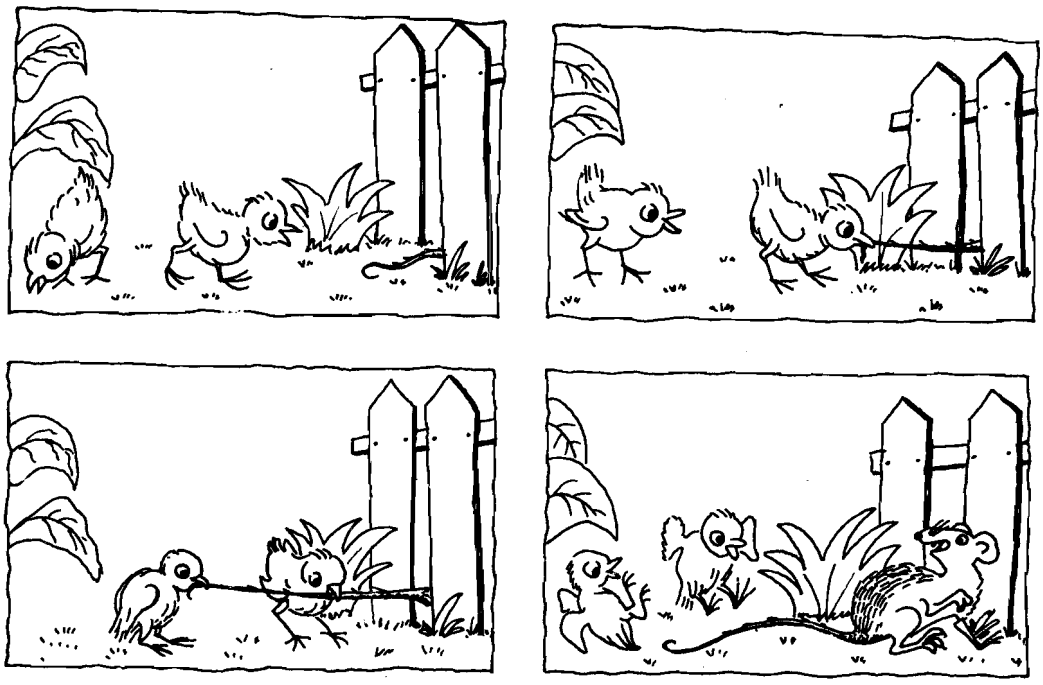


Fig. 14: An example of pictures used in Task 3

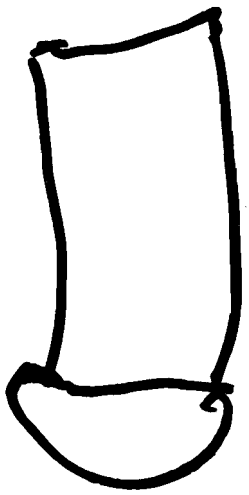


Fig. 15: A 5-year-old's drawing of a glass

TASK 4: Give children plenty of paper and coloured pencils or crayons. Ask them to draw whatever they want to. Then ask them to share what they have drawn with the rest of the class, or group. Having a dialogue with children about what they have drawn always encourages them to articulate their ideas.

As we have observed earlier, children's drawings are not always understood by adults. As children grow older, their pictures become more discernible. At this stage if you ask them what they have drawn, you could find a more focussed answer, allowing you to ask whether they would like to add some details in the picture in order to make it better than it is. You can talk to them about what is happening in the picture and encourage them to add more things to it. This kind of interaction with children about their pictures helps them draw up a better visualisation and pictures.

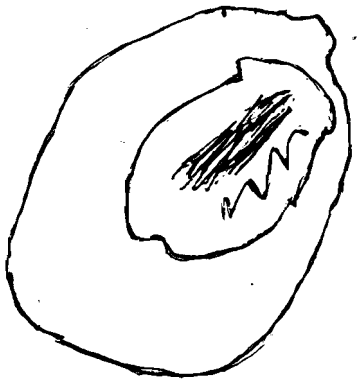


Fig.16: A 3-year-old's drawings of two stones, one on top of another. The squiggle in it is his signature.

TASK 5 (This is for older children): Give each child an object to draw from different angles without her moving around it. This would require her to imagine what the object would look like from different points and from different directions. Encourage her to look for symmetry in the ways groups of objects are placed around each other.

You could also place groups of objects in a symmetric manner and ask her to draw them from the front, and imagine them from the top. You could also show her a picture involving objects around her and ask her to place the objects as shown in the picture.

Either way, talk to her to see how far she realises the symmetry in the objects or groups of objects. Through smaller tasks you can build on this understanding of symmetry.

OTHER TASKS

There are many ways in which other mathematical abilities can be developed while developing the spatial abilities of children. For instance, consider the following activities that can **develop children's problem-solving abilities also.**

- They could play "20 questions" about the identity of geometrical solids.

- Children could be encouraged to use drawings to understand and solve word problems.
- They could also be asked to build and use physical models for solving problems.
- You could give them problems built around board games (like snakes-and-ladders) for solving which they would need to use manipulatives.

The kind of activities we have just suggested, or others that you evolve, can be given to the whole class. While the children are involved in doing them, **you could go around the classroom**, spending a few moments with each child, helping her to look at pictures given to her or drawn by her more carefully. **Any activity is meaningful if the child is interested in it**, and is encouraged to talk about what she is doing in it.

Here's an exercise about this now.

E12) List at least 3 activities that can help children simultaneously develop
   i) their spatial and mathematical reasoning abilities;
   ii) their spatial ability and the ability to make connections and find patterns.

E13) Recall the guidelines you studied in Unit 7 for developing activities. How would you rate the activities you have suggested in E11?

Let us now close this unit with a quick look at what we have covered in it.

12.6 SUMMARY

In this unit we have discussed the following matters.

1. Children's abilities to read information from pictures and to visualise and express ideas.
2. The present textbooks do not adequately keep in mind the development of this ability in children. They do not think about what children will get out of the illustrations.
3. How children's drawings are often lacking in proportion, perspective, position, etc. How spatial properties like reflectional and rotational symmetries in an object can be useful for representing them in 2D.
4. Classroom activities to help children acquire the ability to read pictures and represent the world around them in 2D.

12.7 COMMENTS ON EXERCISES

E1) For example, consider the following questions: Was the language clear to her? Was she seeing a different story in the pictures? Did she consider each picture as having completely different characters? What was the reasoning behind her statements regarding these matters?

E2) Teachers try to teach concepts through the use of 2-dimensional representations. But the children may not be capable of reading the pictures as the teachers expect them to be read. How children relate to 2-D representations needs to be understood by the teachers before using them.

Only, then can the children and teacher communicate. What else can teachers learn from this example?

E3) You could also ask the children questions to help them look at the issues involved carefully. For example, you could ask about proportions, near-far, etc. What are the main differences between the responses by children of different ages? For example, there may be a difference in perspective.

E4) From the pictures drawn try and identify the common pattern. Are their proportions for different places depicted similarly? What have they given importance to in terms of size, what have they made small or ignored? How have they kept track of the direction?

E5) Allow children to voice their ideas without any fear. Record them in your mind. You can, then, give children basic data about distances and again ask them to make estimates of the relative sizes. Record what they say again. Compare these estimates with the actual proportions. What is the order of magnitude of the difference you find?

Did some of them say that the temperature difference is because the earth is nearer to the sun in June? Did some others say this is because the axes are inclined? Whatever their reasons, ask them why these factors make a difference? Is it because the rays have to travel farther and lose their energy, or because they spread more and become less intense? Or, is it some thing else. Listen to their explanations carefully and record them. Do their answers change, if relative sizes are told to them? If so, in what way?

E6) Take, for instance, how eclipses occur. Children are shown pictures of the positions of the moon, earth and sun at different points of time to explain this phenomenon. They are told that when the earth comes between the sun and the moon there is a lunar eclipse and when the moon comes between the earth and the sun there is a solar eclipse.

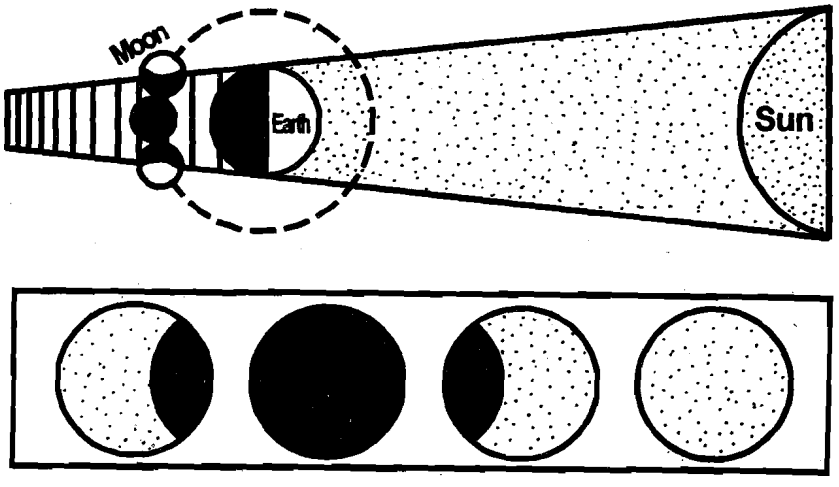


Fig. 17: A picture explaining partial and total lunar eclipses in a typical textbook

They are also told that when the moon faces the sun in such a way that reflected light falls back on the earth then we have a full moon night. Further, when it is between the sun and the earth in such a way that no reflected light can reach the earth, we have a 'no moon' night. An obvious question that arises from these descriptions is: Why is there no lunar eclipse on each full moon night?

Most of us may not have thought about this. We do not provoke children to think about such questions either. In the classroom our emphasis is only on telling them child some facts about the positions and some relations derived from these positions.

Think about other such examples.

E7) A lot of information is contained in process pictures. It is supposed that the child will be able to derive this information and separate the information from the pictures. We expect the child to get correct information about relative sizes of the objects depicted. We expect her to correctly conclude about relative ratios in different stages or in different components of the pictures. Are we right in our expectations?

Consider all these, and other related issues, while getting the children's replies.

E8) The process that you asked them to represent should have been seen by them earlier. If possible, choose the same process for both groups. Examine the two diagrams. Have the children in both the groups shown the same kind of pictures and broken up the process in the same way? What are the symbols they have used? What are the other differences that you see between the two sets of diagrams?

E9) For example, if you are teaching Class 3 you may feel that it is necessary to talk to children about pictures and ask them to articulate what they understand from a picture. You may give them tasks of relating texts to pictures and adjoining correct texts to the correct pictures.

You may also think of many other such implications for Classes 6 to 10. For instance, you may like to re-examine, with these children, pictures given in their textbooks to explain phenomena. Ask children to interpret such pictures and give them a notion of correct proportions and representations in the diagrams being studied.

What other implications are there for your classroom?

E10) You could look at the pictures from many angles. For example, you may find that the proportions are not according to the actual sizes. You may find that some objects are not placed as they actually are in relation to other objects, or it may be that the perspective in drawing different objects keeps changing. Or you may find that certain elements are given more prominence, and therefore, drawn bigger. You could also compare the diagrams made from the front as well as from the top for any difference from these aspects. Write down whatever you can gauge about their spatial abilities.

E11) The need to understand the symmetry helps in making a better visualisation, helps in anticipating positions as well as improves the aesthetic sense. There may be other uses which you may be able to think of, for example an increasing ability to identify patterns in nature and forming rules. These patterns could be in plants or other materials around us.

E12) i) For example,

a) using paper-folding to prove that $\frac{1}{2} = \frac{2}{4}$,

b) building models to prove relationships between similar triangles.

ii) a) Analyse why so many triangles are used in cranes.

b) Explore relationships between squares and rectangles, or between circles and spheres.

E13) Once you have thought of the activities, compare them with the guidelines you made in Unit 7. The guidelines included participation of children, space for thinking by children, absence of memorisation, etc. Look at all the p oints in the schema of an activity and compare them with the activities that you have suggested. Based on this analysis, rate the activities you have made.