UNIT 8 LEARNING TO HANDLE DATA

Structure **Page Nos.**

8.1 INTRODUCTION

In this unit and the following one, we will talk about the basic ideas involved in introducing the handling of data in primary school classes. A question that people ask is if data handling is an area of mathematics that requires separate attention. We try to answer this in Sec. 8.2, while discussing what data is.

A doubt that some people have expressed is whether primary school going children need to and can handle data. In Sec.8.3 we talk about data handling that children do in any case, and what related tasks can be introduced in the classroom. We hope to convince you that day-to-day activities of children as well as adults involve handling data. Thus, we need to help children acquire some techniques that will be useful in this.

To share data, we need to record and display it. In Sec.8.4 you will study some techniques of recording data. These are not new to you. The only new suggestion being made here is that children in primary school can learn and use them. In fact, we suggest some activities for children that will help familiarise them with various ways of recording data. Similarly, Sec.8.5 contains some ideas for introducing children to techniques of displaying data. We are suggesting here that children can learn to use them at an early age. We, as teachers, can introduce some of these techniques through activities to be done in the classroom, even if the curriculum does not formally mention data handling as an area of mathematics.

Of course there is a lot more to data handling than gathering and presenting it. We deal with the other aspects in the next unit.

Objectives

After studying this unit, you should be able to

- explain what 'data' and 'handling data' means;
- explain why primary school children need to and can gather as well as present certain data;
- suggest activities that can help children develop their ability to gather and represent data.

8.2 WHAT IS DATA?

The word 'data' is the plural of a Latin word 'datum', meaning 'given'. You may be familiar with the use of this word in some contexts. But you may still wonder about what 'handling data' is doing in this course which is meant for those who teach elementary school children. To see why we have included it, let us understand what 'data' means, and why data handling is important.

It is often said that we live in an age of information. During the last fifty years or so, there has been a great increase in the availability of information. Thanks to newspapers, magazines, radio, television, cinema and newer and newer technologies based on computers, we are exposed to a lot of information. **Data is information**. Usually, we consider data in the context of a situation that we want to study. For instance, if we want to know how many people are literate and upto what level, we will look at the pertinent information, i.e., the relevant data. We will gather this pertinent data and present it in a systematic manner. Now it will have a certain objective — to be able to infer various levels of literacy and education of the population.

So, when we usually talk of data, we look at it as **information collected in a systematic manner with the aim of reaching certain related conclusions**.

In newspapers or magazines, you will find several examples of data, like the prices of essential commodities, the departure times of trains, the names of theatres where various movies are running, etc. We have shown you some examples in Fig. 1 below.

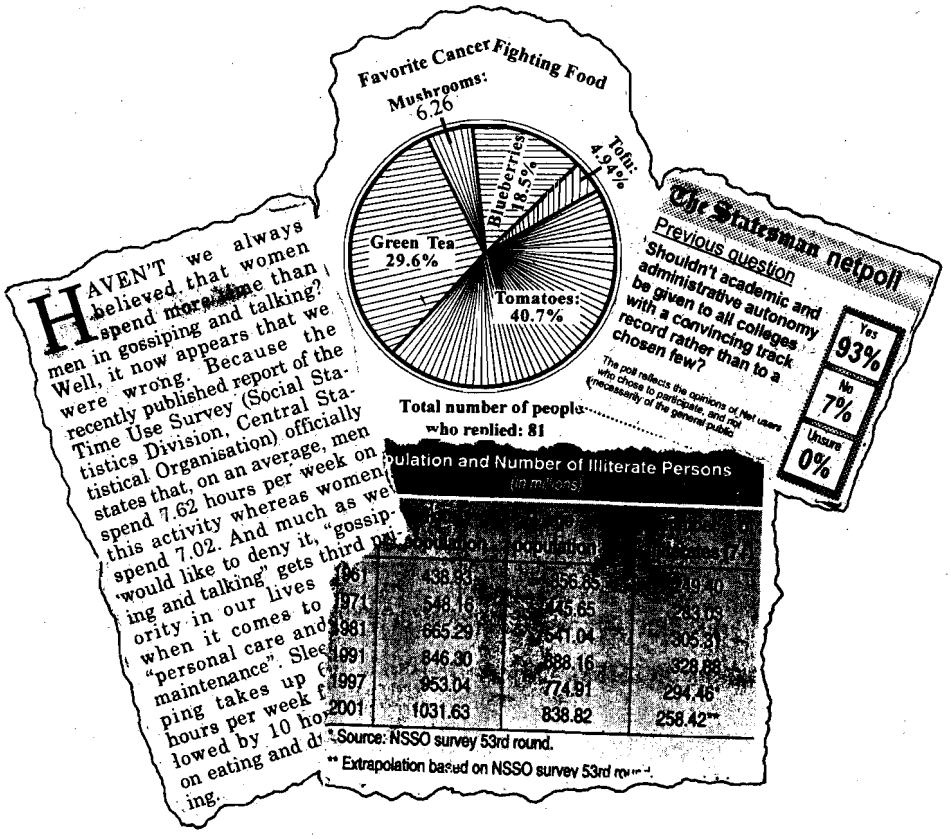

Fig.1: Data of various kinds

The weather, of course, is a daily source of fresh data. This is what the following example deals with.

Example 1: According to my newspaper, we are in the middle of a heat wave this June. The maximum temperatures in Delhi during the last seven days have been given by the newspaper as below:

Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Max. temp. (Celsius)	45.6	44.7	46.2	46.0	46.5	44.7	43.3

These given numbers carry some specific, quantitative information about the heat wave. The newspapers also carried some related information. The Monday papers, for example, told us that Sunday had been the hottest day in 50 years.

? Did the collective presentation of the data by the newspaper help in any way? Would there be any problem if it had not been used?

? Can you make any additional statements related to the data above, for example, that Thursday was the hottest day in 50 years?

From Example 1 we see that even simple data had to be organised so that we could easily make sense of the information contained in the numbers. There were natural questions that arose and could be answered from the data, for example, 'Which day in this week was the coolest?'. What other questions arise in your mind from this data?

Data isn't always in the form of numbers, as the following example shows.

Example 2: A group of children were playing street cricket. I began wondering about the kinds of comments children made in such situations. So, I decided to gather any data I could regarding this matter. I decided to hang around the impromptu cricket grounds to observe the children playing, and to pick up any remarks made by them. Over the next few days I heard them making comments like "See me bat like Azharuddin", "My bowling is like Akram's". Apart from the ones above, at other games I heard the children yell out:

- That was a great catch, Rahul!
- He's an allrounder, our Kapil Dev.
- My sister is the Tendulkar of our team.
- Amar is a brilliant batsman, like Lara.
- Rahul is like Jonty Rhodes, such a brilliant fielder.

Looking at this data, I gathered that none of the girls or boys playing said they were emulating a female cricketer. I could also infer that the children weren't restricting their heroes to Indian players only — their heroes were international!

? What conclusions would you arrive at from this non-numerical data?

———— × ————

What we have done in Examples 1 and 2 is to **sort (categorise)** some information we have in a systematic way. Then we have analysed it and drawn some conclusions from it. These processes, put together, form what we call 'data handling'.

Fig.2: Gathering data while playing

Why is data handling not a part of the primary school curriculum? I happened to be present at an interesting discussion on this subject. The participants, Anamika, Butt, Charan and Devi were all actively involved in developing ideas for teaching mathematics in the primary school. But it seemed that this was the first time they had sat down to talk about data handling in schools.

Anamika: Data handling is a neglected area of school mathematics. It's not taught at all in most schools. In fact, it's not even recognised as a separate area of mathematics.

Butt: But is there any need to teach it separately?

A: I'm not saying you go to the class and announce "Today we will do data handling". But people should at least be aware of it as an area of mathematics that children need to learn.

Charan: I wonder if children can really learn it.

B: But it's nothing but arithmetic, right? And children do enough arithmetic in school.

Devi: No, no, data handling is not just arithmetic.

B: Why not?

D: Well, it involves special techniques.

A: Besides, a lot of data handling doesn't even require much arithmetic.

B: I'm not convinced. If children can perform operations on numbers, they can operate on data.

A: All data need not be numbers.

B: Can you give an example?

C: May I interrupt for a moment? Even if we agree that data handling by itself is an area of mathematics, is it relevant for small children? They can't learn these special techniques, right? So maybe we should forget about it for the primary classes.

A: I feel it should be included in the curriculum. I think it hasn't been included so far because we are following curricula and textbooks that have not changed with the times.

D: Yes. Also, we spend so much time on teaching children how to carry out multiplication, division, etc., that we don't give them time for anything else.

The discussion continued, but this was enough to set everybody thinking. Here's a chance for you to note down what you think about what we have just discussed.

E1) Do you agree with Butt's statement that data handling is just doing arithmetic? Why? Also give an example of non-numerical data.

We will come back to the issue of teaching data-handling in schools. First, let us see whether data arise in our daily lives in ways other than through newspapers and TV reports. The question is: Do our own activities, in our homes and our places of work, **require** us to handle some kinds of data? The following example may give you some idea about this.

Example 3: Madhu teaches in a primary school. She was sure that she does not deal with data in her daily life. When I asked her how many children are normally present in her class, she said, "About thirty, no, twenty-five." Some days later, she brought a piece of paper with the following numbers on it:

16, 21, 23, 28, 30, 25, 28, 24, 31, 26.

"What's this?", I asked.
"These are the attendance figures for my class," she said, "the number of children actually present on the first ten working days of July. Everyday, on the blackboard we write down the number present on that day, and I keep a record of the figures."
"So you seem to be handling quite a bit of data", I said.
"Yes, you're right. I have been thinking ... I do handle this and other kinds of data. For example,..."
And she gave me several other examples of data that she gathers or comes across in her day-to-day activities.

———— × ————

Here's an exercise about the points we have tried to bring out in the example above.

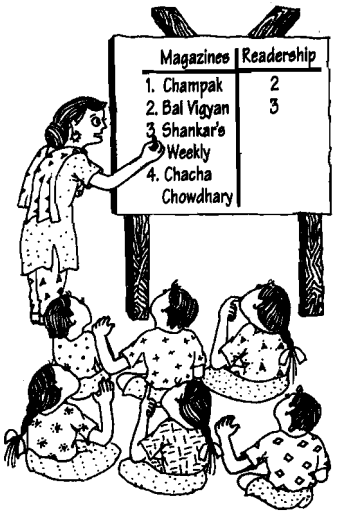

Fig.3: Gathering data in the classroom.

E2) a) Madhu changed her view on data-handling in daily life. Do you agree with her present view? What other kinds of data do you think a primary school teacher would usually be handling?
b) Do you think the attendance data could be better organised? If so, how?

E3) Give at least **two** examples of data that you handle in the course of your work, and at least **one** example of data that you handle in your other activities.

The examples in this section have related to data that we, as adults, come across and need to handle in some form. But we are still left with the questions: Do primary school children need to learn methods of handling data? If yes, what do we, as teachers, need to do to help them develop this ability? We turn to these questions in the next section.

8.3 CHILDREN AND DATA

In the last section we saw that we, as adults, handle data in all sorts of everyday contexts. Children, too, are often engaged in activities that require handling data. One common source of data is television. With the wide spread of TV, it is likely that most children you teach will have some access to it.

According to 'India 2000', 87% of the Indian population has access to TV.

Children may also generate data through their own games and activities, as in the example below.

Example 4: Roshanara was teaching Class 3. She found some children in her class playing the following game. When they reached school in the morning, each of them made a guess about the number of children present that day. They wrote their guesses on slips of paper. Later, when the teacher wrote the attendance figure on the board, they compared it with their slips. Whoever had the correct figure was the winner. At first Roshanara thought they were just counting, but then she realised that the figures were written before the whole class had assembled. When she asked them about the game, at first they were reluctant to talk about it. Then one of them said, " We know that 26 were present yesterday." So they were keeping track of the previous day's attendance!

Roshanara decided to turn her discovery into a game for the whole class. On the board she began to write the attendance figures for the previous two days, in addition to the current day's. Everyday all the children would write their guesses based on estimates from the two earlier days, and hand over their slips to Roshanara. On most days, several of them guessed right. One of the children was given the responsibility for a week of maintaining a record of who had guessed right how many times. At the end of the week, Roshanara gave a toffee to the one who had the highest score. However, she gave up playing the game since it was taking too much time and attention from the class.

——— × ———

Why don't you do some related activities now?

E4)a) Find out what TV programmes children in your neighbourhood watch. Note down instances from these programmes which put out or generate data for the viewer.

b) Look carefully at any two outdoor games played by children in your neighbourhood. Find out whether these games generate data for the players and, if so, in what way.

When I told another teacher about Roshanara's game, she protested, "All this is fine, but what kind of classroom activities can I find for my 5-year-olds who can't even write numerals properly? Is it possible to invent something which can be done by the whole class?" I, then, told her about the following activities that have been tried out in some primary schools in Delhi under the School Mathematics Project.

Activity 1: On a big piece of chart paper, the teacher (or older children) makes a chart with twelve columns, corresponding to the months of the year. Each child is asked to bring an empty matchbox from home, and to mark it in any way. (In one school, white paper was stuck on each matchbox, and children drew patterns of their choice on the paper.) Each child pastes her matchbox in the column corresponding to the month of her birth. So the chart can look like the one in Fig. 10, Unit 7.

The teacher can then prod the children into thinking about questions like

- in which month do we have the most birthdays?
- in which month do we have the least birthdays?
- how many birthdays fall in the first three months of the year?

The children can themselves ask other questions and draw several inferences, some of which may surprise you! (This was tried out in Classes I and 2. The report from all the schools was that children greatly enjoyed the activity, and were getting a feel for analysing data.)

Activity 2: The teacher cuts out thin long strips of paper and hands them to the children. Each child measures the circumference of her head with it, making a mark on the paper to show this length (see Fig.4(a)). Then the child cuts the strip to the exact length. All the children write their names on their chopped strips and paste them on a long board, using the same base line. It could look something like the one in Fig.4(b).

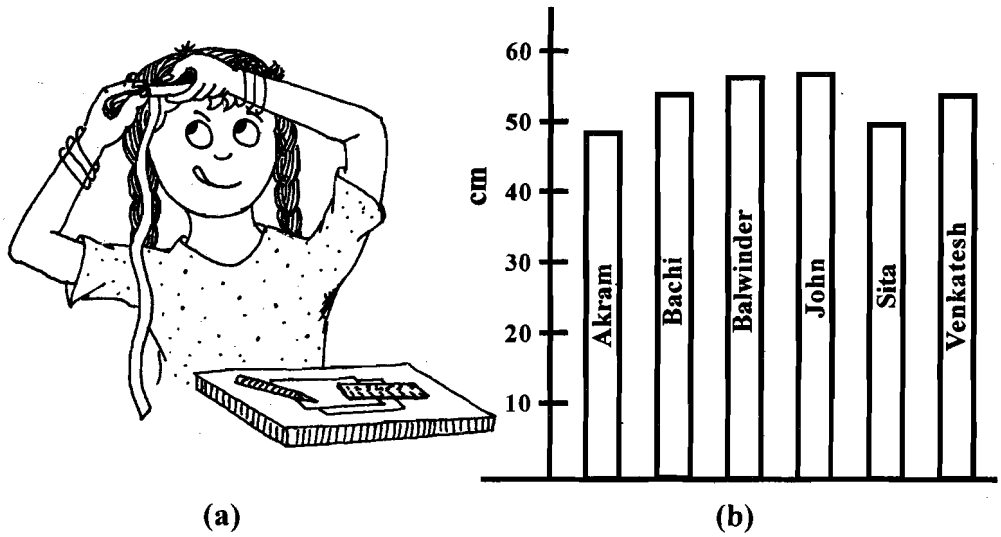

Fig.4: (a) Child measuring the circumference of her head; (b) The measurement cuts of the whole class

You could begin the process of getting children to analyse the data — whose heads are smaller than whose? How many children have the same size of head?, etc.

Again, when this was tried with children of Class 1, they really enjoyed it. They also came out with all kinds of statements about each others head sizes, and head size vs. body size, etc.

Here's a related activity for you.

E5) Try both the activities given above with young children and note down your observations.

We have just seen several ways in which children generate data. We have also seen some ways in which it can be presented. Why don't we just present the data or ally? Also, if we are going to record it, what are the various ways in which we can do so? Let us discuss these questions now.

8.4 RECORDING DATA

As the examples of the previous sections show, we all need to handle data in our daily lives. Even children can and do handle certain kinds of data. What these examples also show is that in most situations we need to record data, that is, it is not enough to just keep it in our memory. Why is this so?

Could it be that the data may be too much to handle without recording (as in Example 3)? This is one reason. Another is that we can't always trust our memory, and we may need to use the data at a later time. A third reasons is that we may need to share data with others (as with Madhu in Example 3).

We shall discuss details of analysing and interpreting data in the next unit.

Are there any other reasons you can think of? For instance, as you've seen in the activities in Sec. 8.3, recording and displaying data properly helps us to analyse and draw inferences from the data. For this we need to record the data and present it in a way that helps us to answer the questions we have in mind. So we need to develop some specific methods for recording it. This is where classroom work can help.

One way that children can record data is already indicated in the previous section — by using concrete objects. Each such object is a **token** which stands for something. For instance, when you want to draw money from a bank, you first stand in line to give in the cheque, and you are given a token. Then you go to another window where you hand in your token and get your money. The token stands for your place in the queue. Coming back to recording data, each matchbox in a birthday month chart in Activity 1 in Sec. 8.3 is a token, denoting a child. In other words, the chart is a **record** of the actual data of children's birthdays.

Think about more instances in which concrete representations of data can be used while doing the following exercise.

E6)a) Give an example of a real-life situation in which concrete tokens are used to record data.

b) Design a classroom activity in which children record data using concrete tokens.

You may feel that the use of concrete tokens may not be very convenient. You are quite right — they can only be used in the simplest of cases. Do you think there is any reason for introducing this inconvenient method in the classroom? If you look at AMT-01, and have dealt with young children, you will get the answer!

Other methods of recording data involve the use of pencil and paper. For instance, you may find children drawing a picture in place of a concrete token. For example, a birthday chart could be made to look like this:

January 

February 

Of course, drawing detailed pictures takes too much time. Besides, the details of a picture are usually unimportant in recording data. So a simplified picture, which does not necessarily look like the object, is more convenient. (Such a simplified picture is called an **icon**.) So the month chart above could as well look like this:

January ☺ ☺ ☺

February ☺ ☺

⋮

When data are to be recorded quickly, however, we can use even simpler icons. A friend of mine who teaches mathematics once came across a group of children playing a 'game' they had invented. The aim was to count the number of vehicles passing a given spot in a certain interval of time. The children were doing this simply by counting out aloud. Then one of them suggested a variation of the game, in which different types of vehicles — cars, scooters, buses, etc. — were separately counted. This version, however, quickly ran into trouble, because the children couldn't keep track of the different kinds of vehicles. After watching for some time, my friend joined in, and encouraged the children to try different methods of keeping a record. One method tried was to record the count on paper, marking C for a car, B for a bus, S for a scooter, and so on. A typical record looked like this:

C C C S S S C B S C

Eventually, the children, with a little help from my friend, figured out a more efficient way of keeping count. They made a separate row for each kind of vehicle, and put a mark in the appropriate row whenever anything passed. For example,

Car | | \ | /

Scooter | | | |

Bus |

At the end of their game, the children would only need to add up the number of bars denoting each vehicle to get the total tally.

Such a simple bar icon that represents 'one', and is added up to give the total count or tally is called a **tally bar**. In the example above, the children discovered the use of tally bars through an activity, under adult guidance. Tally bars are very useful in recording whole number data. To make them more readable, they are often grouped in fives, with the fifth bar cutting across the first four. Thus, instead of recording | | | \ | | / one writes 𝍸 | | . This way one can see at a glance that the number recorded is five plus two, i.e., seven.

Now, try an activity that may help you appreciate the use of tally bars.

E7) Look at the page opposite this one. How many times do each of the letters 'a', 'e', 'i', 'o' and 'u' appear on it? Try counting them, keeping the count in your head. (Remember, you have to keep separate count of a's, e's, etc.) Now try counting them using tally bars. Which method did you find easier? In which method do you think more errors are likely?

So far we have spoken about recording data with concrete objects and with icons. Can these methods be used to handle all kinds of data? We have used icons to count the number of children present, the number of birthdays in a month, the number of cars of a given make. But how can we use concrete objects or icons to record the temperature data in Example 1? How can we show 45.6 using icons? For such data, which consists of decimal fractions, actual numerical values have to be recorded. In the following unit, we shall talk more about handling such data. Meanwhile, here is an activity for you to do with your class or with any other group of children.

E8) Let the children measure each other's heights using non-standard units, or a tape measure, or a metre scale, depending on their age. Get the whole class to suggest ways of recording the heights. What methods did they suggest?

Such activities as the one in E8, can have other uses too; for instance, a record of the children's growth helps in seeing how fast each child is growing. There are many other things we can do with the data, as we shall see in the next unit.

For now, let us discuss the importance of presenting data in an appropriate way.

8.5 DISPLAYING DATA

So far, we have seen several ways of recording data. Very often, we need to share it with others. While recording it, we can (and often do) use our own individual methods. But to show data to others, we have to use methods that are clear and commonly understood. Only then can others appreciate the conclusions we are drawing from it.

One of the commonest ways of displaying data is in the form of a table. This was the method used in Example 1, in which each day's temperature was shown against that day. However, this kind of table is not suitable for all data. Consider, once again, the example of birth months of children. A table similar to that of Example 1 would look like this:

Table 1

Name	Month
Aarti	February
Mansoor	June
Balwinder	March
Charu	September
⋮	⋮

Now, what is our purpose of gathering this data? Do we want the birth months of individual children? Or, do we want to know how many children were born in a particular month? If we want the latter, then the relevant information is not very obvious in this form. Also, this table will have too

many rows to be read conveniently. So, giving the same information month-wise, as in Table 2, will be more useful.

Table 2

Month	No. of children
January	3
February	4
March	2
April	2
⋮	⋮

In Table 2 we show how many times something happens, i.e., the frequency of occurrence. For this reason, a table like this one is called a **frequency table**. Let us consider an example of how children can be helped to see the utility of such tables.

Example 5: In a certain school, fruits are distributed among all the children once a year. Each child is asked to give her option in advance from amongst bananas, mangoes, oranges and guavas. The monitor of Class 3 made a list of all the children in the class, with the choice of fruit noted against each name. When she showed it to the teacher, he said, "Looking at this, I can't make out how many bananas, etc., we need for this class." The child thought about this, and then came out with a frequency table (see Table 3).

Table 3

Bananas	12
Guavas	7
Mangoes	10
Oranges	4

She gave the class teacher this table on a piece of paper. Of course, the teacher found this much easier to handle for the purpose of placing an order than a long list of names.

However, the frequency table doesn't tell us which child wanted which fruit. So, at distribution time, the monitor resorted to using her earlier chart.

——— × ———

As the examples above show, we can present data in different ways. Depending on our purpose, we choose the way we want to present it.

E9) a) Try the activity above with your class or group of children. You need not actually distribute fruits. You could just collect everybody's preference and get the class to make a frequency table.

b) How did the children record and display the data?

c) In which class do you think the term 'frequency table' should be introduced? Why?

Instead of using numbers to show 'how many', we could also use a graphical method as in Activity 1 and 2 (Sec. 8.3). In the simplest method,

in each row (or column) we draw a bar whose length is proportional to the number showing 'how many'. Such a method of presenting data is called a **bar diagram**. A bar diagram has an obvious visual advantage over a frequency table. Questions like "In which month are there the most birthdays?" can be answered at a glance. No numbers have to be read and compared.

On the other hand, bar diagrams do bring in an extra complication. We have to 'choose a scale'. In other words, we have to decide in advance what length of bar represents a unit or 'one'. This decision usually depends on practical considerations. For instance, in Activity 1, what is the unit that represents one child? A matchbox. But, if we were discussing the growth of the population of India every 10 years, then our horizontal scale could be 1cm = 20 years (see Fig.5).

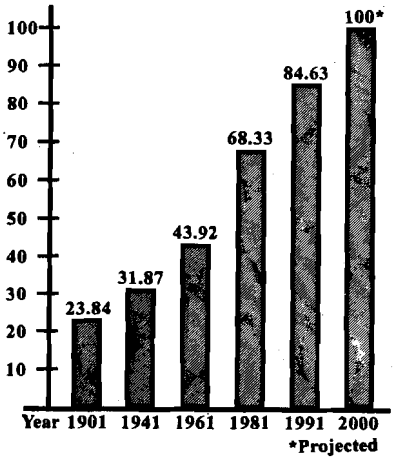

Fig.5: A bar diagram showing the population of India, in crores. (Source: Census of India)

On the vertical scale, also you need to make a choice of unit. For instance, in Fig.5, 1 cm = 10 crores. So, the standing bar of length 5 cm represents 50 crores.

Here are some exercises now.

E10) Get the children to make a bar diagram of the data on preferences of fruits. How did you get them to choose an appropriate length as a unit? Did they use the same units for the vertical and horizontal scales? (A choice of scale could be 1 cm = 1 person. If it is to be drawn on chart paper, 3 cm = 1 person may be a more suitable scale.)

E11) Make a bar diagram of the data collected by you in E7. What is a suitable choice of scale for the horizontal axis? Would 1 cm = one (occurrence of a letter) be appropriate? And what is your choice for the vertical axis?

Bar diagrams can also be used for data which vary continuously (e.g., heights). However, we will postpone consideration of such bar diagrams for the time being.

Let us now briefly summarise what we've talked about in this unit.

8.6 SUMMARY

In this unit we have discussed the following points.

1. The meaning of 'data', and why handling data is not merely doing arithmetic.

2. Ways in which primary school going-children can and do handle data in their daily lives.

3. Activities relating to gathering and presenting data that children of different ages and abilities can perform in the classroom.

4. Some activities for children to record data, using concrete tokens, icons and numerals.

5. How to introduce children to display data by means of tables and bar diagrams.

8.7 COMMENTS ON EXERCISES

E1) You have come across several examples of data being presented in your newspaper and in this unit. Accordingly, answer and justify your response.

It would be useful if you gave an example of qualitative data from your own surroundings.

E2) a) Suppose a teacher, or anyone else, is interested in buying a new product. Then she would conduct an informal opinion poll about it from friends, neighbours, colleagues, etc. Here too, she would gather and use the data to come to some conclusions.

b) Example 1 may give you some idea.

E4) b) In North India, 'gilli-danda' is a popular game. Marbles are common in many parts of the country. To find out if they generate data, you will need to find the rules used in your neighbourhood, since they vary a lot.

E5) While making your observations also consider the questions in A1 to All of Unit 7.

E6) a) You may find the use of concrete tokens common in regions where people are not familiar with written numerals.

b) Objects like matchsticks and bottle-caps can be used as tokens. While designing the activity, keep in mind the points made in Unit 7.

E8) This activity is quite open-ended. If you are going to meet the same children later, it will be useful to make and keep a permanent record of the data.

E9) a) Note that we re **not** suggesting that you give the formal definition of the term 'frequency table' to the children. We are saying that this is not necessary. Without the definition also, children can easily form such tables and arrive at reasonable conclusions by using them.

b) Did the children use tokens, or icons, or both?

E10) Note down the main points of the discussion with and amongst the children that led them to make their final choice of unit.