UNIT 7 MEASURES AND MEASUREMENTS

Structure

7.0 INTRODUCTION

We have already discussed in the previous unit that every physical object that we see around us has two characteristics. Those are the ***shape*** and the ***size***. Shape speaks of what the figure or object looks like. We say, "The figure looks like a circle". The term circle here speaks of the shape. Similarly when we see a sculpture made of stone in front of a temple, we say, "It is a stone-made lion". The term 'lion' here speaks of the shape of the object that we see.

But when we say that the square drawn on the page is too big, the term 'big' speaks of the size. The light house, made long back near the sea shore, is quite high. Here, 'quite high' speaks of the size of the light house.

Let us see the statement below:

"Between the two jokers playing in the circus one is too bulky and the other one is too short".

Can we say the extent of shortness of the joker?

Can we say the extent to which the joker is bulky?

We cannot say exactly.

The characteristic of an object that helps us knowing the bigness or the smallness of it is the measure of it.

Similar characteristics of different objects have a certain measure and other characteristics, not similar to the characteristics spoken of earlier have a different measure. For example, how much space a figure covers on a plane is its area measure, whereas how much water a solid body displaces when submersed in a vessel containing water, speaks of its volume-measure.

In this unit we shall be discussing about various types of measures, the units and scales of those measures and the process of measuring different aspects of physical objects and some common phenomena.

For completing the study of this unit you will need *about 7 (seven) hours*.

7.1 LEARNING OBJECTIVES

After studying this unit, you will be able to

- know different units of measurement of different aspects of objects and processes.
- using units of different measures in your daily life activities.
- make calculations relating to length, area, volume, capacity, weight, and time.

7.2 CONCEPT OF MEASUREMENT AND MEASURES

Everyone is familiar with measurement. In our daily life, we are required to measure something or other. For instance, the length of the cloth required to make a shirt, the weight of vegetables or groceries required to be purchased from the daily market, amount of water one drinks per day, the height and weight of the children in a class, the size of the classroom or our bedroom, the area of the school garden, the time you require to reach school from your home, your body temperature, etc. In all such cases we are to measure something. In all these situations, measurement means to express the attribute in terms of a quantity comparable to a unit. In other words, measurement is quantification of the size or some definite aspects of the size of an object like length, area and volume. Measurement is an application of numbers and helps children to see that mathematics is useful in everyday life, and to develop many mathematical concepts and skills.

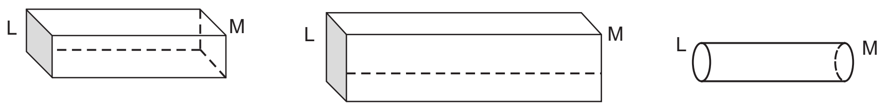
Children in primary school need to learn about several kinds of measure. Length, area, volume, time are some important measures that are included in elementary school curriculum. But for a child of 7 to 9 years, these appear to be quite abstract. Therefore, as a teacher you need to make child familiar with these concepts.

A child, from the beginning of experiencing the world, is familiar with the 3-Dimensional (3-D) solid objects like fruits, toys, coloured blocks, cubes, rectangular solids, match box, cylindrical solids such as chalk sticks, rollers etc. By handling the 3-D objects, the child gains ideas about the 2-dimensional (2-D) figures. As for example, playing with cubes or handling match boxes or drawing the diagrams of these objects on a paper (a 2-D object), he/she recognizes the surfaces of these solids to be plane figures which can be spread on a surface of a table or on a paper. Either observing the surfaces of the 3-D objects or their representation on 2-D planes (like drawing the figures of 3-D objects on a plane like paper or wall or floor), the child experiences the features of 2-D objects. Further, observing the edges of 3-D solids and the sides of the 2-D figures, and from some common objects like thin threads and wires one gathers the experience of 1-Dimension.

Engaging children in activities like sorting different common objects into groups and drawing the figures of 3-D and 2-D objects, you can help them in strengthening their conceptions of the dimensions of the objects. From such activities, they will conceptualize that with 1-dimensional objects only one number i.e. length is associated, with 2-dimensional objects two numbers i.e. length and breadth are associated and with 3- dimensional objects length, breadth, and height (or thickness) are associated. Involving children on such activities with several variations with different shapes and sizes, developing understanding of the notions of length, area, volume and their measurement becomes easier.

The following are the measures that commonly used and the child in the elementary school can experience through different activities and from the real life experiences. In the next section, we shall be discussing these measures in detail.

1. **Distance measure:** Length, breadth, height, radius are all distance measures. Each of them represents the distance between two specific points.



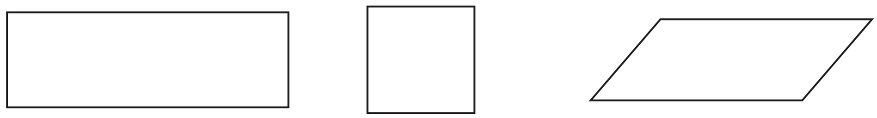
(a) (b) (c)

Fig. 7.1

We see three blocks of wood in the Fig.7.1. Each of them has 2 end (L, M). There is some distance between the two ends. It can be seen that the distance between the two ends of the block in (b) is more than the distance between the two ends of each of the other two.

Thus the distance between the two ends of the blocks is a common characteristic of the blocks. This is known as the **length-measure**.

2. **Area - measure**: Each 2-D shape encloses some region on a plane. The measure of enclosed region is known as the area-measure.



(a) (b) (c)

Fig. 7.2

Each of the figures above encloses a part of the page of paper. Thus each 2-D shape has an area measure.

3. **Volume–measure:** 3-D bodies occupy a portion of the space. The extent of space occupied by a 3-D body is its volume-measure. A 3-D body (not soluble in water) displaces a certain quantity of water when submersed in it. The quantity of water it displaces is known as the volume-measure.

4. **Weight – measure:** When we carry a body or lift it above the ground, in case of some, we are not to strain too much, whereas in case of some others, it strains us too much. 3-D bodies also show a force with which those are pulled towards the earth. The bigness or the smallness of the pull of the earth on 3-D bodies represents their weight-measure. The characteristic of the body that gives the feeling of heaviness speaks of the weight-measure.

5. **Time – measure:** When did an event happen during the day? How long do we take to complete a work? To answer such question we need to be acquainted with the time measure.

Measurement as comparison of two similar entities:

- Naresh was helping his students in class VI in preparing a plot in the school garden. While demarcating the boundary of the plot the group decided to carve out a rectangular plot from the school premises that the longer side would be twice in length than the shorter side. While some students were searching for a measuring device, Nitin took a stick of two cubits long and took two stick lengths on one side and took four stick lengths on the adjacent side and completed the plot.

- It was Monday and it was the turn of students of class V of the school to bring drinking water from the nearby tube well and fill up the storage container. They were given only one small bucket to fill the container. They found that the container was completely filled with 18 buckets of water.

Let us examine the above two examples of measurement. In the first example, a stick was used to decide the measure the lengths of the sides of a plot of land. In other words, the lengths of sides were compared with that of the stick and the specification that one side would be twice in length of the adjacent side was duly met. In the second example, the capacity of the container was compared with that of the given bucket. Can you use bucket as a measure of the length of the side of the plot or the stick to measure the capacity of the container?

From these examples you can realize that measurement is a process of comparison between two similar entities. The length or breath of the plot can be measured by another object known to have some definite length like a meter scale, or a stick of a definite length. Similarly the volume of the container can be measured by comparing it with another known measure of volume like a liter can or a bottle or bucket with known capacity. Since meter scale and the liter can are not similar measures, they cannot be used interchangeably.

Comparison of two similar entities can be done using any one or more than one of the five methods usually employed for the purpose. These are:

a. By observation.

b. By superimposition,

c. By indirect methods,

d. Using non-standard units, and

e. Using standard units.

The last two methods will be discussed separately in the next units. Let us see how we can use the first three methods for comparing two similar entities for measurement purposes.

You can try this activity with children in class I or II. Give them 10 coloured sticks of different lengths and ask them to arrange them in increasing order of their lengths. You will find that most of them arrange them by simply comparing them as to which one appears to be longer and which one appears to be shorter. Similarly you can show them five pebbles of different sizes and ask them to arrange them in order of their heaviness- the heaviest of them to be placed first and the lightest in the last place. You will find how quickly and how easily they can complete task correctly. These are simple examples of measuring by observation.

In a class the teacher was showing two coloured ribbons, red one in the right hand and green one in her left hand and asked children to point out the longer of the two ribbons. Some told the red ribbon is longer while some other pointed to the green one to be longer. Mere observation could not produce the correct measure. Then the teacher asked, “How can you check which one is longer?” One student proposed to superimpose one on the other. When it was done, green ribbon was found to be longer than the red one.

There are situations where observation or superimposition cannot be employed for comparison. For example, take a narrow glass and a wide glass of slightly different heights ans ask whose capacity is more. One method may be filling up one of the glasses full with water and pour it into the second glass. If completely emptying the first glass and it does not fill the second glass completely then we can conclude that the second glass has more capacity than the first one.

7.3 NON-STANDARD AND STANDARD MEASURES

Any sort of measure is always associated with a number, as numbers are the media through which bigness or smallness is expressed. The number associated with a measure comes out of a comparison. For example, to associate a number with the length of the block shown in fig.6.1 (a) we need to compare the length of the block with the length of another body. Thus a **specific length** is chosen with which the length of the body under observation is required to be compared. That specific length is known as the **unit length**. The ratio between the length of a body and the unit length is a number which expresses the length of the body.

Similarly **unit area**, **unit volume**/capacity, and **unit weight** are also used to measure area, volume/capacity and weight respectively. Each of these is taken as a ***unit of measurement*** of the specific attribute. These units can be of different forms as per the situation and requirement. This can be clearer from the following example:

A screen rod used to hang window-screen was broken and required a replacement to be purchased from the market. What should you do so that you can get the rod of right length from the market? Possible actions are that

1. The broken rod can be taken to the shop and a new rod of equal length can be purchased.
2. The length of the rod can be measured by using a stick and the new rod can be purchased by using the stick for ascertaining the required length.
3. You can measure the rod by your foot and can determine how many ‘feet’ the length of the rod is and accordingly you get the rod of equal length.
4. You can cut a thread equal in length of the rod and can procure a new rod of the length of the thread.
5. You can use a meter scale to determine the required length of the rod.

The solutions provided in 2, 3, and 4 are situation or person specific and are subject to vary from person to person who uses these measures. These are examples of ***non-standard units*** of measurement the examples of which will be discussed for different attributes in the next sections. In contrast to these measures, a meter scale is a standard measure used in almost all countries throughout the world. Any where the length of a meter is fixed and does not depend on the person or situation or time. Hence, it is an example of a ***standard unit*** of measuring length.

Standard units are comparatively easier to use as it is simple and is understood easily by everybody throughout the world. The standard units, although do not have any strong logical basis, have evolved through common acceptance and scientific refinements over the ages. Thus these units have been nearly perfected for accurate measurements. Sub-units (e.g., centimeter and millimeter are sub-units of meter) and compound units (e.g., kilometer is a compound unit of meter) are well defined in most of the standard units which are usually not available with non-standard units.

Non-standard units of measurements have been evolved to meet some immediate or some local needs. If you are preparing a sweet dish, you do not always go for the measures of rice, sugar and milk by the cooking manuals. By experience you can have handful of rice, five spoonful sugar and two glasses of milk and yet the dish would be as tasteful as the dish prepared by following the accurate measures of those ingredients. These non-standard measures may work well for you, but may not be as useful for another person who might have different measures fulfilling his/her requirements.

In a locality/community, some commonly agreed units are used to measure length, weight, area and volume since a long time. These are standardized units within that locality/community or culture. You will find such units in every culture. However, such units are confined to one culture and may not be intelligible in another culture.

ACTIVITY - 1

Prepare a list of non-standard units of measurement use in your locality, the equivalence of each with the respective standard units and the advantages and limitations of those non-standard units for the people of your locality.

....

....

....

Check Your Progress

E1 State any three differences between standard and non-standard units of measurement.

E2 What are the needs for the standard units of measurement?

ACTIVITY - 2

Use string to measure the distance around your wrist and neck. How many wrists make a neck? Compare your findings with those of your class mates.

....

....

....

ACTIVITY - 3

Draw several different rectangles on a squared paper. State a rule for finding the area of a rectangle given its length and width.

....

....

....

In spite of the advantages of the standard units, at the beginning stage of learning to measure, the non-standard units need to be used. Because of the familiarity with these types of units, the children would know the different ways of comparing and gradually become aware of the need of standard units.

There are mainly two categories of non-standard unit. One category of units varies according to person like the hand or cubit. You can try such units for measuring the length of any object in the classroom (say the length of the table). You can ask the children to measure it by their hand with cubits and fingers as the unit of measurement. Record the length of the table so measured by different children in a tabular form.

Estimation and measurement: Ask the children to guess the length of any one edge of the table in terms of the measure of hand or stick before they actually measure using the particular unit of measurement. Let them realize the accuracy of their guessing or estimating the size. They can be asked to estimate the height of a plant, the capacity of a bucket in terms of the capacity of a given mug etc. How does estimation helps in measuring objects in the long run?

Estimation plays an important role in measurement. It helps in detecting and eliminating the errors committed by the child. By making estimation as a habit before measuring any attribute helps the child in choosing proper units, making mental comparisons of the attributes with the chosen unit of measurement and thus makes the process and outcome of the measurement more meaningful and accurate for the children.

Children could be asked to estimate the measures before they actually measure any particular attribute of the object of measurement because then they will understand the significance of the numbers that they obtain as the result of measurement. For example, if a child measures the length of a desk (which is actually 37cms) to be 63 cms holding the meter scale in the opposite way, then he/she can immediately realize the mistake had he/she earlier estimated its length to be around 40cms.

Check Your Progress

E3. State any two benefits of using non-standard units at the early stage of learning to measure.

E4. Give two instances when the ability to estimate the size is useful.

7.3.1 Measuring Length

As discussed earlier, learning to measure begins with measuring with familiar non-standard units. While children are engaged in measuring with non-standard units, they should be encouraged to estimate and to develop the skills of using the units properly.

Quite a large number of objects from the immediate environment of the child can be used as non-standard units of length like sticks, wires, threads, leaves, tendrils, papers etc . Most frequently the body parts are used as the non-standard units in every culture throughout the world (see the box below). The names of these measures are different as they are called in different languages.

Body parts used as non-standard units of length

***Finger*:** the width across your first finger.

***Hand*: h-** the width across your hand with your fingers together.

***Cubit:*::c** length of your arm from the end of your middle finger to your elbow.

***Pace*:** length of a step or stride.l.eide

***Fathom*:f** distance from fingertips of left hand to right hand with arms outstretched.

***Inch*:in-** distance from the tip of your thumb to the first knuckle.

(Diagram for each measure may be given for each measure 7.3)

In comparison with measurement of area and volume or capacity, the use of large number of non-standard units is much more and more frequent in the measurement of length by all irrespective of age and education. The use of non-standard units at the early stage of schooling is important for a number of reasons:

a. Objects that are familiar to children are used as non-standard units and as such they are not burdened with acquiring new names and terms while getting used to the skills of measuring objects. Further, these units because of their familiarity with children become more meaningful than the abstract units like centimeter, or meter.

b. The non-standard units are more appropriate size of a unit ,for the first practical measuring tasks that young children undertake. Centimeter may be too small and therefore too numerous for the children to measure their familiar objects like length of the desk, height of a friend.

c. The experience of measuring with non-standard units can encourage children to the idea that scales can be invented for a particular measuring task when a standard scale is not available or when the standard scale is inappropriate.

d. Through using non-standard units children become aware of the need for a standard scale. For example, when they discover that the length of the table by using their hand is around 2 cubits becomes one and half cubits when their teacher uses her hand to measure the same length. Measuring the length of various objects around using the body parts as measuring units by all children in the class may help the children to realize that these units give different results when used to measure the length of a particular object by different persons. This realization arouses the necessity for searching for a standard unit for measurement.

ACTIVITY - 4

List the materials available in the immediate environment which can be used as non-standard unit of measuring length.

....

....

....

Standard units of length: At the elementary school level, the standard units of length that are frequently used in mathematics text are meter, centimeter, millimeter and kilometer. At the initial stage, kilometer is a very long distance beyond the normal conception of the child. Therefore, at the stage of introduction of the standard units of length, children should be made familiar with meter and its sub-units centimeter and millimeter.

When and how to introduce the standard units of length to children?

Standard units like meter and centimeter should be introduced only when the children need for a standard scale for measurement. At the first stage, provide sufficient scope for children to practice with the non-standard units to develop the skills of measuring length of different objects i.e. selecting a unit of measurement, comparing the length of the body with that of the unit length and expressing the result of comparison using the number and the unit like 3 cubits, 2 sticks, 5 paces etc.

In the second stage, when the children are skillful in measuring objects with non-standard units and realize that with these units it is not always possible to determine the exact measure of an object and feel troubled to decide which one is the correct measure, at that time non-standard units like the stick with a fixed length can be used. And when they are familiar with the use of stick to measure the length of different entities with very near accuracy, as we have discussed in the earlier example, then the standard scale i.e. meter scale can be introduced. If we introduce the standard unit in this manner, it would be quite meaningful for the children.

Measuring with a meter scale: While the children are practicing to measure with a stick, you should ensure that one end of the stick coincides with one end of the object being measured. In the measurement of the length of the desk, the stick should be placed close to one of the edge (longer edge) of the desk and one end of the stick should coincide with the beginning point of the edge being measured. A mark should be given on the edge of the desk at the other end point of the stick. And after it the stick should be removed and placed coinciding the edge such that the beginning end of the stick should coincide with the mark that you have put on the edge of the desk and put a mark on the edge of the desk at the other end point of the stick. This process should continue in succession till the total length of the edge is measured by the stick. The number of sticks covering the total length of the desk is the measurement of the length of the desk. When the children are well conversant with this process, they are now ready to use the standard meter scale.

(A diagram with two pictures may be given at this place depicting the above mentioned process Fig. 7.4).

Measuring with a standard scale is nearly similar to the process just described above. Some additional care as suggested below need to be taken to enable the children to learn using the scale correctly:

- *Familiarizing children with the marking of sub-units on the scale*. They need to be clear about the division marked on the scale at equal distances. On a meter scale, to begin with, they should be able to identify the centimeter marks. After they become familiar with using centimeter in measuring length, they may be introduced to meter and millimeter.

(Diagram of a meter scale with centimeters marked on one of its edge to be given here Fig.7.5).

- *Appropriately placing the scale with the object of measurement*. Placing the scale correctly and closely alongside the object to be measured is very important.
    - Demonstrate to children to place the scale alongside the object so that the '0' mark of the scale coincide with one end/edge of the object. This is very important for the beginners. They should also be shown how disturbing such placement may change the scale reading of the other end point of the object.

(At least 2 to 3 diagrams to be given here showing the correct coincidence of the '0' point with one end/edge of the object (preferably a pencil) and incorrect placements away from '0' point. Fig.7.6).

- Allow the children to place the scale such that one end point of the object coincides with any point on the scale other than the '0' point (say 1, 2, or 3) and mark the difference in the reading of the scale, coinciding with the other end point of the object.

(appropriate diagram may be given here Fig. 7.7).

- *Estimating the length before exactly determining it.* As discussed earlier, always encourage children to estimate the length of the object being measured before going to determine the exact length of the object using the standard scale.

- *Correctly calculating the length.* The children should be led through several instances of measuring different objects with a ruler or a scale to determine the exact length of the object they are measuring.

  - At first, when the child aligns the '0' point of the scale with one end point of the object being measured, then the figure on the scale coinciding with the other end point of the object determines its length.

  - When the child aligns any point other than the '0'point (say 1, 2, or 3, etc.), then difference in readings on the scale at the two end points determines the length of the scale.

  - While using a particular unit of length for the first time, for example, the centimeter, the children should be provided with materials like wires, rods, sticks, paper strips etc whose length could be measured by complete units (i.e. 3cm, 5cm, 10cm etc.) without using any part of the unit. When they become competent in such measurements, they can be given objects where they can use the sub-units or parts of the unit (for example millimeters).

- *Developing the measuring skills.* Measuring with a standard scale requires some basic skills like alignment of the scale with the object, taking correct readings and calculating the differences of readings. None of these is a difficult skill to acquire, but children very often commit mistakes due to seer carelessness. Taking care at the early stage would help the children in developing these skills with ease.

- *Choosing appropriate ruler or scale.* Scales of different lengths and forms are available in market. Scales of 1meter, 30 centimeter and 15 centimeter lengths are commonly available and used in the schools. Besides, children may be exposed to measuring tapes of different lengths used by carpenters and masons, iron rods used in measuring clothes in shops and such other scales.

At the early stage of measuring length with standard units in the classroom, scales or rulers of 30 cm length would be handy for use by children as this scale would be appropriate for measuring most of the familiar objects around them. Scales or tapes of larger lengths may be required, depending on the length of the objects to be measured. If the length of the classroom or verandah of the school is going to be measured meter scales of larger length need to be selected for use and when small lines drawn on the note books or small objects are required to be measured, then scale of 15cm length would be more appropriate.

Measuring lengths of objects is comparatively easier for children to understand and to perform. You can encourage children in this through different activities in and out of classrooms. Some such activities are as follows:

- Preparing non-standard scales using coloured sticks with equal parts marked with contrast colours.
- Preparing centimeter scales of different measures like 10cm, 15 cm, 20 cm etc. with each centimeter portion of the strip coloured differently from the other.
- Demarcating play field for playing games like Kabdadi, Kho Kho, Badminton etc.
- Participating in long jump, high jump, and measure distances or heights jumped for each jump.
- Drawing designs using straight lines of different lengths.

7.3.2 Measuring Area

Before going to measure the area of an object, let us see what is exactly meant by area. We have seen that the measurement is done on a straight line segment. The line segment which is one dimensional (1-D) could be represented by the edge of a table, a straight wire, lines in a map, a pencil etc. Now, let us consider the figures given below:

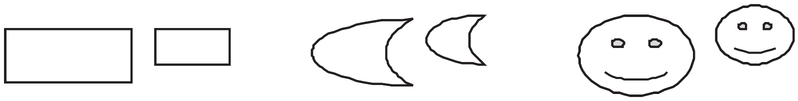
(a) (b) (c) (d)

Fig. 7.8

With our knowledge of measuring length, which aspects/parts of the figures shown above can we measure?

- "The lengths of the lines constituting the boundaries of the figures, of course."
- "But do the lengths of the boundaries describe the shapes and sizes of the figures?"

The boundary of a figure tells about the shape of the figure, but is not sufficient to give any idea of the size of the figure. As for example, compare the pairs of figures given below:



(a) (b) (c)

Fig. 7.9

In each pair of figures, you can find striking similarity in their shapes.

"But what is the difference between the two figures in each pair?"

The two figures in each pair are similar in shapes but are not of same size. If you ask children to identify the bigger of the two in each pair, nearly all of them can point to the bigger one correctly.

When a group of children were asked as to why they chose one to be bigger or larger than the other, some of the responses were:

"One looks bigger than the other."

"When I place one figure on the other, I can distinguish the larger one."

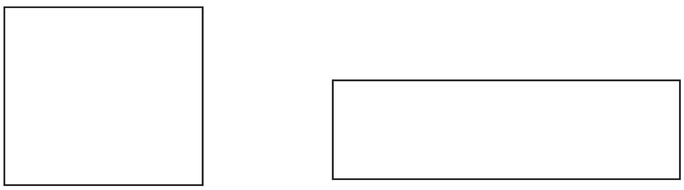
"The one that covers more portion of the paper is the larger one."

"One figure that spreads more on the table than the other is the bigger one."

From the responses, it seems that the children could perceive correctly about the largeness and smallness of figures and are very near to the idea of area.

Area is a characteristic of a plane figure. It is the *spread of the figure* on a plane or the portion of the plane covered by the figure ; the plane may be a paper, the surface of a table or a glass plate or of some such objects.

But, difficulty arises when the children are asked to compare two different figures which are not similar like the two figures given below:



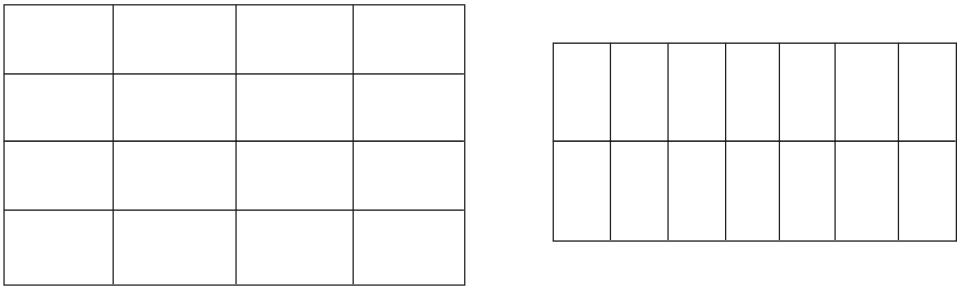
(a) (b)

Fig. 7.10

Notes

How to know which one of the above two figures has more space coverage or, to be specific, has more area?

By superimposing one on the other, we cannot compare their areas as we did in cases of similar figures in the previous example. In such cases, it becomes necessary to estimate the area of each figure by using an object which can be considered to be the unit for measuring area. Let us take match boxes of a particular size and of a definite brand (such a collection would have match boxes of nearly equal surface area). Now place the match boxes close to each other on the two figures such that there would be no gap or no overlapping in between the match boxes as shown below:

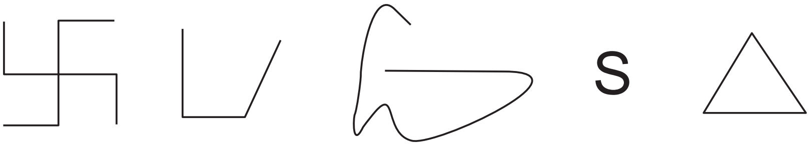


(a) (b)

Fig.7.11

You can see that the figure 7.11(a) is covered by 16 match boxes whereas the other figure is totally covered by 14 match boxes of same size. Therefore, you can now say with reason that the figure 7.11(a) has more area than the figure 7.11(b). Besides comparing the areas of the two figures, we could estimate the area of each figure with the help of a smaller unit like the surface area of a match box.

Can you estimate the area of the following figures?



(a) (b) (c) (d) (e)

Fig.7.12

We cannot calculate the area of these figures as there is no region in the plane bounded by any of these figures. Unlike our concepts of closed figures like triangles, quadrilaterals or circles, these are *open figures* and do not enclose any region.

At the initial stage of learning area of a plane figures, you should use familiar materials like match boxes of any particular brand, plastic squares of equal size, squares of equal size cut out of coloured papers, the books or note books of same size. Some activities of measuring with such objects that can be practiced in the classroom are given here:

- Covering the teacher's table with note books of equal size and calculate how many such note books are required for the purpose.
- Covering the top surface of the students' desks by books of equal size.
- Covering the surface of a book or a note book with the match boxes (you can change the style of placing the match box by changing the faces of the match box and ask the students to calculate the number of match boxes required in each case).
- Decorating a portion of the classroom floor or wall with coloured papers of equal size.

In estimating or comparing areas of plane figures we use smaller units like match boxes of same size such that the figures are entirely covered by the chosen unit. But what happens when some portion of the figure remains uncovered by the unit of measurement i.e. the match box in our example. For this purpose, we follow a common practice i.e. if the portion of the figure is less than the half of one unit we do not take that portion into calculation of area. And when the portion is equal to or more than half of the unit, then it is taken as a full unit for calculation of the area of the figure.

From the above discussion we can conclude that area relates to 2-D objects and to compare or estimate the area of the closed figures, we fill up the figures with smaller units in such a way that no unit should overlap another and no gap should be left in between. Several small plane objects of equal sizes can be used as estimating area measure. In calculation of the area of a figure, the portions of the figure left out after being covered by the full units of measurement are calculated as one unit if the portion is equal to half or more than half of a unit.

Standard Units of Area Measure: The area of a square is considered suitable for any standard unit for measuring area. As for example, a square, each side of which is of length 1metre, is shown in Fig. 7.13.

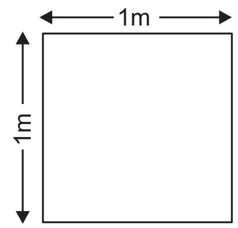


Fig. 7.13 A meter square

Area of such a square is taken as 1 square meter and denoted in symbol as ***1 sq m***, or $\mathbf{1m^2}$.

Note: The area of 1metre-square is *defined as* $\mathbf{1m^2}$.

If you are measuring area of your classroom, the surface area of the wall of your school, the area of a plot in the garden and such other large closed spaces, the unit of 1sq m is the appropriate unit for measuring the areas.

But, for measuring small areas like the figures drawn on your note books, size of the paper required for covering a book, or the size of your handkerchief, you need a smaller unit of area as the unit of 1sq m would be too large to measure such small areas. For those purposes **1sq cm** or **1cm^2** would be a befitting unit.

How to determine the areas of geometrical figures using standard units?

Observe the rectangular figure *ABCD* of length measuring 5cm and breadth 3 cm. Since the lengths of sides are measured in cm–scale, the appropriate unit of measuring area in this case would be 1sq cm or 1cm^2.

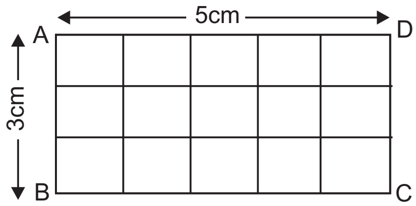


Fig. 7.14

Let us arrange the pieces of square-size papers of area 1sq cm each without overlapping each other nor would having any gap between them, then the picture wil be similar to the Figure 7.14. It requires three rows with 5 small squares (1cm^2 each) in each row. That means we require 15 small squares (5 small squares in each row × 3 rows) to completely cover the rectangle ABCD. Therefore, the area of the rectangle ABCD is 15 time of the unit of 1sq cm or simply 15sq cm or 15 cm^2.

The method of determining the area of a rectangular figure using 1cm^2 as the unit can be as follows:

In order to calculate the area of the rectangle ABCD (Fig.7.14), line- segments are drawn parallel to $\overline{AB}$ and parallel to $\overline{AD}$, such that the rectangle is divided into centimeter-squares.

No. of squares in 1 row = 5 and no. of squares in 3 rows = 5 × 3 = 15

Thus we see that the area of a rectangle = no of units along its length × no. of units along its breadth.

In short, we write:

$$\boxed{\text{Area of a rectangle} = (l \times b)\ \text{cm}^2}$$

Where 'l' represents the no. of units along the length and 'b' represents the no. of units along the breadth . In the above figure (Fig. 6.14), $l = 5$ (not 5cm) and $b = 3$ (not 3 cm)

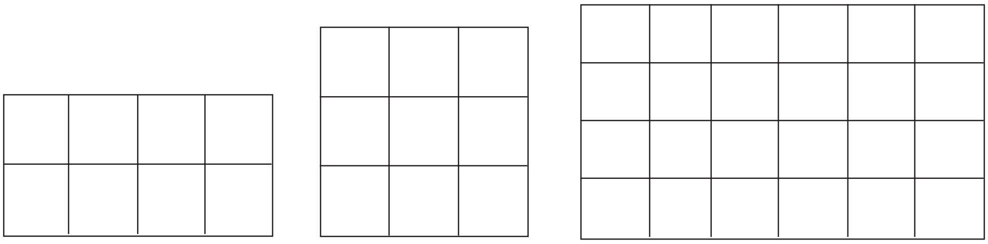
Hence, area of the rectangle ABCD = $(l \times b)$ cm^2 = (5×3) cm^2 = 15 cm^2

Similarly, area of a square = $(l \times l)$ cm^2

Notes

Check Your Progress:

E5. What is the area of each of the following figures where each small square represents the area of $1cm^2$?



(a) (b) (c)

Areas of other geometrical shapes like triangle, quadrilaterals, and polygons are calculated making use of the area-rule for a rectangle.

Area of Irregular Figures: For measuring area of irregular figures, you can use centimeter graphs or centimeter thread graphs. Both of these work on same principle. Place the irregular figure, say a leaf, on the graph and draw the outline of the leaf on the graph (or place the figure under the thread graph (Fig.7.15). To calculate the area of the leaf, count the squares covered in the outline of the leaf. If the outline of the leaf covers half the cell or more than the half, it should be taken as a full square. If it covers less than half of a square, then that square is not taken into account. The total number of squares counted gives an approximate area of the figure in centimeter squares. This is a crude approximation. One of the best ways of finding the area of a irregular closed region is to take the sum of the areas of very large number of vertical or horizontal rectangular strips partitioning the region.

(Please draw the picture as suggested).

Higher and lower area-units: ABCD is a metre-square (Fig. 7.16). It is divided into centi-metre-squares by drawing line segments parallel to $\overline{AB}$ and parallel to $\overline{AD}$ at intervals of 1cm.Thus there are 100 small squares along each of the sides $\overline{AB}$ and $\overline{AD}$ of ABCD.

∴ The total no. of small squares in ABCD = $100 \times 100 = 10{,}000$

Each small square is of area $1cm^2$ [as it is a centimeter-square]

Thus we see that $1m^2 = 10{,}000cm^2$

Similarly, it can be proved that $1cm^2 = (10 \times 10)\ mm^2 = 100\ mm^2$

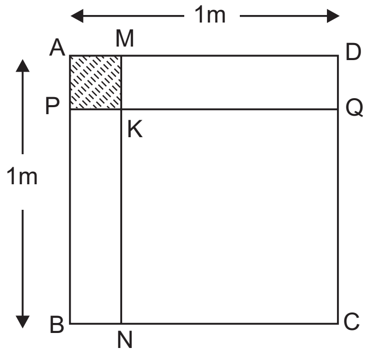


Fig. 7.16

Land measure: Usually the standard unit of measuring area of land in the traditional system of measurement is 'Acre'.

In metric system, 'Hectare' is the unit of measuring area of land along with 'Are'. hectare is equal 1hectare = $10{,}000m^2$ and 1 are = $100m^2$. From these you can calculate to find that 1 hectare = 100 are and 100 hectares = 1 km^2. Incidentally, 1 hectare = 2.471 acres

7.3.3 Measuring Volume

We have so far discussed about measurement of 1-D (measurement of length), and 2-D (measurement of length as well as area) objects. Let us discuss the measurement of different aspects of a 3-D object. Most of the objects around us have three dimensions – length, breadth and height or thickness. Name any object around you - be it a table, chair, desk, book, ball, bat, pencil, chalk- it must be a 3-D object and each occupies some definite portion of the space.

The amount of space occupied by an object is the volume of that object.

How to determine the quantity of space occupied by an object? Before trying to answer this question, first we should ensure whether children have grasped this sense of volume of an object by simple guessing through visual comparison of objects.

"Does a pencil occupy more space than a ruler?"

"Does a cricket ball occupy more space than a foot ball?"

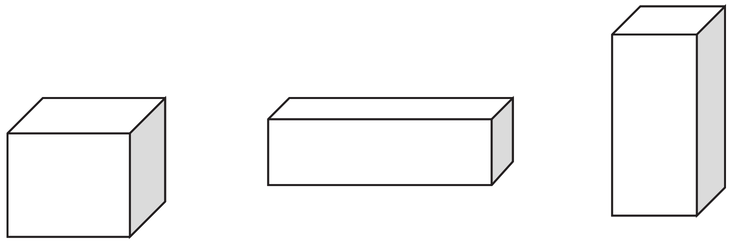
"Does a piece of chalk occupy more space than a duster?"

Notes

"Does a mango occupy more space than a lemon?"

"Does a cow occupy more space than a buffalo?"

After you become sure that children can compare the objects, you can show them some wooden blocks of cubes and cuboids as shown in the Fig 7.17 and ask them to compare the volumes of these blocks.

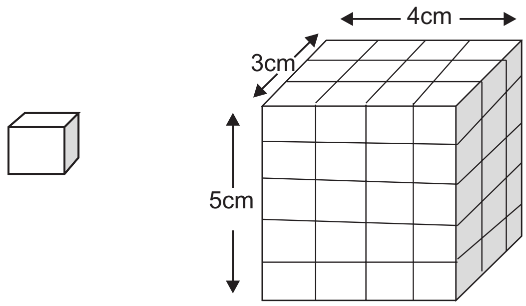


(a) (b) (c)

Fig. 7.17

Here, the children face the difficulty to estimate the volumes of the blocks. For this they need to know the ways of determining the volume of an object.

As in the cases of length and area, the standard unit for measuring volume needs to be introduced. Small unit of cube of 1cm× 1cm ×1cm is usually used as a standard unit for volume measurement.



(a) (b)

Fig. 7.18

This unit cube with each edge measuring 1cm is called a centimeter cube (Fig.6.18a). Its volume is taken as **one cubic centimeter** and is denoted by **1cm^3**.

For measuring large objects, larger unit of volume like **one cubic meter** or **1m^3** may also be used.

Let us see how we can measure the volume of a regular solid like a cuboid as shown in Fig. 6.18(b). As shown in the figure the cuboid is of 3cm× 4cm ×5 cm size. You can observe that there are the cuboid consists of 5 slabs of 1cm thickness and in each slab there are 3 rows with each row having 4 centimeter cubes. That means each slab has ($4 \times 3=$) 12 cm cubes and in 5 slabs there are altogether 60 cm cubes. Hence the volume of a (3cm × 4cm × 5cm) cuboid is 60 cubic cm or 60cm^3.

From this example we may deduce that

The volume of a cuboid = (l × b × h) cubic units, where l= the length, b= the breadth and h = the height of the cuboid.

In a cube, we know that $l = b = h$, hence the ***volume of a cube = l^3 cubic units***.

If we have solid objects in the form of cuboids or are regular 3-D objects, we can calculate their volumes using or appropriately modifying the formula for determining the volume of a cuboid.

There is a common method of measuring volume of any solid object. This is derived from the meaning of volume as the space occupied by the object. If you totally submerge the object in a liquid, it will displace equal volume of the liquid.

ACTIVITY - 5

Take a glass trough or a transparent plastic bucket and fill it with water. Mark the level of water on it. Then take piece of stone or pebble tied with a thread and lower it inside water in the pot. Mark the level of water when the object remains inside water (name it as w_1). Take another bigger piece and submerge it in water inside the pot and mark the level of water in the pot (w_2). Can you find the difference between levels of water (between w_1 and w_2)?

....

....

....

(Please give two diagrams as per the description given in this activity)

Using this property, the volumes of solid objects are measured using cylindrical glass jars with calibration of volume expressed in cubic centimeter (cc). In this method, the calibrated glass jar is filled with water or some other liquid to some extent and the initial level of the liquid is noted. Then the object which volume is to be determined is totally submerged in the liquid and the level of the liquid in the jar is noted. The difference between the two levels gives the volume of the object.

The other way is to fill any vessel completely with water or any liquid in such a way that any additional drop of the liquid will overflow out of the vessel. Then submerge the object into the liquid in the vessel and take care to collect every drop of the liquid displaced out of the vessel due to the submergence of the object. The volume of the displaced liquid is equal to the volume of the object.

Capacity and Volume: We discussed the ways to measure volume of the solid objects by the method of submergence in liquid. But, this method cannot be used for measuring the volume of liquids. Moreover, liquid substances have no definite shape. They take the shape of the vessel in which they are kept. The capacity of a vessel or a container refers to the volume of liquid, or sand, or salt or some such substance that it can hold. If a bucket can be filled completely with 20 bottles (of equal size) of water, then the capacity of the bucket is 20 such bottles of water. And if the capacity of each such bottle is 1 liter, then the capacity of the bucket is 20 liters.

At the initial stage of learning, the children should be given a lot of opportunities to use non-standard units of measuring capacities of different vessels. Some such activities that can be conducted by children in and out of school are:

- Using cups to fill the tea pots /kettles, or any other pots used as utensils with water.
- Filling pots with water using a fixed bottle.
- Filling drinking water storage in the school with water using a bucket.
- Filling sugar in the can using a small cup.
- Measuring sand with a tin can.
- Measuring volume of rice/paddy/wheat/any seeds with a small tin/plastic can.

While practicing with the non-standard units like spoon, cup, jug, tin can, plastic mug etc, always insist on the use of one measure in measuring a particular item. You can try different cups to measure an amount of rice, and also measure the same amount of rice with only one cup. You can find the difference in the two measures.

It is only when the children become quite adept in using non-standard units of measuring volumes, then the standard units of cubic centimeter (cc) and liter can be meaningfully introduced. They may be familiarized with the devices used to measure oil in the retail grocery shops.

The standard unit of measuring the liquid is a **litre** or **liter**. One litre is equal to 1000 cubic centimeters or 1000 cm^3.

E6. What is the standard unit that you will use while measuring the volume of a solid by measuring that of the displaced water by the solid?

E7. A water reservoir is 3 m long, 2 m broad and 1m high. How many litres of water does it hold?

7.3.4 Measuring Weight

The children, from a very young age, are familiar with the process of weighing the objects by experiencing heaviness of an object the activities in the market. The child might have experienced the weighing of rice, vegetables, groceries and other food items using standard weights and common balance. But, at the beginning stage, children should be familiarized with the process of weighing with a balance using non-standard weights like small stones, pieces of brick, wood, iron or any metal. At this stage children may be encouraged to perform the following activities:

- *Preparing a model of common balance with a beam and two pans hanging from the two extremes of the beam*: A thread is attached at the exact middle point of the beam. When equal weights are placed on the two pans the beam remains horizontal to the ground when it is raised with the thread at the middle of the beam.

- *Weighing with non-standard units:* Children should be encouraged to use the improvised balance they have made in weighing different materials like sand, leaves, seeds, etc. with non-standard units. Through such activities, they would develop the skills of using the balance properly in two main ways. First, they would master the mechanics of the balance like properly lifting the balance, putting the weight and the things to be weighed in proper pans, and keeping the beam horizontal by adjusting the materials being weighed. Second, using balance they can divide and subdivide the materials into two, four or eight equal parts.

When they become well versed with using the improvised scales and non-standard weights, they will feel the need of a proper balance and the standard weights. As they grow up, they should be exposed to different types of weighing devices like spring balance, electronic weighing machines, machines to weigh very small and very large weights.

Gram and kilogram are commonly used units to measure weights of familiar objects. Children are more exposed to weighing vegetables and groceries in kilograms, half-kilogram (500grams) and quarter kilograms (250 grams).

7.4 METRIC SYSTEM OF MEASUREMENT

There are two major systems of standard measuring units used in different countries. These are the Metric System and the British or Imperial System. In every system there are two types of measuring units – *the base units* and *the derived units.* The units for length, mass, and time, (along with those for temperature, electric current, luminous intensity and amount of substance) are called the base units because the units for other measures like area, volume, capacity, and velocity etc. can be expressed in terms of these base units. For example, the unit of area can be cm^2, that of volume can be cm^3 or that for velocity can be kilometer per hour (expressed shortly as km/hour). Using these base units of measurement, the Metric system is also called **c-g-s** (centimeter-gram-second) **system** or sometimes as **m-k-s** (meter-kilogram-second) **system.** Similarly, the British system is known as **f-p-s** (foot-pound-second) **system**.

Metric system is internationally accepted system and is known as '***International System of Units*** or ***SI Units'*** (***SI*** stands for the French version of the International System of Units i.e. ***Système international d'unités).*** The SI includes two classes of units which are defined and agreed internationally. The first of these classes are the seven SI *base units* for length, mass, time, temperature, electric current, luminous intensity and amount of substance. The second of these are the SI *derived units*. These derived units are defined in terms of the seven base units. All other quantities (e.g. work, force, power) are expressed in terms of SI derived units.

In this section we shall be confining our discussion on the SI units of length, capacity and mass (commonly used as weight). The units of area and volume are closely associated with and are reported using the unit of length as indicated earlier in this unit. At times, we have tried to compare these measures with the corresponding units of traditional and the British system as in some areas of measurement in our country those systems are also used and makes sense to common people.

The History of Metric System

The Metric System was developed in France during the sixteenth and seventeenth century and Gabriel Mouton, the vicar of St. Paul's Church in Lyons, France, is the "founding father" of the metric system. He proposed a decimal system of measurement in 1670.

In 1790, during the hectic period of the French Revolution, the National Assembly of France requested the French Academy of Sciences to "deduce an invariable standard for all the measures and all the weights." The Commission appointed by the Academy created a system that was, at once, simple and scientific.

- The unit of length was to be a portion of the Earth's circumference.
- Measures for capacity (volume) and mass were to be derived from the unit of length, thus relating the basic units of the system to each other and to nature.

- The larger and smaller multiples of each unit were to be created by multiplying or dividing the basic units by 10 and its powers.

The Commission assigned the name "metre" (in the U.S. spelled "meter") to the unit of length. This name was derived from the Greek word, metron, meaning "a measure." The physical standard representing the meter was to be constructed so that it would equal *one ten-millionth of the distance from the North Pole to the equator along the meridian running near Dunkirk on English Channel in France and Barcelona in Spain.*

A surveying team under the direction of two men, Pierre-Francois-Andre Mechain and Jean- Baptiste-Joseph Delambre, spent 6 years in measuring the "arc" that the earth made in a line between Dunkirk in France on the English Channel and Barcelona in Spain. The surveyors underwent much harassment and even were jailed, at times, while making their measurements, because some of the citizens and area officials resented their presence and felt they were up to no good. It was later found that Delambre and Mechain had not properly accounted for the earth's flattening in correcting for oblateness. However, the meter remains the invariable standard for the metric system, and its length has not changed even though the official expression of the definition the meter has changed several times to improve the accuracy of its measurement.

Meanwhile, scientists were given the task of determining the other units, all of which had to be based upon the meter.

The initial metric unit of mass, the "gram," was defined as the mass of one cubic centimeter (a cube that is 0.01 meter on each side) of water at its temperature of maximum density (about 4^0C). For capacity, the "litre" (spelled "liter" in the U.S.) was defined as the volume of a cubic decimeter — a cube 0.1 meter on each side.

After the units were determined, the metric system underwent many periods of favor and disfavor in France. Napoleon once banned its use. However, the metric system was officially adopted by the French government on 7 April 1795. A scientific conference was held from 1798 to 1799 (with representatives from the Netherlands, Switzerland, Denmark, Spain, and Italy) to validate the metric system's foundation and to design prototype standards. Permanent standards for the meter and the kilogram were made from platinum. These standards became official in France by an act of 10 December 1799.

Although the metric system was not accepted with enthusiasm at first, adoption by other nations occurred steadily after France made its use compulsory in 1840. Most of the countries around the world adopted this system around 1950 and 1960's. There are a few countries including U.S.A. which have not adopted the metric system as yet.

The metric system in weights and measures was adopted by the Indian Parliament in December 1956 with the *Standards of Weights and Measures Act*, which took effect from October 1, 1958.

The Units in the Metric System: In metric system, the sub-units (smaller units) are taken as $\frac{1}{10}, \frac{1}{100}$ etc. of the unit and the super-units (higher units) are taken as 10 times, 100 times etc. of the basic unit. This makes the calculations convenient.

The system is as follows:

Higher Units

Kilo unit = 1000 units

Hecto unit = 100 units

Deca unit = 10 units

Unit

Sub-Units

Deci unit = $\frac{1}{10}$ units

Centi unit = $\frac{1}{100}$ units

Milli unit = $\frac{1}{1000}$ units

Let us see how this structure of the metric units are uniformly used in defining the units of measurement in length, capacity and mass (or weight)

***Unit for Length Measure*:** Unit of length measure the metric system is **metre or meter.**

Higher Units

Kilo metre (km) = 1000 m

Hecto metre (hm) = 100 m

Deca metre (dam) = 10 m

Unit : Metre (m)

Sub-Units

Deci metre (dm) = $\frac{1}{10}$ m

Centi metre = $\frac{1}{100}$ m

Milli metre = $\frac{1}{1000}$ m

From among these, kilometer, metre, and centimetre are frequently used in measurement of lengths of varying distances and commonly understood.

Although metric system has been adopted in our country since 1958, yet the unit of length like inch (=2.54 cm), foot (=12 inch) and yard (=3 feet) are still used in several events of measurement like in land measurement and also by tailors for measuring cloth for making dress.

***Units for capacity measure*:** It is a common experience that liquid has no shape. It takes the shape of the container in which it is kept. Thus for deciding the unit for measuring the quantity of liquid we either use weight measure unit or we use volume measure unit.

Litre is the unit of capacity measure (i.e., volume-measure).

The volume-unit is known as 1 litre (equal to 1000 cm^3). Different containers are made of different capacity measures.

Higher Units ↑

Kilo litre (*kl*) = 1000 *l*

Hecto litre (*hl*) = 100 *l*

Deca litre (*dal*) = 10 *l*

Unit: Litre (*l*)

Sub-Units ↓

Deci litre (*dl*) = $\frac{1}{10}$ *l*

Centi litre (*cl*) = $\frac{1}{100}$ *l*

Milli litre (*ml*) = $\frac{1}{1000}$ *l*

Litre is the most frequently used unit to measure the liquid substances like milk, water and oils

Units for measure of Mass (Weight): The basic unit is **gram**. Other higher and sub-units are given below.

Higher Units ↑

Kilogram (kg) = 1000gm

Hectogram (hm) = 100g

Decagram (dag) = 10g

Unit: Gram (g)

Lower Units ↓

Decigram (dg) = $\frac{1}{10}$ g

Centigram (cg) = $\frac{1}{100}$ g

Milligram (mg) = $\frac{1}{1000}$ g

Notes

From among these, kilogram, gram and milligram are commonly used.

Besides these units of mass, 'quintal' and 'metric ton' are used to weigh very heavy materials. One quintal is equal to 100 kilograms and 1 Ton = 1000 kg or 10 quintals.

Check Your Progress:

E8. State the major advantage of the Metric system over the British system of measurement.

E9. If 1 kg of rice costs Rs.25, what is price of 5 quintals? If this quantity of rice is packed in smaller packets each containing 20kg, how many packets can be made?

7.5 MEASUREMENT OF TIME

Time-measure is related to the revolution of the earth about its axes and rotation of the earth around the sun.

The duration between two consecutive sunrises is commonly known as **a day**. But the scientists count a day as the duration between two **consecutive mid-nights**. Thus, a day starts at a mid-night and ends at the next midnight. This duration is known as a **solar-day**.

A solar day is the time which the earth takes to rotate once about its axis.

A complete rotation in degree- measure system, has a measure of 360 degrees.

To bring in coherence between the time-measure and degree measure (as these are both related to rotation), unit divisions are made on the basis of sub-multiples of 360.

Thus, the duration of a solar day is divided into 24 equal divisions and each division is known as an hour. 1 hour = 60 minutes and 1 minute has been taken to have 60 seconds.

Thus :

1 solar day = 24 hours

1 hr = 60 minutes

1 minute = 60 seconds.

Solar year : *The duration in which the earth completes one rotation about the sun is known as a*

Relation between a solar year and a solar-day.

1 solar year = 365 days 5 hours 48 minutes 47 seconds
Roughly, 1 solar year = 365¼ days

Notes

A calendar year is taken to have 365 days

Thus every year we lose about 6 hrs i.e., ¼ of a day.

Hence in 4 years we lose 1 day. To make it up, in every 4 years, one year is taken to have 366 days and this year is known as a leap year.

The year number which is divisible by 4 is a leap year and the month of February is taken to have 29 days instead of 28 as in case of other years. So in a calendar, we have 31 days in each of the moths of January, March, May, July, August, October and December; 30 days in each of the moths of April, June, September and November, 28 days in February with one extra day (i.e. 29 days) in every leap year. The children can easily remember the days of the calendar months in different ways. Singing a song on the months may be one interesting way.

A Song of the Months

Thirty days hath September

April, June and November

All the rest have thirty one

Except for February alone

And that has twenty-eight days clear

And twenty-nine in each leap year

Exceptions :

The year numbers that have zeroes at the ten's place and unit's placeand are merely divisible by 4 only are not leap years. But from among them which are multiples of 400 are leap years.

Thus, 2000 was a leap year, whereas 1900, 1800, 2100, 2200, 2300 etc. are not leap years.

Clock time : There are two types of clock: 12 hour-clock and 24 hour-clock.

- Ordinarily we use 12 hour- clocks. In such a clock, the numbering of hours on the dial of the clock are limited within 1 to 24. The hour hand rotates once over the clock-face in 12 hours and the minute hand rotates once in 1 hour.

- Mid-night and noon are indicated by 12. We say: 12 Mid-night, and 12 Noon.

  The time strictly between 12-midnight and 12-noon is indicated as **am,** such as in the morning we say 5 am or 6.30am or 8 am and the time strictly between 12-

Notes

noon and 12-midnight is indicated by **p.m.** like 4 pm in the afternoon**,** 7pm in the evening.

- 24 hour clocks are used in railways and airways.

  Midnight is indicated as 24hr and the subsequent hours are counted as 1 hr., 2 hr., 3hr., and so on till the following midnight. There is no use of *am* and *pm*. In this system, the clock-face shows the numbers from 1 to 24 and the hour hand rotates once over the clock face in 24 hours.

Time Sense: Before the child could read the clock and calendar, he/she should have developed a sense of time i.e. the sense of past, present and future. When the children come to the school for the first time at about 6 years of age, they have developed such sense to a considerable extent. They can talk in terms of what happened yesterday or last week, what they are doing now and what they are going to do tomorrow. Beginning with the idea of yesterday, today and tomorrow, you can lead them to express in terms of last month or last year or some years back arrange the events in terms of the date of their occurrence. Similarly, you can discuss with them regarding the events that are going to happen tomorrow, next week, next months and in years to come. For all these purposes, you can in different times involve them in formal or informal discussions on the questions related to events occurring in past, present and future. Some such questions are:

- What is the day to-day?
- What was it yesterday or what it will be tomorrow?
- Who are absent in your class to-day?
- Who were absent yesterday?
- In which period tomorrow mathematics is going to be taught in your class?
- What day is to-day?
- What day will be tomorrow?
- Who is older, you or your friend?

The more you discuss with children along these lines, you will be able to sharpen their sense of time. In addition to such discussions, provide situations when they can be able to arrange three or more events in serial order of time, beginning from the distance past to immediate past and proceed to immediate and distant future. In other words, they try to arrange events on a time line. Once they understand and successfully arrange the events chronologically, you can then proceed to acquaint them with clock and calculation of time.

Instant and Duration of Time

The recording of time depends on your requirement of the type of period of events you want to record. For example study the three situations:

Notes

1. How many years have passed since India got independence?
2. What is the difference in the ages of two of your friends Seema and Sehna?
3. How much time did Rohit take in answering the classroom test completely in Mathematics?

The first question requires knowing the year in which India got its independence (1947A.D.) and the present year from which the difference is to be calculated (say 2011A.D.). Simply deducting 1947 from 2011 you get the answer.

The second situation requires the exact dates of birth in terms of the year, month, and date of birth of each of the two friends. It is slightly more complex than the first one.

Suppose the dates of birth of the two friends are as follows:

Seema was born on 18^{th} Ocober 1999 and Sehna was born on 12^{th} September 2000.

You can calculate the difference in their ages in two different manners: (i)Calculate the present age as on a definite date (say, 1^{st}. April, 2012) and find the difference between their present age, (ii) Calculate the differences between their dates of birth which would be equal to their age at any instant of time. We have taken the second method to calculate the difference in their ages.

To find out the difference between their dates of birth you arrange their dates of birth as shown below and calculate the difference in their

	Year	M	Day
Sehna:	2000	09	12
Seema:	1999	10	18
	00	10	24

You can explain how to calculate the difference when months and days are involved. Since in this case 12 days are less than 18 days, therefore, we have to borrow 1 month (=30days) from the 9 months and calculate the difference between(30+12 =) 42 days and 18 days to be 24 days, Again, we are left with 8 months from which 10 months cannot be deducted and hence we borrow 1 year(=12 months) and subtracting 10 months from (12 + 8 = 20) months we get 10 months. Thus we get the difference between the dates of birth of two friends and on that basis we can say that Seema is 10 months 24 days older than Sehna.

In brief, in order to help your students to develop skill in measuring time, you need to plan several types of activities that include reading the clock accurately, stating the time in am and pm, calculating difference of time between two events.

Notes

Check your progress

E10. Rama left for her hostel in her college on the morning of 11.11.1911 and is likely to come back at the night of 12.12.2012. How many days would she be absent from her home?

E11. From among the following years, identify the leap years.

1536, 1600, 1682, 1700, 1820, 1980, 2000, 2006, 2012.

E12. On the 10^{th} January 2008, the repair work of a school building started and continued for a period of 65 days. On which day was the work completed?

7.6 LET US SUM UP

- Measurement is quantification of some particular aspects of objects arrived at through comparison of the particular aspect with another similar object of fixed dimension(a unit).
- Length is one dimensional, while area and volume are associated with 2-D and 3-D objects respectively.
- While observation, superimposition and indirect methods are used for measuring objects, non-standard and standard units are predominantly employed for the purpose.
- Non-standard units using body parts or locally available materials may not be as accurate as the standard units, but are more meaningful and beneficial for the beginners to anchor the concepts of units and processes of measurement.
- Before acquainting with the standard units of measuring length, area, volume, capacity and weight, children should be made familiar with the processes of measuring the attributes. When standard units are introduced, children should be encouraged to employ their experiences gained by using non-standard units.
- Every child in elementary schools should be facilitated to acquire skills in using the standard metric units of length, area, volume, capacity and weight after gaining knowledge of the units, sub-units, and higher units in each of the aspects.
- Metric system has been accepted as the international standards (SI) of measurement with seven *base units* for length, mass, time, temperature, electric current, luminous intensity and amount of substance.
- Time is measured in terms of solar year, solar months, days, clock hours, minutes and seconds.
- Children should be provided scope for developing skills in recording time of events and calculating duration of events.

Notes

7.7 MODEL ANSWERS TO CHECK YOUR PROGRESS

E1. State any three differences

E2. They are accurate, uniform across the world, and are used in scientific measurements.

E3. State the examples

E4. Non-standard units are familiar to children, hence they are meaningful and can be easily handled by children before they could try standard scales.

E5. (A) $8cm^2$ (B) $9cm^2$ (C) $24cm^2$

E6. Cubic centimeter (not in litre as it is the unit of capacity measurement or of measuring liquids)

E7. 6000 litres

E8. In Metric system the higher units and sub-units are stated in multiples or sub-divisions of 10 of the main unit of measurement.

E9. Rs. 12500.00; 25 packets

E10. 398 days

E11. 1536, 1600, 1820, 2000, and 2012.

E12. On 14^{th} March, 2008

7.8 SUGGESTED READINGS AND REFERENCES

IGNOU (2008). *Teaching of primary school mathematics(vol.5): Measurement*. New Delhi: IGNOU.

7.9 UNIT-END EXERCISE

1. Describe the methods of comparison as a means to measuring different objects.

2. Compare nature and utility of the non-standard and standard units of measurement with suitable examples.

3. Why the metric units of length, mass and time are considered as the SI base units and other units like those of area, volume, capacity and mass as derived units?