Motion and Measurement of Distances

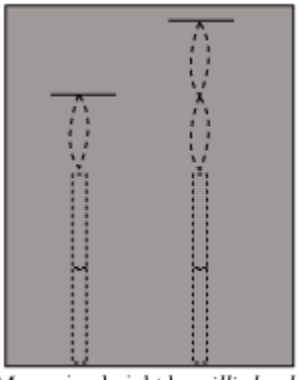
Non Standard Method of Measurement

Go to a cricket ground with your friends. Measure the length of the cricket pitch using your foot span as the unit of measurement. Tell your friends to do the same and record the length of the pitch measured by each person. **Is the measurement the same for everyone?**

Measurement without standard scales:

Raju and Ravi fight frequently over who is taller. They decide to measure their heights by standing next to a wall and marking their heights.

They measure the height of each mark by using a *gilli-danda* to measure the distance between the foot of the wall and their respective marks.



Measuring height by *gilli-danda*

It is found that Raju's height is equal to two *dandas* and one *gilli*, whereas that of Ravi is equal to two *dandas* and two *gillis*. Hence, Ravi is taller than Raju. **However, can you rely on such measurement? Does this type of measurement accurately determine their heights?**

Measuring the length of a cricket pitch with the help of your foot span or measuring a person's height with a *gilli-danda* are non-standard methods of measuring distances.

Measure your own height first by using a *gilli-danda* and then by using a stump and a bail. Will you get the same result in both cases? If not, then can you explain the reason for this?

Your height in terms of a *gilli* and a *danda* will not be equal to your height in terms of a stump and a bail because the lengths of a *gilli* and a *danda* are not equal to lengths of a stump and a bail.

Thread levelling:

In the activities, you found that it is difficult to measure the exact length or height using foot span, *gilli-danda*, or other unconventional methods of measurements. However, you can measure the exact height or length using thread.

Take a section of thread. This will be your **one thread length**. Now, fold and mark the thread as $\frac{1}{2}$ in the middle. Fold the thread again and mark $\frac{1}{4}, \frac{1}{8}$ … at the folding points respectively. These points will indicate $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}$ … thread lengths. Now, you will be able to measure your exact height in units of thread length.

Try to measure the exact length and breadth of your bed in units of thread length.

Tailors, carpenters, and farmers need a uniform system of measurement to measure respectively the length of a cloth; the length, height, and width of a block of wood; and the area of a cultivated land.

Non Standard Units of Measurement:

In earlier days the length was measured by using units that were based on hands and feet.
These units include:

- Cubit- It is measured as the distance between the tip of the outstretched middle finger and the elbow.
- Hand span- It is measured as the distance between the tip of the thumb and the tip of the little finger of fully stretched palm of a hand.
- Fathom- it is the distance between the tips of the outstretched arms.
- Pace- It is the distance between two walking steps.

These units were considered unreliable because they can vary from person to person as the length of hands and feet are different in different people.

Difficulties with non-standard measurement systems:

Measuring lengths using labelled thread is also a non-standard system of distance measurement. Some difficulties naturally arise in measuring distances. Suppose your teacher asks you about the length of your desk. You can easily find the length in units of hand span or thread length. However, if he asks you to measure the distance between the school and your home or between the sun and the earth, then you will face difficulties. You cannot measure these distances using your hand span, *gilli- danda,* thread length, etc. Such quantities required a standard scale of measurement.

System of Measurement

To measure various quantities such as distance, height, width, weight, etc., a system of measurement is needed.

Measurement of LengthSo, you have learned the standard methods of distance measurement. Here are the key points of the lesson for you.

- **Instruments for measuring lengths**

  Various types of instruments are used to measure lengths and distances. The use of a measuring instrument depends on the nature of object and the type of surface of object.

- A metre scale is used to measure the lengths of straight objects. For example, the length and width of a table, the length of a book, etc.

15 cm scale

Metre scale

- A measuring tape is primarily used to measure accurate lengths of curved surfaces. For example, to measure the girth of a tree, to measure the size of your chest, etc.

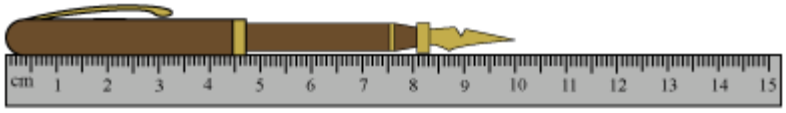
  A tailor uses a measuring tape for accurate measurements.

- **Proper measurement**

- To measure the length of any object, you must follow some steps:

  Step I: First, choose an appropriate instrument for the measurement of the length of the given object.

  Step II: Place the chosen scale in contact with the object along its length. Make sure that the zero mark of the scale is in contact with one end of the object.



  Step III: Then, take the reading on the scale that is in contact with the other end of the object. This reading shows the length of the object.

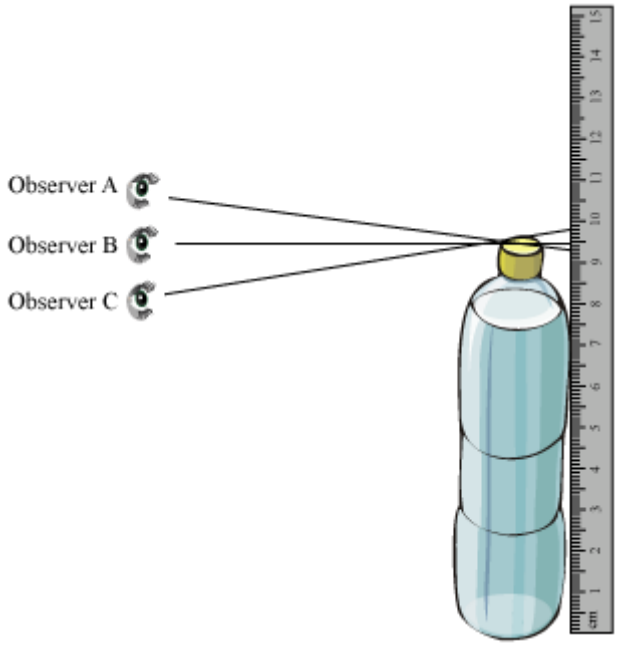
- To measure the length of an object using a broken scale, you should follow these steps:

  Step I: Place the broken scale in contact with the object along its length.

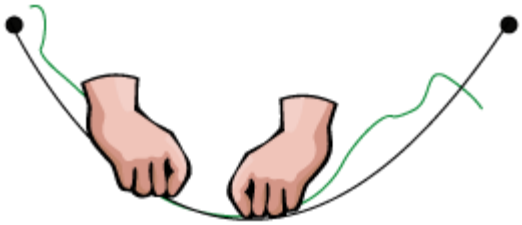
  Step II: Then, take the readings on the scale at both the end points of the object and then, subtract both the readings. This gives the length of the object.

- **Precautions while measuring lengths**

- While taking a measurement, your eye should be focussed exactly at the point from where the reading is to be taken as in case of observer B in the given figure.



- **Measurement of curved lines**



You can measure the length of a curved line using a string. For this, draw a curved line on your notebook. Then, fix a string on one end of the curved line. Thereafter, place the string on the drawn line. Using your fingers and thumbs, stretch the string along the curved line tightly until you reach the other end of the line. Then, remove the string and measure its length using a metre scale.

It will give the length of the curved line.

One very important thing is, do not use elastic tape to measure the length because it might stretch and may alter the result.
Try to measure the circumference of a circle using a section of thread.

Types of MotionSo, you have already learned that all the objects around us can be classified as either **moving** or **stationary**. This classification of object is based on whether they change their position with time or not. If an object changes its position with time, then it is called moving object.

Here, we will discuss different types of motion of moving objects and the basis of their classification.

Classification of motion:

The motion of objects can be classified depending on the way they move. Let us learn more about the aspects of these types of motion.

i) Translatory motion:

In this motion, the object moves in a line such that each point of the object covers equal distance in equal time. It is further classified into two types:

a) Rectilinear motion:

Now, we can define rectilinear motion.

An object is said to have rectilinear motion if it moves from one point to another in a straight line.

Another very common example of rectilinear motion is the motion of a moving car on a straight road.

Try to find more examples of rectilinear motion.

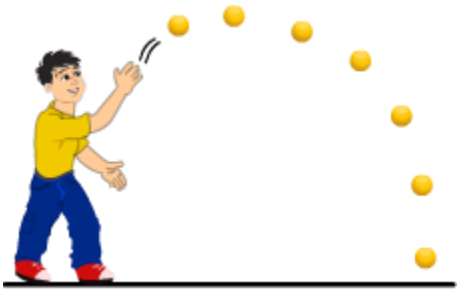
Can you compare the different motion given in the figure?

The motion of a convoy is uniform as the speed of all the vehicles is same throughout. This type of motion in which no change in speed of the object is observed is known as **uniform rectilinear motion.**

While the motion of launching rocket is not uniform as the speed of rocket goes on increasing as it goes higher. This type of motion in which the change in speed with which the object moves is observed is known as **non-uniform rectilinear motion.**

b) Curvilinear motion:

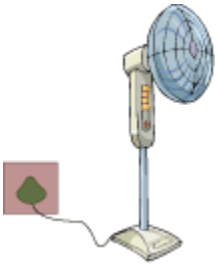
An object moving in a curve path is said to posses curvilinear motion.



Circular motion:

An object is said to possess circular motion if it moves from one point to another in such a way that its distance from a fixed point always remains constant.

You have already seen an example of circular motion in the animation. Another simple example of this type of motion is the movement of the blades of a fan. During their motion, the blades move from one point to another, but the distance between them and the head of the fan remains the same.



List some objects in your house that possess circular motion.

Periodic motion:

An object is said to possess periodic motion if it moves in such a way that it repeats its motion after a certain interval of time.

Other examples of periodic motion are the motion of a swing, the motion of a guitar string, the motion of the head of a drum, etc.

List these objects in a table along with their types of motion. Does any visible part of the sewing machine have a periodic motion?

All oscillatory motions can be termed as periodic motions but all periodic motion can not be termed as oscillatory motion.

For example movement of the pendulum is an oscillatory motion as well as periodic, while rotation of the earth is a periodic motion but not oscillatory. Therefore, the type of motion in which the object moves to and fro repeatedly about a mean or a fixed position is known as **oscillatory motion.**

Vibratory motion is a kind of oscillatory motion in which a part of body

always remains fixed and the rest part moves to and fro about the fixed position. Also, in vibratory motion, the shape and size of the body changes.

The motion which does not repeat itself after regular interval of time is called non-periodic motion.

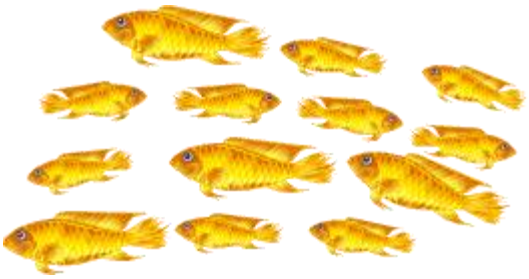
iv) Rotational motion:

An object is said to possess rotational motion if it whirls around a fixed axis that passes through it.

The hands of a wall clock move about the fixed center. Hence, a clock's hands have rotational motion. But remember, the tips of the hands of the clock have circular motion.

viii) Random Motion

If the object changes its direction and speed continuously without following a particular pattern then it is said to possess **random motion.**



For example, movements of fish, butterfly etc. shows random motion as they do not follow a particular direction.

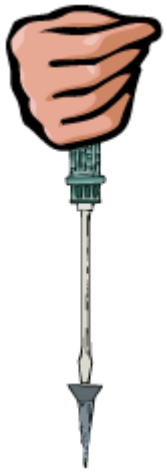
Some moving objects have more than one type of motion. Let us see.

Combination of different types of motion

- **Rolling coin**

A coin rolling on a floor moves forward by rotating about an axis perpendicular to the surface of the coin. It shows the properties of both linear and rotational motion.

- **Screw motion**

When you tighten or loosen a screw with the help of a screwdriver, you rotate it clockwise or anticlockwise. As a result, the screw moves straight inwards or outwards, respectively. Hence, you can easily say that screw motion is linear as well as rotational.	

Which type of motion does a moving top have?

Do you want one more example of the combination of motion?