पढ़े चलो, बढ़े चलो
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RMSA MIZORAM

Student Workbook

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CLI
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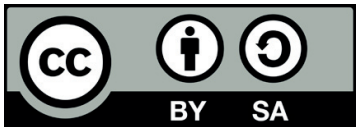


CLIx/Eklavya Team
Version 2017-PE01

CONTENT

MOTION

If you were to drive or design a scooter, a car, a truck, a train or an airplane you need to know about speed, velocity, acceleration etc. These terms helps you describe and analyze motion. You can also use these terms to analyze a cycle ride, a walk, an animal's motion, a shooting star etc. This chapter will help you to learn the scientific

way to investigate and analyze the motion in a straight line.

Content

Measurement

1.1 Importance of measurement

In our day to day life we use many different measurement units like kilogram, meter, kilometer, liter etc in different contexts. There are different equipment such as scale, weighing balance, beaker etc.to measure these physical quantities.

In the scientific world, there are standardized units for all the physical quantities. For example kilogram is the unit of mass, meter is the unit of length.

Standardization of measurement units is important for uniformity. For example, 1 meter length in India will be equal to 1 meter in U.S.A. too.

To reduce error one should:

1. Repeat the measurement activity number of times.
2. Take care of the least count of the scale.
3. Take care of other parameters that may affect the activity.

1.2 Make your own measuring tape

Making a paper tape of at least two-meter length

Make your own paper tape

Material Required:

1. Three A-4 size paper sheets (one side used paper will do)

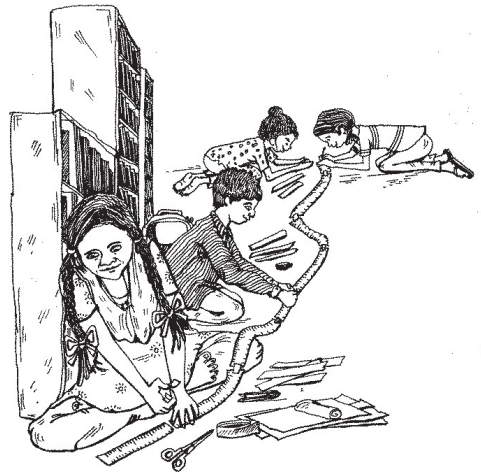
2. A sketch pen

3. Scissors

4. A scale

Process to do the activity:

1. Use a scale to draw some lines on paper, draw them one centimetre apart from each other.



2. Cut the paper strips along the drawn lines.

3. Join the paper strips together, lengthwise, using gum/tape on any one end

4. Choose any side of the strip as the starting point. Start marking the lines from 0, 1, 2…..200.

Your centimetre tape is ready to use now. You can coil it to keep it in your pocket.

1.3 Measurement of steps

Estimation of length and its standardization

Let's measure the length of your steps:

Can you estimate the distance between the two walls of your classroom?

Can you estimate the distance between the front door of your classroom and the door of your principal's room?

Can you estimate the distance between your home and the school?

Let's work out for the distance between your home and the school :

You have made a measuring tape. For shorter distance, you may use it but as the distance becomes larger, measuring the entire length using only 2-meter long tape becomes tedious.

There is another way to work out the approximate length to the school from home or vice versa.

You can use your step to measure these long distances. You just have to count the numbers of steps that you take to reach the school from your home.

1.4 Standardization Of Scale

<u>Make Your Step Your Scale</u>

Material required:

1. Empty space to walk

2. A paper tape

3. Chalk/Marker

Process to do the activity:

1. Find an empty space near your classroom, it could be a corridor or any other empty space. The only condition is that you should be able to walk and take at least 20 steps naturally.
2. Mark a starting point to begin your walk.
3. Measure 10 meters from this point. That will be the end point of the walk.
4. Walk on it a couple of times.

Is your step count always the same?

Now walk on the path 10 times and make a table to record the data. Every time count your steps and fill in the data in the table given.

Has your step count been varying a lot?

Is there a range within which these numbers fall?

You have done an important finding -"The range". The range helps you to predict that if you walk the distance 11th time, the number of steps you will take to cover the same distance will be within the range.

Walk another 5 times on the path to test if your prediction was right or wrong.

Table 1.4: Step Count table

1	2	3	4	5	6	7	8	9	10

1.5 Average Length Of A Step

What is the average length of your step?

One more discovery to be made

You have walked on the 10 meter path 10 times, now please work out the average of all 10 numbers in your notebook.

Divide the distance you walked with "the average" to find out the average length of your step.

So, the average length of your one step = 10 meter/average number of steps

What is the average length of a step?

This number is the average number of steps you take to cover the distance of 10 meters.

Look at this number and compare it with the numbers in the table.

Are all the numbers of the table close to this number?

Now you have two predictive powers in your hands: one is "the range" and second is "the average".

<u>Test your predictive power:</u>

Walk a much longer distance that you can measure with

your paper tape. Now count your steps while you walk. Multiply it with the average length of your step to get the length of the distance.

Verify your finding:

Now use your paper tape to measure the same length that you just measured using your steps. ***Compare these two numbers. Are they close enough?***

Distance from your home to the school:

To know the distance from your home to the school, count your steps to the school from home every day.

Please make the following table in your notebook to keep a record of these numbers.

Table 1.5: Number of steps

Number of days	Number of steps

Average Number of Steps = ...

The distance between your home and the school

*= Average number of steps * the average length of your step*

Hurrah!

Riddles of Motion

Do you now realise that motion is a riddle in itself? Are you interested to explore it further?

Let us summarize what we have understood about motion in this unit

You feel something is in motion if it changes its position or speed with respect to you or with respect to some other object in your view.

When we say that a boat is in motion, we consider stationary objects such as trees, land etc. as our reference point and see the change in position of the boat with respect to these objects. Also, we consider the change in time that takes place when a moving object reaches from one point to another.

If two objects, say our two boats, move at the same speed in the same direction, then by sitting in one boat and observing the other boat alone, you would not be able to say if that boat is in motion or not. Because, as far as its motion with respect to your boat is concerned, it is not moving.

That is why we don't feel the motion of the earth's rotation and its revolution around the sun because we are moving with it at the same speed.

We have also noticed that the observer plays an important role in describing a motion. The path a moving object covers varies according to the position of the observer. For example, as you saw in the video of the ball and the moving car, from front view it appeared that the ball is not coming back at the same position from which it was bounced. Whereas, from the top view of the observer moving with the ball, it appeared that the ball returns to the same position from where it was bounced.

All motions are relative!

Let us now explore some other concepts used to describe and analyse motion such as Speed, Average Speed, Instantaneous Speed, and Constant Speed.

Speed

You watched the scooter video and worked out average, instantaneous and constant speed.

In real life, it is difficult to maintain constant speed as there are so many hurdles on the way in the form of vehicles and bumps on the road, etc. You can get constant speed but for short time intervals only.

That is why the speed that we commonly encounter or talk about in our daily life is average speed. Average speed of an object is the total distance covered by the object divided by the total time taken to cover this distance.

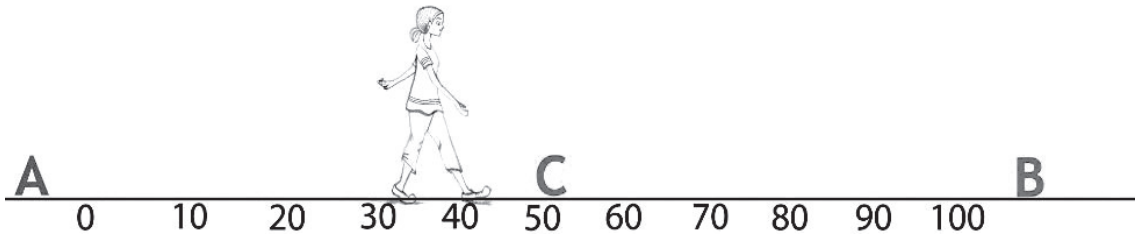
To find the instantaneous speed at any moment, you just need to look at the speedometer of the running vehicle.

However, for an object moving with constant speed, the instantaneous speed and the average speed will be the same.

In the next lesson we will learn what is displacement and what is its relation to velocity?

$$\text{Average Speed } (v_{avg}) = \frac{\text{Total Distance } (\Delta d)}{\text{Total Time } (\Delta t)}$$

Displacement and Velocity



There is a subtle difference between distance and displacement.

The distance between two points could be anything depending on whether it is measured straight or long and winding, but displacement will always be the shortest distance. Which means the straight

line from the initial point to the direction of terminal point of a journey is displacement.

These ideas were explained using the example of Lily's journey on a straight path. Further, speed and velocity were also elaborated using the same example.

Now you know that to calculate speed you use total distance covered in the total time spent whereas to find out velocity you consider total displacementcovered in the total time.

You noticed that distance and speed do not have information of direction and they could be zero or positive, but never negative. While displacement and velocity have an extra information of direction and they could be positive, negative or zero.

So, we need distance and displacement covered by an object in a time period to know its speed and velocity respectively.

In the next chapter, you will get to know how speed or velocity can be represented visually.

Graphs of Motion

5.1 Introduction to graph

Graph is also a way to represent motion

In earlier classes you have used graph for various exercises. In case you want to refresh your memory, there is a video on the clix platform explaining how a Graph paper looks like and what does horizontal and vertical line mean?

In motion you deal with distance-time graph, displacement-time graph, speed-time graph, velocity-time graph and acceleration-time graph.

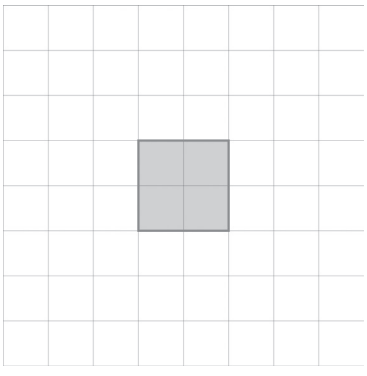
On the graph, time is always represented on the X axis and distance, speed or velocity is represented on the Y axis in context of motion.

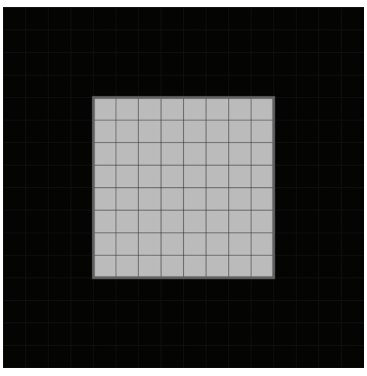
The relationship between these two helps you to discover the nature of motion.

5.2 Let's Check

How much do we know about graph?

1. In the two adjoining images, the area covered by the shaded part is:
   a. not equal
   b. cannot say anything
   c. equal



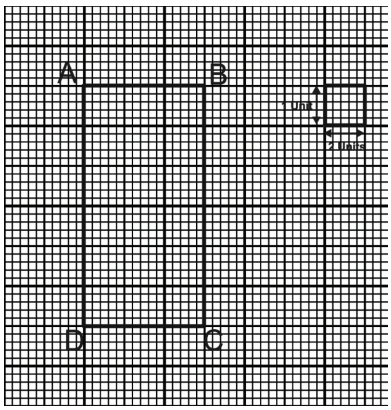


2. Shape ABCD covers 18 squares. Suppose the height of the square is 1 unit and width is 2 units, then the height and the width of the shape ABCD will be:

   a. Height = 3 units, Width = 6 units

   b. Height = 6 units, Width = 6 units

   c. Height = 6 units, Width = 3 units

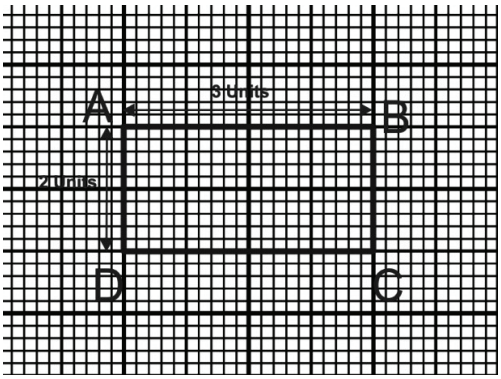


3. Shape ABCD has height 2 units and width 3 units. Area covered by the shape is:

   a. 6 unit

   b. 6 unit^2

   c. 10 unit^2



5.3 INTERPRETATION OF GRAPH

Tortoise and rabbit's race

Let's begin with a famous story of the race between a tortoise and a rabbit that you might have heard.

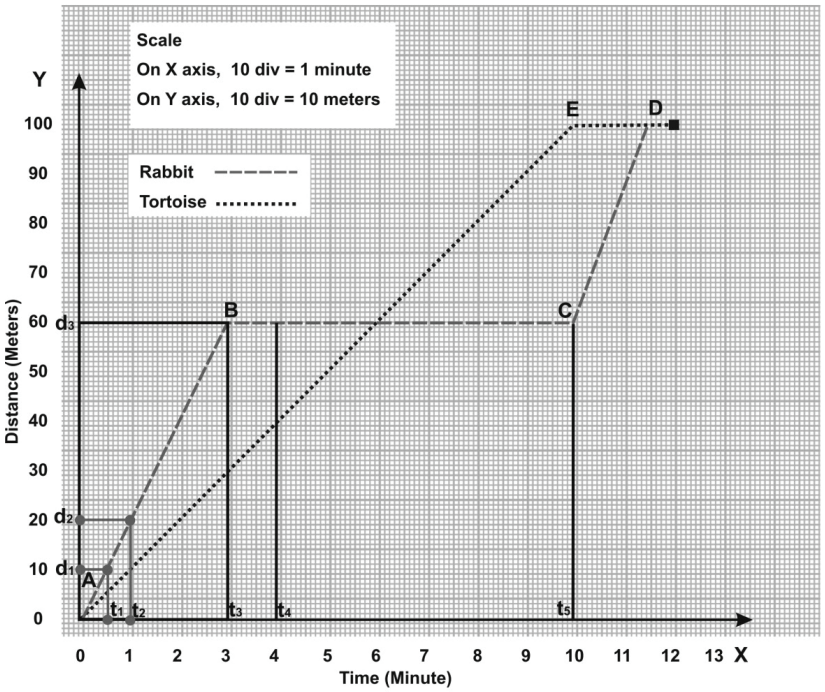
In the story, the rabbit runs faster and rest on the way while the tortoise runs with slower speed but moves continuously till the end point. Finally slow and steady runner wins the race.

The graph below depicts the story of the race between a tortoise and a rabbit.

To tell your friends how both rabbit and tortoise were moving over time compared to each other, you need to know how to interpret the graph.

On the line segment AB in the graph, distances d_1 and d_2 corresponds to times t_1 and t_2, which shows position is changing with respect to time. That means line segment AB in graph represents motion.

Similarly, line segments CD and AE also represent motion. Now, you can see on the line segment BC,



distance from origin d_3 corresponds to time t_3. Further, distance d_3 also corresponds to time t_4. For two different times we have same distance from the origin. So for this segment of graph, position is not changing with time and this represents the state of rest.

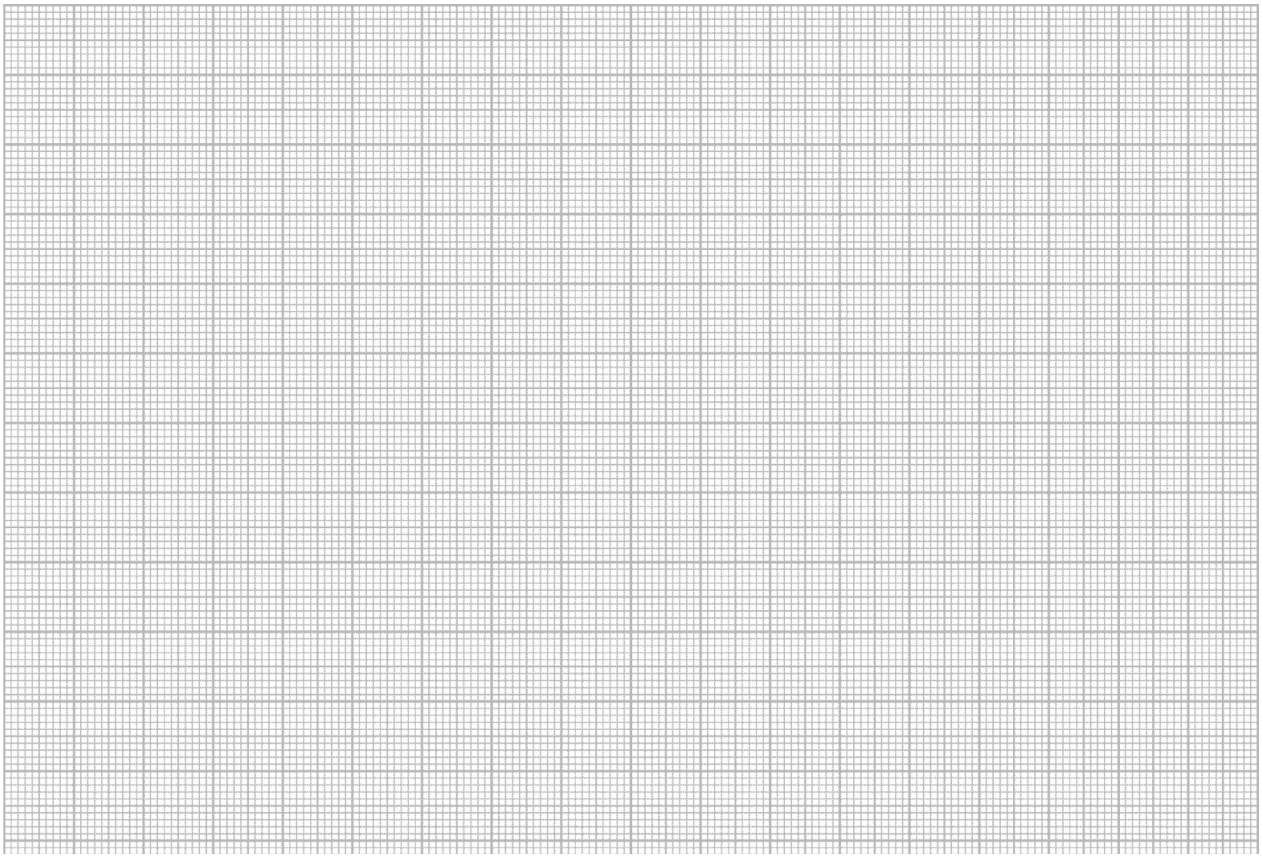
Can you figure out which curve (ABCD or AED) corresponds to rabbit's motion and why?

5.4 Position time graph

LET'S DO EXERCISES

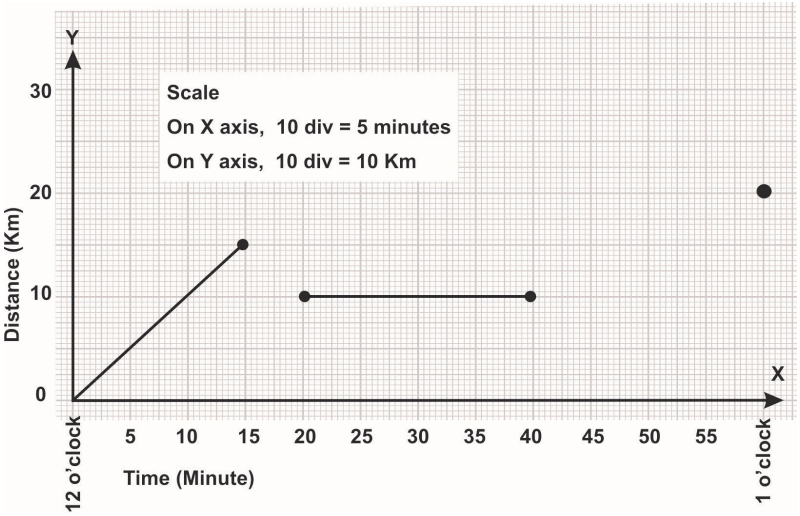
1. Use the table given to make another graph of the race between the tortoise and rabbit.

Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	11.5
Rabbit (meter)	1	20	40	60	60	60	60	60	60	60	60	87	100
Tortoise (meter)	0	10	20	30	40	50	60	70	80	90	100	100	100



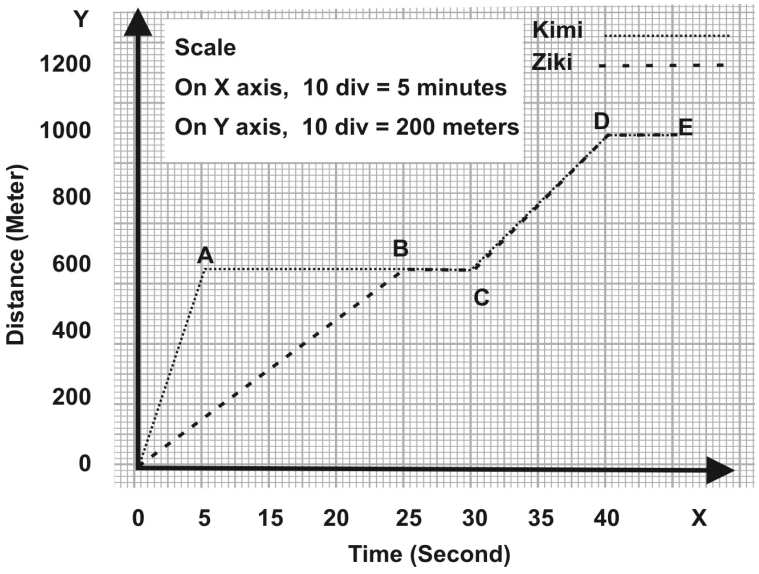
2. A goods train is going from Itarsi station to Bhopal station. At 12:00 PM it leaves Hoshangabad and after 15 minutes at an upward track, its engine and brakes fail and the train rolls backward for 5 km and stops on a plane track. The driver and the train guard inform the controller. A new engine takes 20 minutes to arrive there. The new engine pulls the train and helps it to cross the valley in next 20 minutes. The graph and table given below is based on this story but are left incomplete. Can you draw the remaining portion of the graph and fill in the table as well?

Time (min)	12.00	12.15		12.40	
Distance (km)	0.0		10		20



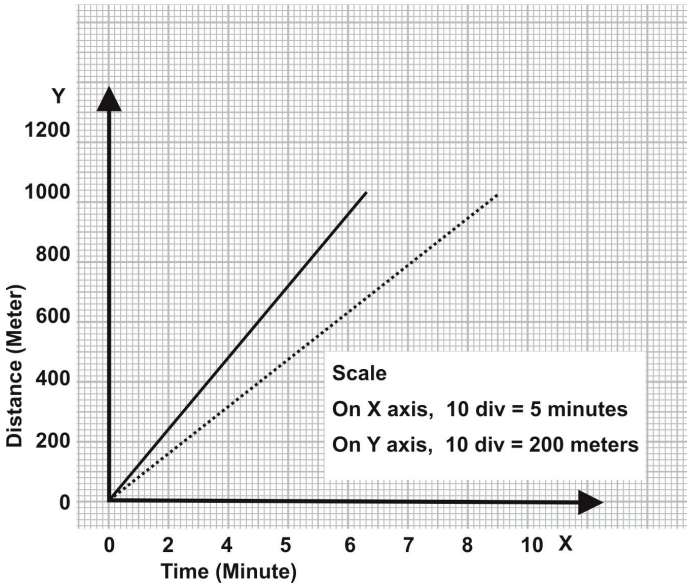
3. *The graph given below shows the journey of two sisters Kimi and Ziki from their home to the school. Kimi takes a stop at a book shop. After a while Ziki also joins her. Then from the shop they go to the school together. Fill up the table given using the information given in the graph.*

Who takes less time to reach the shop?	
For how long did Kimi stay at the shop?	
Can you identify the part of the line depicting Kimi's stay at the shop?	
What was the distance between the school and the shop, between the home	



Time (sec)	Kimi (m)	Ziki (m)
0		
5		
15		
20		
25		
30		
35		
40		

4. *Vimal and Abid participate in 1000 meter race. The slope of the graph shows their run. Who ran faster, Abid or Vimal? Why do you think so?*



5. *A school bus with kids leaves the village at 10 AM. At 11 AM when it reaches the bridge, the river is flooded and flowing over the bridge. The bus has to stop there for two hours. At 1 PM, when the river flow goes down and the water level is lower than the bridge, the bus crosses it. It takes the bus another hour to reach the school. By that time the school is already over. The bus begins its return journey right away. In just one hour it drops the kids at the village. Depict this story on a graph.*

5.5 Speed time graph

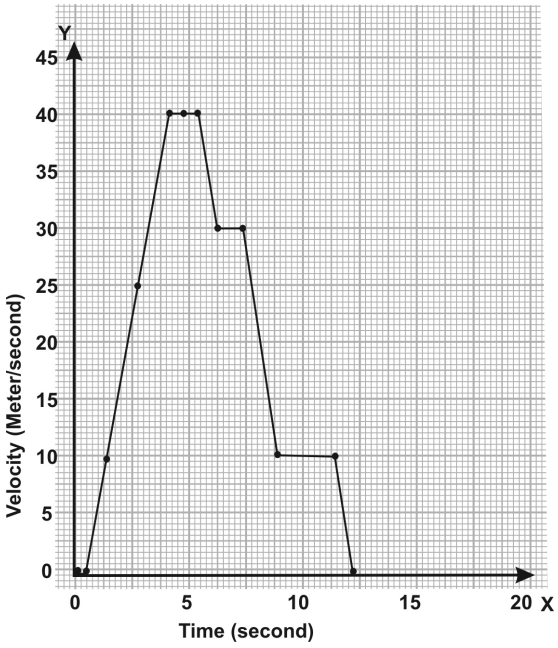
Let's do exercises

1. The graph represents a motorcycle ride.

(i) Mark the point(s) on the graph that shows the motorcycle is at rest.

(ii) Mark the point(s) on the graph that shows motorcycle with constant velocity.

(iii) Complete the given table based on the graph.

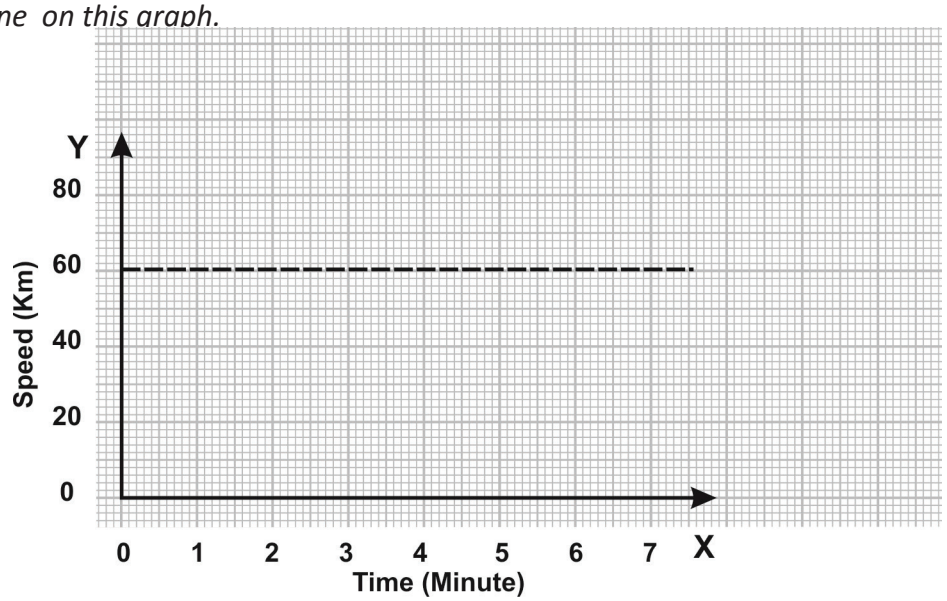


(sec)	Speed (m/s)
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

2. Police control room receives an information that a black suspicious car is going to pass, please stop it and check it. At 12'o clock the car moves past the front of the station. The police start their patrolling jeep exactly at 12'o clock but for 2 minutes they could not move the jeep due to some engine issues. Please answer:

(i) If the car is moving still why the line is running parallel to the x axis horizontally?

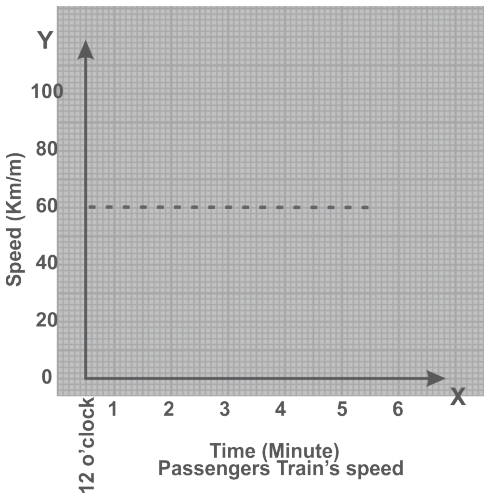
(ii) Please draw the first 2 minutes of the police jeep when it was not able to move. Draw the line on this graph.

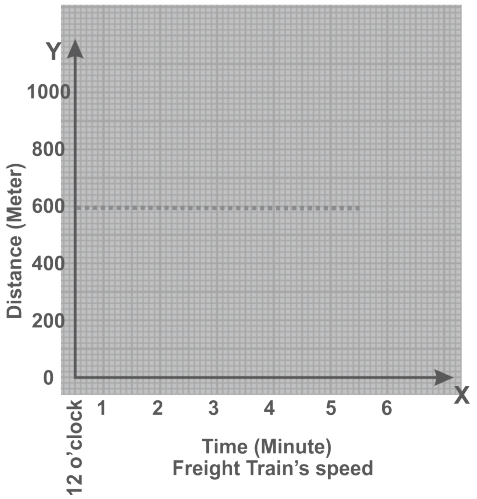


3. Look at the graph and answer the following:

(i) Please identify which train is in motion and which is at rest.

(ii) Tell us how these graphs are different.

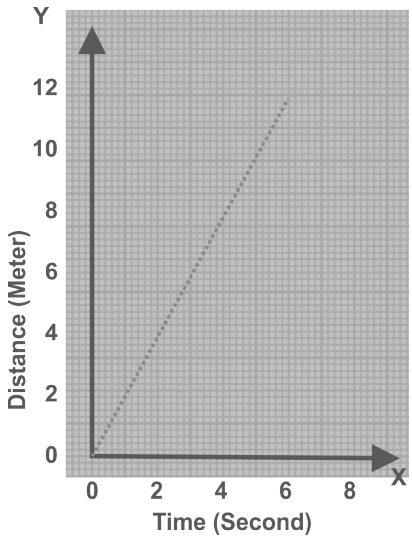


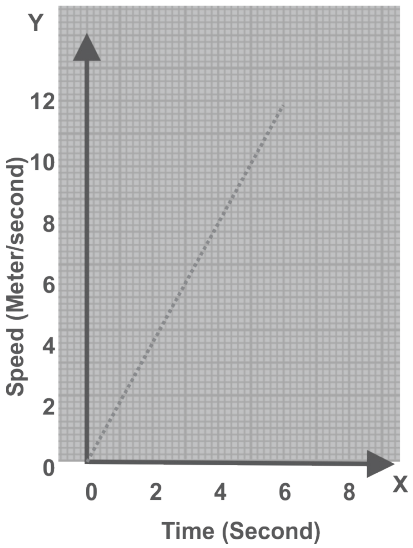


4. Use the data given in the table below to plot the graph of two objects moving with different velocities.

Time (sec)	0	1	2	3	4	5	6
Object 1 speed (m/s)	0	2	4	6	8	10	12
Object 2 speed (m/s)	0	1	2	3	4	5	6

5. *Look at these graphs – Do they represent same kind of motion? How do they defer from each other?*





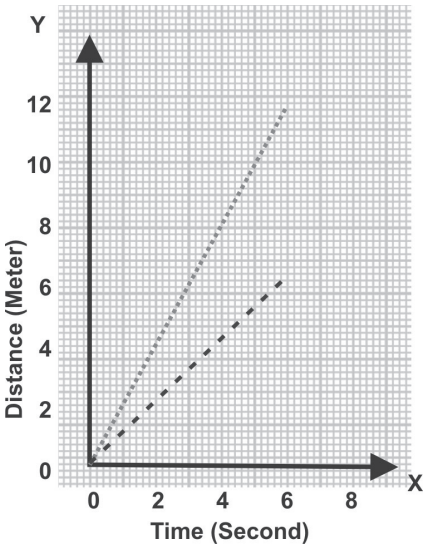
Look at the velocity-time graph of a moving object. The area enclosed by the velocity-time curve and time axis gives you the total distance covered by the moving object. You will learn this in the equation of motion. Please fill up the blanks to get the distance for the graph given below.

Area of a triangle = ½ x a x b

= ½ x.....x.....

= 36 unit

You will use this method to find the distance in section on equation of motion, where you will learn how to relate four quantities to get equations to work out complex problems of motion.



5.6 Let's check

Here are the few questions based on what you have learnt, let's check and try to answer them:

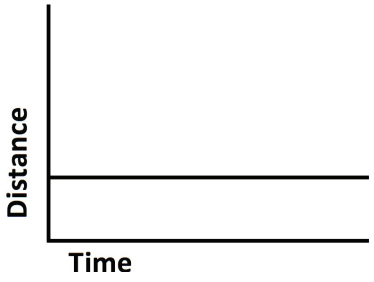
1. What does the graph explain about the state of the object?

   a. Object is at rest

   b. Object is accelerating

   c. Object is moving with a fixed speed

   d. None of the above



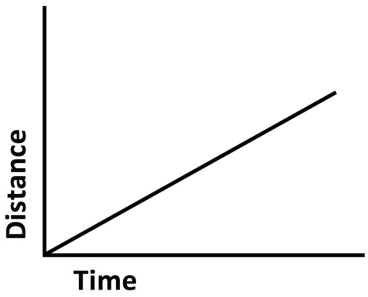
2. Now, what do you think this graph explains about the state of the object?

   a. Object is at rest

   b. Object is accelerating

   c. Object is moving with a fixed speed

   d. Both (B) and (C)



3. Compare the slopes and choose the correct option:

a. (1) is accelerating at a faster rate

   (2) is accelerating at a slower rate

b. (1) is accelerating at a slower rate

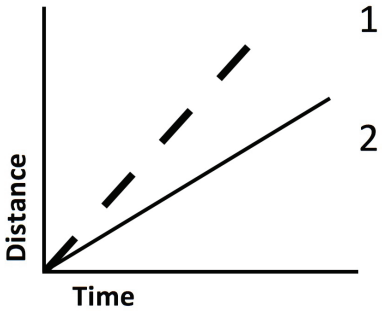
   (2) is accelerating at a faster rate

c. (1) is moving at a slower speed

   (2) is moving at a faster speed

d. (1) is moving at a faster speed

   (2) is moving at a slower speed



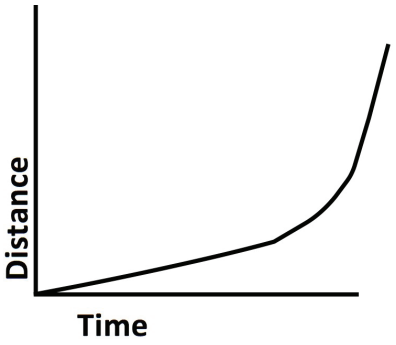
4. Now, come on... how do you interpret this curve?

   a. None of the above

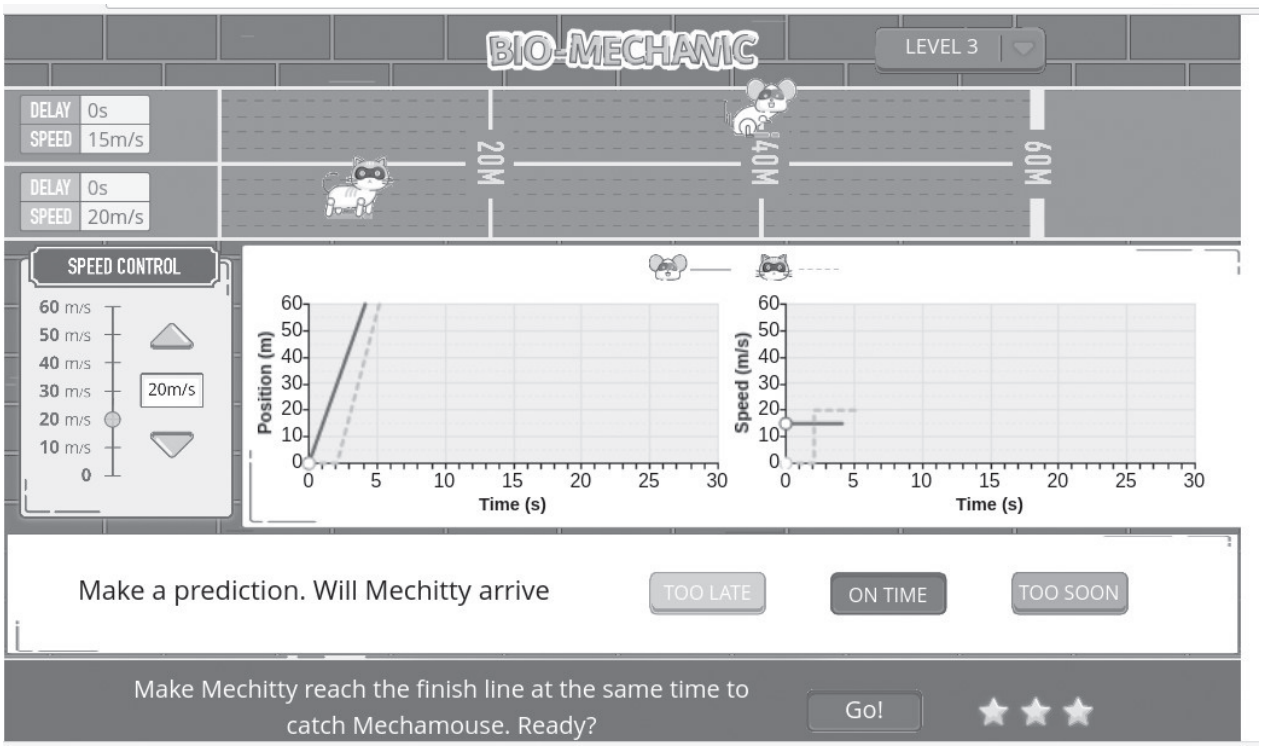
   b. The object is accelerating for the whole time

   c. The object is stationary for some time then accelerating

   d. The object is moving at a constant speed



Run Kitty Run Game



In the game you had various tools – time (delay), speed and graph to work out the speed of your cat to match the speed of the mouse which was being controlled by the computer itself.

You also got an opportunity in the game to link the motion on the track with the position-time graph.

At some level you also change the slope on the track to change the speed of your kitty.

The game also helped you to check your estimations about the speed or time that the cat would take to catch the mouse.

Hope you enjoyed the game.

How to figure out change in velocity

7.1 A way to investigate motion

Is the cycle moving with the same speed between the two points or is the speed varying?

If the speed of a moving object does not change with time, we call it to be in uniform motion.

Say, if an ant covers 1 cm distance in one second and continues to cover same 1 cm distance in every second we can say it is in uniform motion.

If the speed of a moving object changes with time, we call it to be in non-uniform motion.

Say, if another ant covers 1 cm in first second, 2 cm in the next second, 1.5 cm in the third second we can say it is in non-uniform motion.

Non-uniform motion is quite common, everyday examples including a bus traveling on the road, birds flying, breeze blowing, water flowing. It is difficult to find the examples of uniform motion around us.

To be precise, we need to get some data to prove our point in science. Simply saying something does not work in science.

So how do you prove if a motion is Uniform or Non-Uniform?

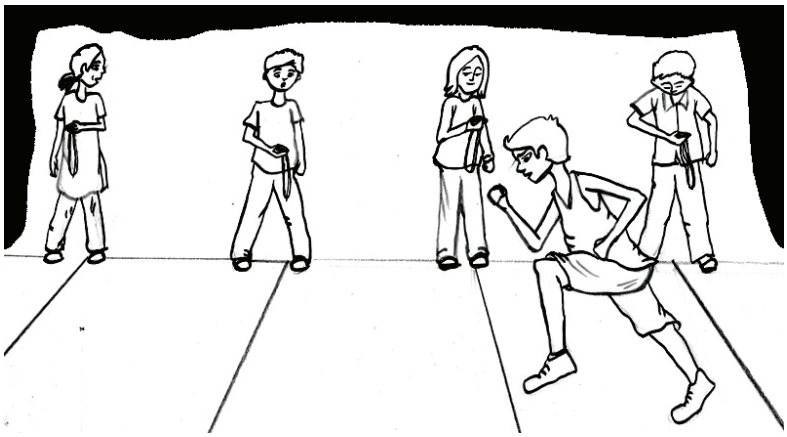
Before we learn a method to investigate motion, let us try to answer the following questions:

Suppose you run a 50-meter race. Could you estimate whether you will run from start to finish at the same speed or whether your speed will vary?

You may have also ridden a bicycle down a slope without pedalling. Did its speed increase as it rolled downhill? Did the speed keep on increasing?

7.2 Discover your own motion

A running race activity



Investigating motion of a runner in a race and analysing whether the motion of a runner is uniform or non-uniform.

You need to organize a running race event. The entire class will participate in it in groups of six members each.

Following are the details of the activity to be conducted.

Material required to perform the activity:

1. Measuring tape or meter scale; to measure the track
2. Four stopwatches per group; to record the time
3. Paper and pen; to note down the data

Process to do the activity:

1. Find a track at least 40 meter long and divide it into four equal segments. For example a 40 meter track could be marked at the intervals of 10, 20, 30 and 40 meters.
2. Place one of the group members as a timekeeper with a stopwatch at each segment to record the time.
3. Set a starting point and ask one of the group members to run till the end point.
4. Note down the data for the run.

With a loud sound “Start” the person starts the race. All timekeepers keep their stopwatches to zero. Once the runner passes the first segment, the first timekeeper standing there stops his stopwatch. The same process is observed for each segment till the runner crosses the end segment point.

7.3 Workout change in speed of runner

Change in speed: running race activity

Collate data of the running race activity and calculate the average speed of the runner. This will give you an insight whether the speed of runner is uniform or non-uniform throughout the race and if there is any variation of speed through the various segments.

Hope all of you have looked at your data. Now let us reflect on the following questions before moving ahead.

Table 7.3 (a): Time Taken **Note: You may also choose a track of different length and change the table accordingly.**

Username of the participant	Time taken (sec) for Segment 1 (0-10 meter)	Time taken (sec) for Segment 2 (10-20 meter)	Time taken (sec) for Segment 3 (20-30 meter)	Time taken (sec) for Segment 4 (30-40 meter)

Table 7.3 (b): Average Speed

Username of the participant	Average Speed for Segment 1	Average Speed for Segment 2	Average Speed for Segment 3	Average Speed for Segment 4

Did you take same time to run each segment? Was your run uniform or non-uniform?

You can use the following equation to calculate the average speed. Do not forget to write the unit of speed.

$$\Delta V = d_1 - d_0 / t_1 - t_0$$

7.4 Discussion time

You have done the activity and collected the data. You may have experienced something that you might not have thought of. Here are few questions for you to analyse what you have done.

Do you have same average speed in the different segments of the track? If no, then what could be the reason(s).

If you had only initial and end points, would your average speed give you any indication of the way your speed varied while you were running?

Is the speed maximum at the end point of the race? Did you run so that your speed kept increasing from the beginning to end?

Did you take the same time to run each segment? In the race, did you run with constant speed?

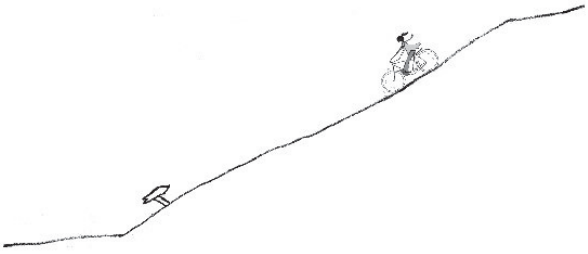
If the motion for a particular time interval is uniform, what is the possibility of the motion becoming non-uniform if the time interval is shortened?

In principle, we can make the time interval shorter and shorter. But in reality, there is a limit to what we can measure. So the time interval should always be clearly specified.

If we analyse the data of all the runners in your class, we can find out who the fastest runner is and who is fastest in each segment. The running example gives you an idea about one kind of non-uniform motion where the change in velocity is irregular.

7.5 Motion in inclined plane

How do you run on a slope



Suppose you are riding a bicycle on a hilly road. From the running race activity, you know that to predict the nature of motion we need to record the distance covered by an object in shorter and equal time intervals.

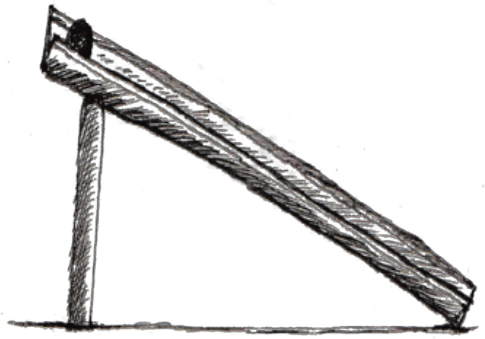
For a cycle on a real road, it will be difficult to record data – there will be other people and vehicles on the road, it will be difficult to find the right place to sit and spot the cycle etc.

In that case, there is a need of designing an experiment that recreates the same event in your classroom. Using this you can observe some parameters of the event and make a close guess about the real life event.

This in general is called a control experiment or a model of a real life situation.

7.6 Rolling ball experiment

Control experiments help scientists study a system in great detail



Now, let us design a control experiment that will be similar to the bicycle ride on the slope. It will help you to record data with better accuracy. Here we are replacing road with an aluminium or wooden plate and cycle with a steel ball or a marble. We are calling it as "Inclined Plane Experiment".

Material required to perform the experiment:

1. *An aluminium angle of length 160 cm*
2. *A marble or a steel ball of diameter 1 inch*
3. *Stopwatches*

Setting up the experiment:

Place one end side of the aluminium angle at a higher point to give it an inclined slope. If the ball is moving too fast, then it will be difficult to take precise measurements. For this, you need to figure out just the right height for the ball to roll down smoothly from the beginning to end.

Process to do the experiment:

1. *Choose any one end of the angle and mark a line across its width at 1 or 2 cm. This is your starting point or zero point at 0 cm mark.*
2. *Now measure the rest of the angle's length and divide it such that each segment is of length 30 cm. (You will get around 5 segments).*
3. *Raise one side just enough so that if you leave the steel ball from top, it smoothly rolls down till the end.*

4. Use stopwatches to record the time it takes to cover each segment.

Note: Please coordinate in your group so that everyone gets a chance to record the time.

7.7 Work out the change in speed of ball

Change in speed: rolling ball experiment

Here is the table to record the data of the experiment. Repeat the experiment as many times as needed to be able to record the time for each segment of 30 cm for at least four different runs.

Let us reflect on what we have done in order to analyse the speed of the ball:

Was it easy to record the time?

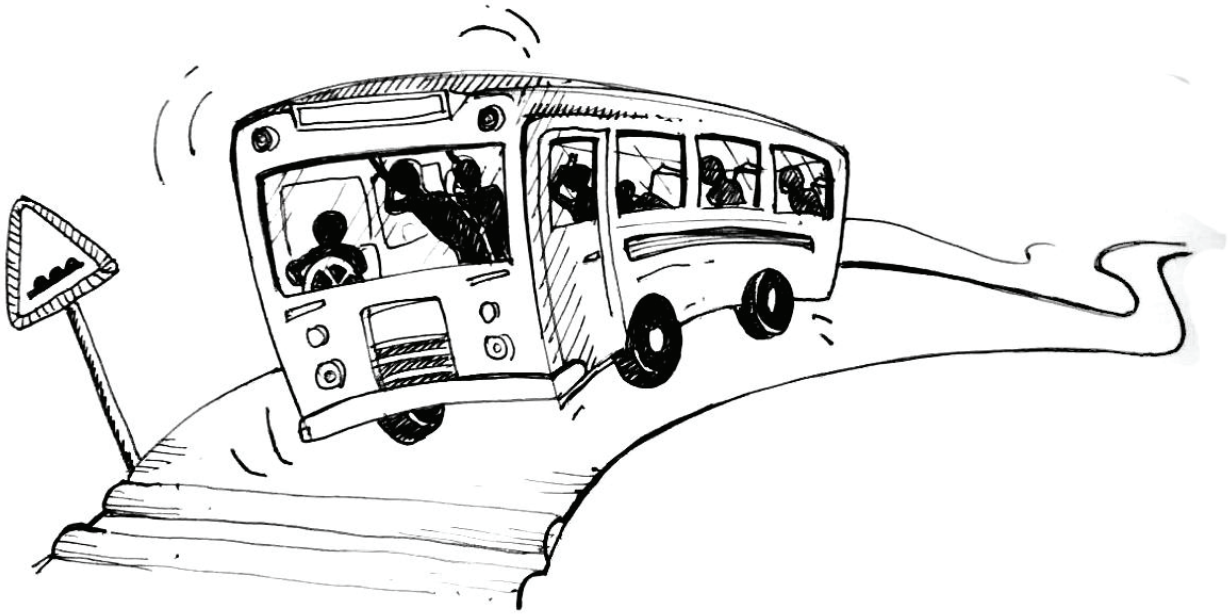
Was the error manageable or high?

Does the speed of the ball change with time?

Table 7.7: Rolling Ball Experiment

Segment	Time t for 1st run (s)	Time t for 2nd run (s)	Time t for 3rd run (s)	Time t for4th run (s)	Average time (s)	Average Speed (m/s)
0-30 cm						
30-60 cm						
60-90 cm						
90-120 cm						
120-150 cm						

Acceleration



In the previous lesson you have done the running race activity and rolling ball experiment. You observed that the speed of ball was not constant over the different length segments of the angular channel. To verify, you may refer the data you have collected. You worked out the change in speed in one second by analysing the data you recorded.

In this lesson, you went through a video analysis tool which allowed you to record the position of the ball at every 30th part of a second and further analyse its motion. It also generated position time curve for every set of data. In this way you analysed acceleration of the runner and the ball rolling down on a channel.

Further, the story of a bus was depicted on a velocity-time graph. The graph showed the accelerated, unaccelerated and decelerated motion of the bus.

At the end, you have also gone through an example of the train whose speed decreases to zero on applying the brake. It showed retardation.

SOUND

Notion of sound is prevalent around us so to laid foundation of sound is important. Hearing, speaking or producing sound is more familiar to us but do we really know what is sound, how is this produced, how does it propagate. Sound is intangible and could only be indirectly perceived/felt. Sound is common but physics of sound is not trivial.

Content

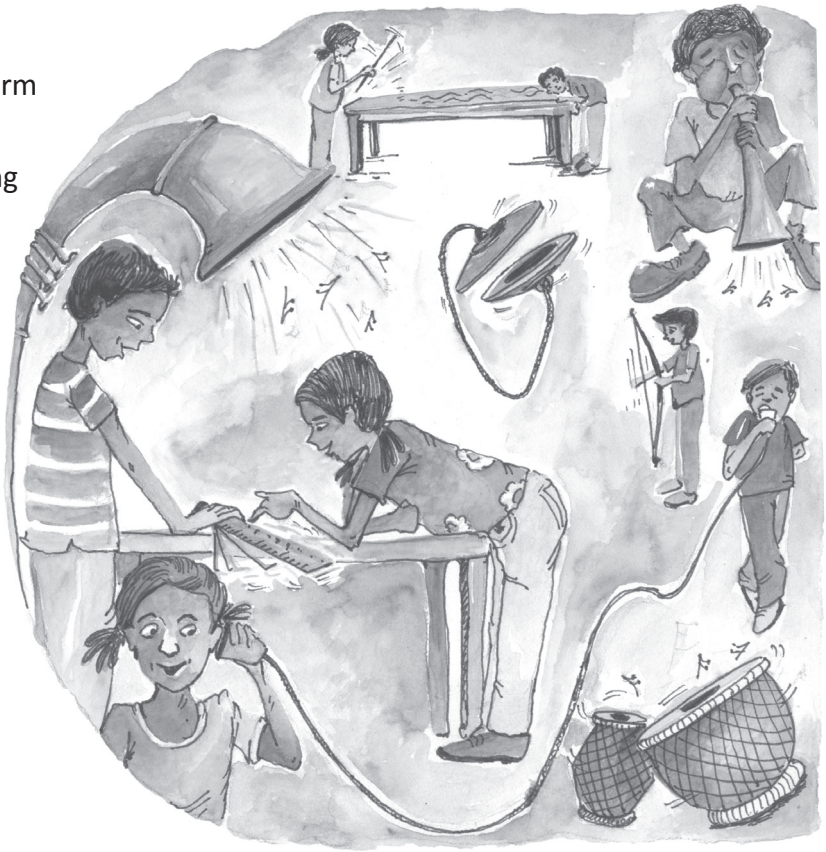
Sounds Around us

1.1 Introduction

All of you are familiar with the term 'sound', right!

You might have heard the chirping of birds, the rustling of leaves, the honking of vehicles, the melody of flute or any musical instrument i.e guitar, harmonium, tabla, dhol, the whistle of train, the bell of a cycle, the alarm clock, etc. We perceive all such sounds through our hearing sense, with the help of the organ-ear.

Let us explore and understand the sounds that we hear. What is sound? How is it produced? How does it travel?



1.2 Where are these sounds coming from?

Listen to the audio clip in the ***computer lab***. Identify the different sources of sound and list them down in your notebook.

Exercise

Sit somewhere in your house. For two minutes, close your eyes and listen to the different sounds that you can hear. Now draw a map showing these different sources of sound in your notebook or on a piece of paper. Please note down the time when you listened to these sounds.

1.3 A science classroom like yours

In the ***computer lab***, watch a video in which a teacher is dealing with the topic of 'sound' . To start with, she wrote on blackboard 'What do you want to know about sound?'.

Exercise

You might also have questions/queries regarding sound. Write your question(s) below.

1.4 Make sound(s)

(i) Make sound(s) with things around you

1. Make a group of 5 members.
2. Make a sound(s) using things around you - e.g. in the classroom/in your bag/ pocket. You have 1 minute to do this. It should be different from other groups.
3. Show it to the class.

(ii) Make sound(s) with things given to you

1. Work in the same group.
2. Make a sound(s) using the thing(s) given to you. You can combine two or more things and you can also use them separately. You have 5 minutes for doing this.
3. You can also use things other than what are given to you.
4. Show it to the class and explain the following:

   (a) How is the sound produced in the design that you made? Is it by blowing, hitting, plucking or in some other way?

   (b) Identify which part of the design is making the sound?

1.5 Sound is vibration

You noticed that sound, in most of the designs, is generally produced by blowing, hitting or plucking. When two objects hit each other, they vibrate and the vibrations produce sound.

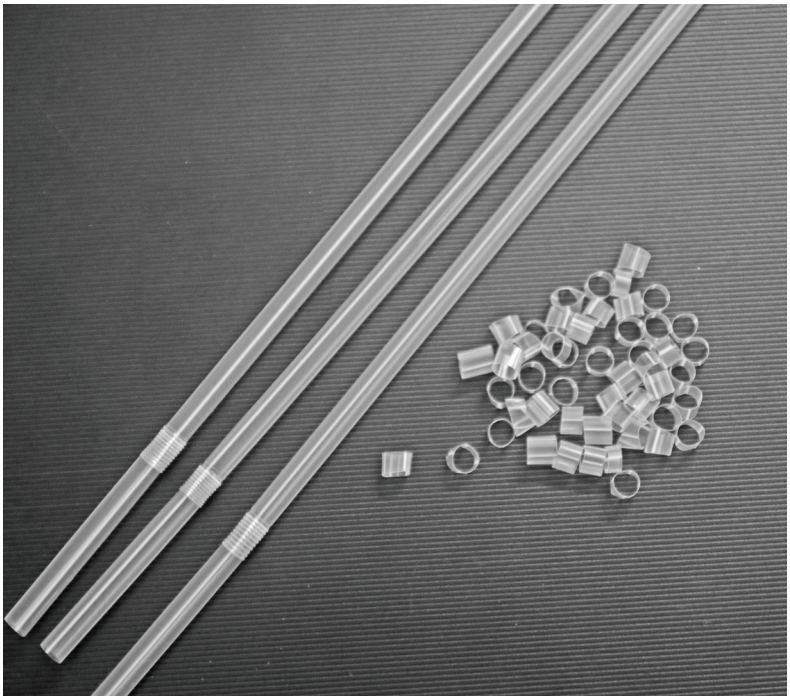
For further exploration
Some vibrations stay for a longer time, that is why we are able to listen to the sound for a longer time example- vibrations of a bell and of a steel plate. Other vibrations die out quickly and their sound stops immediately like the banging of the table, the stamping of your foot on the ground, the splashing of water on the floor. What other examples can you think of?

Try it out

If we ring a bicycle bell and cover it with our palm, the vibrations stop immediately. Why do you think this happens?

1.6 Seeing vibrations

We can directly see things vibrating or we can feel the vibrations by touching things. Let's do an activity to see vibrations when we make a sound.



Activity

Dancing rings on the base of the cup

1. *Hold a paper cup in an inverted position*
2. *Cut a straw to get rings (as shown in the figure)*
3. *Now put the rings on the base of the paper cup*
4. *Hold the cup with both hands close to the mouth and shout into it.*

Why do the straw rings jump around?

You can feel vibrations by touching. You can do this using the paper cup itself. Hold the paper cup inverted and shout. Ask your friend to touch the base of the cup while you are shouting into it.

You can also feel the vibration of your voice. Place your fingers gently against your throat and say 'aaaahhh' or 'hmmmm' or 'hooooo' or any sound- and say it a little loudly.

Where are the vibrations?

You may have experienced that sound is produced by moving a palm of your hand briskly near your ear, by moving a long stick briskly, by jerking a towel, by waving a flag, by clapping, by hitting of a stone on the ground etc. Here you can hear sound but it's hard to see the vibrations.

So, it is possible that sound is produced but you cannot see the vibration or vice versa.

Think of such examples where we do not see two things hitting each other but they produce sound and write about them here.

For further exploration

Hold a bottle opening near your ear and listen. Now fill some water in it and listen. Did the sound change? Now hold a glass or a vessel to your ear. What do you notice? How is the sound produced?

Knowing more about sound

2.1 Loudness

Loudness of the sound corresponds to its amplitude.

In the ***computer lab***, you can watch a video to see the amplitude of three balls moving to and fro from their mean position.

Amplitude is the maximum displacement of the vibrating particle from its mean position.

Amplitude using Audacity

In the computer lab, we will use a tool to "see" sound on the computer screen. There are several buttons at the top left corner of the tool. We are going to use the "record" and "stop" button in the tool. Keep the microphone close to the source of sound.

Suppose you choose to snap your fingers. Now press the "record" button. Snap your fingers gently and then snap them hard. Click on the "stop" button.

You can see that the louder sound has a bigger wiggle and the lower sound has a smaller wiggle.

You can say that the louder sound has higher amplitude than the lower sound.

Now choose the sounds that you want to "see". For example you can clap or bang the table or say "aaa" - change the volume of the sound and observe the amplitude of higher and lower volume. You can also look at the wiggle for the sound made by your design in section 1.4.

Changing volume means you are changing amplitude.

For Further exploration
What does the wiggle stand for? It shows the electrical signal that the microphone sends to the computer through the wires. But how does a microphone work? Are the ears our body's microphones? Do they also send a wiggle to our brain through the nerves?

2.2 Pitch

A shrill or piercing sound is also called a high-pitch sound.

We use one more term for shrillness - that is pitch. Shriller the sound higher the pitch. For example compare the sound of buffalo and of goat. Goat's sound is shriller than buffalo's sound. So, we can say that the goat has a high pitched voice and the buffalo has a low pitched voice.

In the computer lab, watch a video in which you can see the difference between a less shrill and a more shrill sound.

We saw that sound is vibrations. The number of times a particle/object vibrates in a second is called frequency. If it vibrates more number of times in a given time, we say that its frequency is higher. Frequency of vibrations decides the pitch of the sound. Higher the frequency higher the pitch, lower the frequency lower the pitch.

For further exploration

What is the frequency of the rotation of the ceiling fan?

As a ceiling fan speeds up, beyond a point we are not able to see its blades. This is a limitation of our eyes - we can't see things that move too quickly. The sound vibrations also occur too rapidly for us to observe them. For example, if we look at a speaker (watch the video in 4.1), we can see that it vibrates but we are not able to count the number of times it vibrates in a given time.

2.3 World of music

Music is the combination of different sounds i.e. sounds of different frequencies and amplitudes.

Sing a song that you like or speak something into the microphone and record it. Look at the wiggles on Audacity. What do the shapes of the wiggles tell us? Compare the wiggles of loud and low voice.

Project: Making your own music

Now you will create a small 10 second music track of your own by recording sounds on Audacity. You have played around with different objects in Section 1.4 to make various kinds of sounds. You can also create newer sounds by clapping or whistling or some other action. Decide the rhythm and the tempo. A group of sounds (For example, snapping fingers and hitting a plate with a spoon) can be your drum or tabla. A tune that fits in that rhythm will complete the music track - you can hum, sing, whistle, or make music using a design that you made in section 1.4.

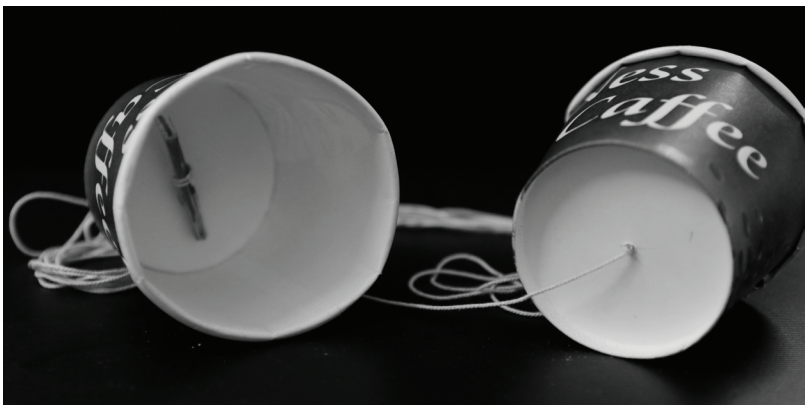
In the music track that you have just recorded on Audacity, identify the wiggles corresponding to each sound that you used.

Sound Travels

3.1 Paper cup telephone

We will make a paper cup telephone using two paper cups and a thread (at least 10 meters long). We will work in a group of 4.

Hold the cups with thread stretched taut between them. Ask your friend to speak softly in one paper cup and listen to it at the other end by putting the second cup on your ear.



The end of the thread is passed through a hole and tied to a small ball of paper or a matchstick. This way the paper cup will not tear.

Can you hear your friend's voice?

Does your friend's voice change when you listen through the cup?

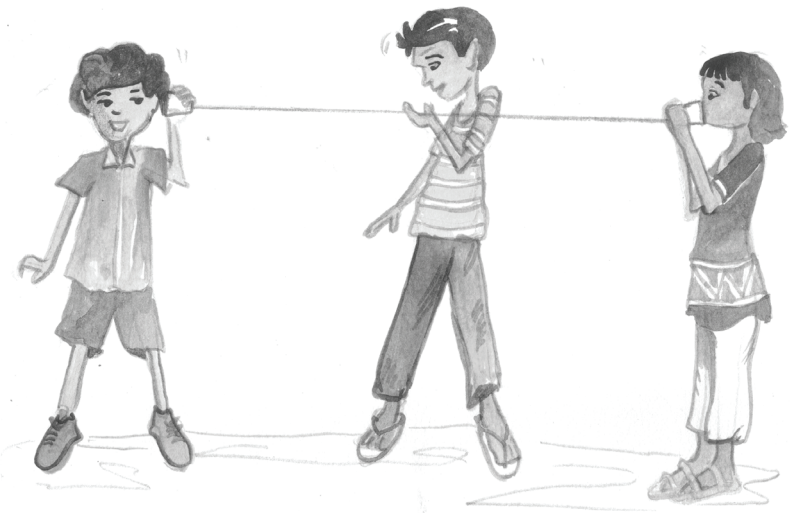
Can you still hear your friend's voice if the string is not taut?

Can you hear even if the thread is wet?

Is the sound different if you use cups of different sizes?

3.1 (A) Paper cup telephone

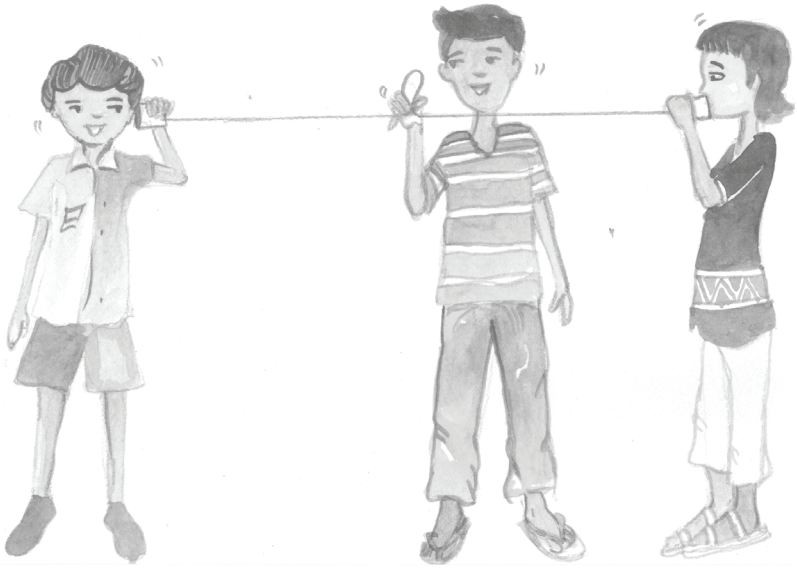
Now ask a member of your group to touch the thread gently while the person who is holding the cup near his/her mouth is speaking. Keep the thread stretched taut.



Ask your friend to touch the thread at different places on the string - close to the speaker and far away.

What did he/she feel on touching the thread while a person is speaking through the cup?

Members can change their role so that each member of the group get the chance to explore all the situations.



3.1 (B) Paper cup telephone

Now ask a member of your group to hold the thread firmly somewhere in the middle. Ask another member to touch the thread gently first at the speaking end and then at the hearing end.

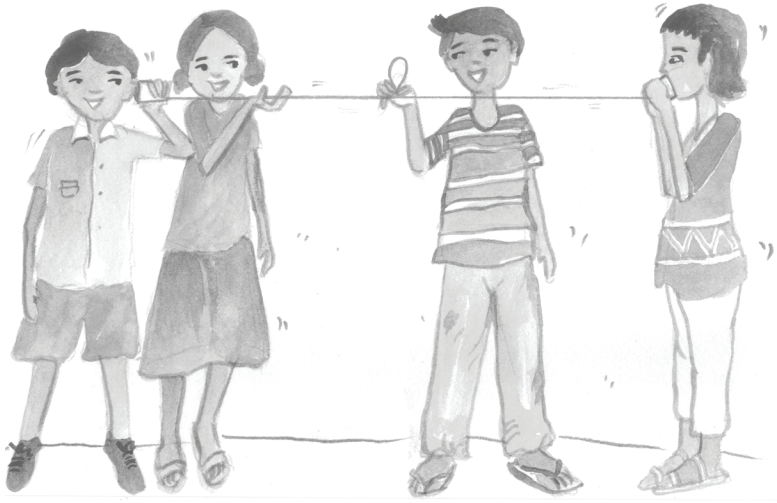
Note that one person should be speaking into the cup while another person holds the thread.

Please keep changing the roles within the group so that every member of the group gets the chance to explore.

What did you feel when you touch at the speaking side and when you touch at the listening side?

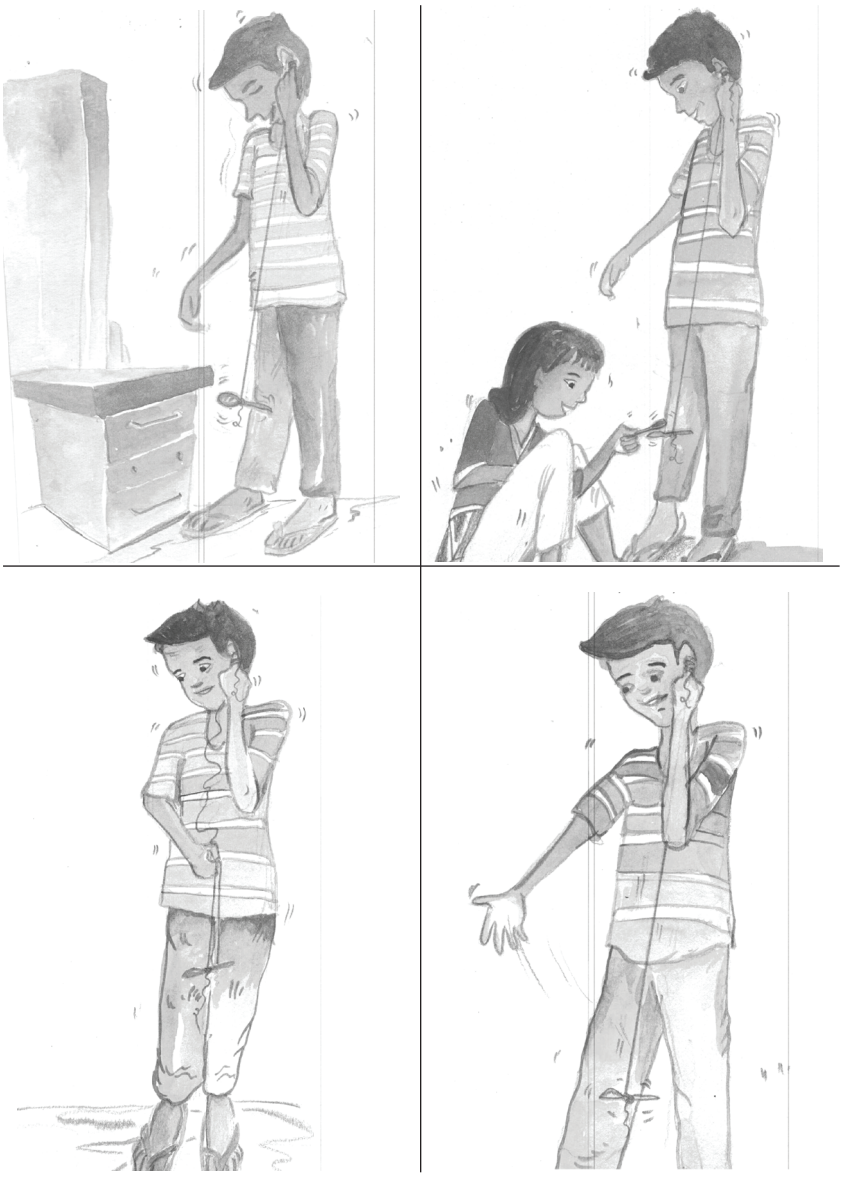
Can you explain why?

Bring your ear near the string (while someone is speaking into the cup). Do you hear anything? How does the string help to make the sound audible?



For further exploration
What is the role of the cup?

3.2 Singing spoon



1. Take a spoon and a thread (long enough).
2. Tie a spoon's handle with one end of the thread.
3. Wrap the other end of the thread in the index finger and insert this in the ear.
4. Let the spoon hang down freely.
5. Let the spoon hit the table/wall or ask your friend to hit the spoon gently with another spoon (or pen/pencil) and listen carefully.

Touch at various places along the thread. **Do you feel the vibrations in the thread?**

Keeping the finger in ear, hit the spoon and lift the thread from somewhere in the middle and release it quickly. **What did you feel?**

3.3 Do walls have ears?

1. Put a mark on the wall of your classroom from inside and outside, just opposite to each other.
2. Ask your friend to go outside the classroom and hit the wall at the mark with a small pebble.
3. You try to listen to it by putting your ear against the same spot on the wall from the inside of the classroom.
4. Hit the wall gently so that your friend (behind the wall) cannot hear the sound directly.
5. Now change the roles and try again.

Were you able to listen through the wall?

3.4 Hitting spoon inside the bucket

1. Fill up a bucket with water.
2. Take two spoons in your hands and hit them against each other inside the water.
3. Listen to the sound of the striking coins coming out of the water.

Will sound be audible if we use oil or any other liquid instead of water?

3.5 Vibrating balloon

1. Hold a balloon in your hand and ask your friend to shout “ouuu” in a loud voice. **What happens? Why do you think it happens?**
2. Is it due to the air that comes from your friend’s mouth? Hold a paper or a notebook between the balloon and your friend’s mouth to block the air. Now ask your friend to shout again. **Do you still feel the vibrations?**
3. Take two steps away from your friend. Ask him to shout. **Does the balloon still vibrate?**

3.6 Sound travels: as vibrations through different media

In all the above activities you noticed that vibrations are there in different places. For instance, in the paper cup activity, your friend feels the vibrations along the string when you speak. The same is true for the singing spoon activity, where you feel vibrations in the string attached to the spoon. Not only that, you also feel the vibrations in the balloon when you stand near your friend making “ouuu” sound. These instances show that sound travels in the form of vibrations from one place to another place. We perceive sound only in the form of vibrations. The vibrations could travel through any media (solid, liquid or gas).

How does sound travel?

4.1 A speaker

We use speakers to listen to music. Speakers are used in mobile phones and in televisions too. **Have you ever observed or touched a speaker while it is producing sound? Does its diaphragm vibrate? (Is a speaker related to a microphone?)**

In the ***computer lab***, watch a video of a speaker producing sound.

Sometimes speakers can create a nuisance, especially when someone plays loud music. **But how does the sound go forth from a speaker?**

4.2 A slinky spring

We will try to see if a slinky spring could provide us clues about how sound travels. Consider a slinky spring kept on a table. We can compress it by giving it a sudden jerk from one side. In the ***computer lab***, watch the slow motion video. You can also try it out in your classroom.

Now let us move our hand back and forth.

In the video you can see that there are alternate regions where the slinky spring is compressed and where it is elongated. The diaphragm of a speaker also moves back and forth. It compresses the air when it moves forward and makes the air rarer/sparser/less dense when it moves back. Just as these successive compressions and rarefactions travel along the slinky, sound travels away from a speaker through air. Sound travels in the same way through liquids and solids too.

4.3 Is air like a spring?

When we pull a spring, it gets elongated and if we push it, it is compressed. A spring always tries to get back to its original position. It doesn't stay in an elongated or a compressed position once we remove the force. On the other hand, a piece of clay or dough cannot completely regain its original shape once we deform it. Let us try to see if air behaves like a spring or like a piece of clay.

Take a plastic syringe without the needle. Insert the piston completely into the syringe. Now block the opening with your finger. Pull back the piston fully and release it. **What do you see?**

Now take off the finger from the hole and pull back the piston completely. Again block the hole firmly with your finger. Push in the piston as much as you can and release it. **What happens?**

Can we say that air is somewhat similar to a spring?

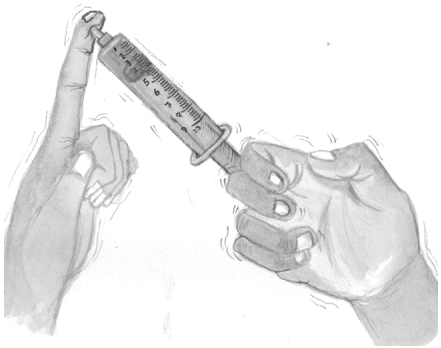
4.4 Does the medium move with the sound?

Every medium consists of some tiny particles that vibrate when sound travels through the medium.

When sound goes from one place to another, do the particles of the medium also travel with it?

Consider the paper cup telephone activity, in which the vibrations are felt everywhere on the string. The string particles are at the same place but the vibrations travel.

4.5 Is this true in other cases too?



Let us do some activities.

Activity: 1

Materials required

1.A 10 meters long string

2.Sketch pen

Procedure

1. *Hold one end of a long string (10 meters) in your hand and ask your friend to hold the other end.*
2. *Mark a small portion on the string with a color.*
3. *Now give a sudden jerk to the string.*

Did the colored mark change its position along the string? (Could you feel light and frequent tugs in your hand? Why does this happen?)

Activity: 2

You must have floated a paper boat on water. ***In the computer lab, watch what happens when there are waves on the water surface?***

Does the boat move with the ripples?

Friends discussing a question

Kanchan was playing with a string. She held the string taut, plucked it with a finger and listened to the sound. She heard a low pitched sound. She decreased the length of the string and plucked it again. This time, she heard a higher pitched sound.

She was so excited, she told this to her friends in the class.

Sonu, one of her friends, found a rubber band in his pocket. He tried the same with the rubber band. But he found the opposite of what Kanchan saw with the string. As he elongated the rubber band by stretching it, the sound became higher pitched.

In the ***computer lab***, listen to their conversation and help them solve this puzzle.

Perform the experiments that Kanchan and Sonu did. You can do your own experiments as well.

ATOMIC STRUCTURE

Content

Why Chemistry

1.1 Why Chemistry

Wow, Chemistry!

Is it possible to think of life today without using chemistry?

Just look at the world around you and note down the stuff, material and things we use today.

Now just imagine that you have jumped back 300 years in time, from today in the 21st century to the 18th century.

Which are the things that you were using in 21st century you would not find in 18th century?

Modern medicine, cement, petrol, synthetic clothes, paper, new kinds of metals, computer, mobile phones, the micro processor and memory chips, the screen of your television and computers….it all came out due to development in chemistry.

Aren't they central part of our life today!

Chemistry helps us understand two fundamental questions - how is the structure of a substance and what particles it is made up of? how could we bond one substance with another kind of substance to create a new substance?

People who use the principles of chemistry, its methods and techniques are called chemists.

Chemists work in pharmaceutical companies producing medicines, they also create new kind of medicines. They work in food processing industries and create new processes to preserve food for longer duration using chemicals. They work with metallurgical industries and create processes to get more and more metals out of an ore. They work in clothing industries; They are the ones who create new kinds of fibres to create clothes to be used in a very specific condition. They work in foundries creating silicon chips to be used in our computers and phones

As it happens the people who work in a specialised area, develop their own language or symbols. It helps them to communicate with each other better and efficiently without loosing any meaning. Chemistry also a special language - it's symbols are made out of English alphabets. Every symbol carries with it some numbers. Everything has some meaning. Then there are methods to measure substances, there are rules that helps us decipher more about the matter.

1.2 Periodic Table

The Periodic Table of Chemical Elements

Group→ / ↓Period	1	2	3		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H																		2 He
2	3 Li	4 Be												5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg												13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc		22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y		40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57 La	*	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89 Ac	**	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og
				*	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
				**	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	

This table is known as the Periodic table of Elements.

This is an amazing treasure. It has information hidden in it about the substances / matter that make up our world. This information has been arranged in rows and columns.

In order to read it we will have to learn the Language of Symbols in chemistry. We will do this gradually.

Look carefully - in every box there are a couple of english alphabets and on top of them is a number.

Perhaps we recognise some of them!

Look at the first box in the first column - it says 'H' - this indicates Hydrogen. Hydrogen is a gas - perhaps you have heard about it somewhere. Above 'H', there is a number '1' written. Soon we will get to know what this means.

Now look at the first box in the 16th column. "O" is the symbol for Oxygen. **Where have you heard of Oxygen?**

Now look at the third box in the first column and the second box in the 17th column. "Na" and "Cl"; 'Na' stands for Sodium and 'Cl' for chlorine. Sodium is known as Natrum in Latin. That is why the symbol for sodium is Na.

Perhaps you know, what we refer to as Table/ edible Salt is known to chemists as the formula NaCl. That is, which is made by combining of Sodium and Chlorine. We call this N-a-C-l.

And, what do you think of H2O? This is the chemical formula for water. It is read as H-2-O. This formula tells us that water is made of Hydrogen and Oxygen both. They are both gases, but when they combine in a particular ratio, they become liquid (water). Isn't this interesting!

Look at the 14th column, 2nd box. 'Si" - Silicon; does that sound familiar? Chips or processors of Memory cards, computers, mobiles - all are made of this.

And now look at the fourth box of the 15th column. 'P' - Phosphorous; this is an essential component of our bones, matchsticks, firecrackers. You will find this interesting - it was first found in human urine.

Just like phosphorus, the discovery of every element has an interesting story behind it. We can discuss that some other time.

Chemists believe that the entire world is made up of only 118 elements. In the periodic table these are arranged in a particular sequence/ order. Around 94 elements are found in nature and rest of them have synthesized in the laboratories.

How did they know that there are only 118 elements in the world - this question may have crossed your mind.

Before that looking at this question, it is important to know what are elements?

1.3 What is an element?

Do you find salt (NaCL) in the periodic table? but you do find 'Na' and 'Cl', isn't it!

Do you find H_2O in the table? but you do find 'H' and 'O', isn't it!

Seperation

You can separate salt from a mixture of salt and sand. Isn't it?

Sorting out substances from one another is called separation. We apply separation technique in our daily life often.

So if you take a substance and If it can be separated into two or more substances, we say it is impure, or a mixture of substances. In other words, if you cannot separate a substance into two or more substances after using all these different methods, the substance can be considered to be pure or just that only substance.

But there is a problem in defining a pure substance in this way. The problem is that you may have tried all the methods that you know about today for separating a substance. Maybe the substance cannot be separated by any of these methods. So you think the substance is pure. But it is possible that a scientist could discover some new method of separating such a substances in future. It is possible that the substance you thought was pure today could then be separated into different substances, using this new method.

For example, suppose you draw water from a well and filter it with a filter paper. Suppose all the water passes through the filter paper without leaving a deposit.

What would you conclude about this water?

Now suppose you heat this water and some deposit is left behind after the water has evaporated.

Would you now consider this water to be pure?

Over several centuries this is what chemist have been working on. They developed kinds of separation techniques and applied to various substances.

For example when you apply electrolysis, you find the water can be broken down or separated into Hydrogen and Oxygen. Since you can not further separate Hydrogen and Oxygen you believe that they are the fundamental constituent substance. we started calling them into Elements. * (about electrolysis)

Lets take the case of phosphorus'

The period was 17th century.

There was one alchemist in Germany, Henry Brand. it was believed that Human urine may contain the philosophers stone, that has the ability to turn any metals into gold. Mr. Brand was trying to find a method to separate this philosophers stone from Urine.

He followed the following process

He let the urine stand for days until it gave off a terrible smell. Then he boiled it down to a thick paster. then in heated this thick past to a very high temperature and let the vapours though a water. What he got was a waxy substance that glowed in the dark.

This was the 13th element discovered.

When then known separation methods were applied it could not be further separated into other substances.

After separating one substances from another they finally reach conclusion that there are these substances, we call them elements, are the basic building block of all the diversity of matter around us.

Then the other question that followed was - what particles these elements themselves are made up of, what is the difference between say hydrogen and oxygen, what makes them different?

But before that lets learn about another important tool of learning chemistry - how to name these elements and substances.

1.4 The language of chemistry -I

You may have observed that different substances have different names in different languages. For example, iron is called loha in Hindi while copper is called tamba. Water also has several names likepani, jal, neer, etc.

Having so many names for substances could create problems in a field like chemistry where work is conducted throughout the world. How would scientists from different countries who speak different languages communicate with each other? There should be some way in which they can understand each other. To make this possible, we must have universally accepted names for different substances. That is, a scientist from any part of the world should be able to recognise the substance by its name.

Many elements like iron, gold, silver, mercury, copper and zinc have been known from ancient times. But many other elements were discovered in more recent times.

When a new element is discovered, the discoverer gives it a name. That becomes the name of the element. When modern chemistry was being developed, the language most commonly used among scientists was Latin, the language of ancient Rome. Thus the names of many elements were based on Latin words. Take the example of hydrogen. One of the properties of this gas is that it combines with oxygen to form water. The Latin name for water is 'hydro'. So this gas was named hydrogen, which means, "gas that makes water".

Another similar case is that of helium. This gas was first discovered in the Sun, not on Earth. The Greek name for sun is 'helios', so the gas was named helium.

Many elements were named after the places in which they were discovered. Some examples are scandinavium and californium. Some elements were named to honour well known scientists.

One example is mendelium, named after Gregor Mendel. The story of oxygen is very interesting. At one time people believed that any compound that contained oxygen would be acidic in nature. The Latin word for acid is 'oxy'. Hence the gas was called oxygen, meaning "gas that forms acid". It was later discovered that acidic property was not related to oxygen. However, by then the name had come into common use so it was not changed. After all, what's there in a name!

The names of many elements are their English names as well.

For example, the chemical names aluminium, carbon, oxygen, nitrogen and hydrogen are also the English names of these elements. However, this is not always the case. The chemical name ferrum is called iron in English while cuprum is copper.

The next step in naming elements was to write them in an abbreviated form. Thus, carbon was given the symbol of a capital C. Generally, the first letter of the name of the element became the symbol of that element. For example: H for hydrogen, O for oxygen

and N for nitrogen. But this caused a problem. There are many elements whose names

begin with the same alphabet. Examples include copper, carbon, calcium and chlorine, which all begin with the letter C.

Can you suggest a way in which this problem can be solved? Should the names of these elements be changed?

No, the names of the elements were not changed. In these cases, instead of using only the first letter of the name, the second or any other letter were added with it. So while carbon became C, cuprium became Cu, calcium became Ca and chlorine became Cl.

Here, too, it is necessary to remember one thing. When two letters are used to form the symbol of an element, the first letter is written in capitals while the next letter is in the lower case. So the symbol for calcium would have a capital 'C' and a lower case 'a' to form Ca.

So we have to learn these formulae by rote?

No, no, don't learn them by rote; you will be able to remember them as you keep on using them.

1.5 The language of chemistry -II

There is one more variation. The symbols of some elements are not assigned according to their English names but according to their Latin names. For example, the symbol for sodium is Na which is derived from its Latin name natrium. Similarly, K, the symbol for potassium, is derived from kalium, and Fe, the symbol for iron, is derived from ferrum.

The names and symbols of some elements are given in the following table:

You may have noticed that names of some common substances like wood, sugar, bronze, paper, plastic, etc, have not been included in the table. This is because these substances are not elements. You will, perhaps, be surprised to know that bronze is not an element but a mixture of copper and zinc.

Are you wondering whether these substances have symbols or not? Do they have abbreviated names or not? The answer is yes, they do. But before discussing these symbols, we need to look at one more aspect.

Name of an element	English names	Latin name	Symbol
Aluminium	Aluminium		Al
Calcium	Calcium		Ca
Carbon	Carbon		C
Chlorine	Chlorine		Cl
Chromium	Chromium		Cr
Silver	Silver	Argentum	Ag
Copper	Copper	Cuprium	Cu
Sodium	Sodium	Natrium	Na
Gold	Gold	Aurum	Au
Hydrogen	Hydrogen		H
Iodine	Iodine		I
Iron	Iron	Ferrum	Fe
Nitrogen	Nitrogen		N
Nickel	Nickel		Ni
Oxygen	Oxygen		O
Phosphorus	Phosphorus		P
Sulphur	Sulphur		S
Potassium	Potassium	Kalium	K

Could you find out about other elements and if the source of their symbol is their English or Latin name?

One advantage of using symbols is that we don't have to write the full name of the substance every time we refer to it. There is another advantage. When we use the full name of a substance, say 'iron', we do not know the quantity of the substance. But when we write its symbol Fe, we know there is only one atom of iron. This represents the equivalent amount of this substance of the atomic weight of iron. To similarly show two atoms of iron we write 2Fe.

How will you show three atoms each of carbon, silver and gold?

Need of the Atom

2.1 Need for an Atom-I

The Challenge of getting an Element in its free state!

Why don't we find elements in their free state?

We had read in the last chapter, that chemists had reached the conclusion that there are some basic elements that generate a variety of substances. They are 118 in numbers.

But it had also became clear that most of the elements are not naturally found in the element state. They are always found combined with another element.

We are now going to discuss this point.

Let us watch a video. In it, the element Sodium will be cut.

Look carefully at the layer that is cut and notice any changes on it.

Is there any change in the glow/shine of Sodium?

The reason for the shine to diminish can be chemically expressed as-

Sodium + Oxygen = Sodium Oxide

The element Sodium started reacting with the Oxygen present in the air and became Sodium Oxide. Due to this chemical reaction, the upper layer became dull/stopped shining.

Perhaps some of you will have an iron kadahi/wok/or deep frying pan at home for cooking vegetables. When we wash it and keep it aside, it gets rusted.

If you keep any iron object outside for a few days, it gets rusted.

Iron + Oxygen = Iron Oxide (the oxide of iron)

Phosphorous is an integral component of life. You have seen that phosphorous is found in bones and urine. It was first obtained from human urine. It is used in fields as a manure in the form of phosphate.

However, in nature, it is never found in its pure or elemental form. We find it as Calcium Phosphate in rocks.

Phosphorous + Calcium = Calcium Phosphate

You have now seen the three elements, Sodium, Iron and Phosphorous - they react chemically under standard temperature and pressure, as they are active in nature.

The substance that is formed after the chemical reaction is not reactive any more. It is stable.

For example, Sodium in its element form is very reactive. Whereas, in the form of Salt it is non-reactive.

Even pure iron starts reacting with oxygen very fast and becomes Iron oxide. Iron ore, from which we obtain iron, is usually in the form of Iron oxide.

Now take a look at the elements in the 18th column of the Periodic Table. They are known as Noble or Inert Gases. These are found in their element form in nature. They are stable and under standard conditions they are non-reactive.

When a substance is made of two or more than two elements and its physical and chemical nature is different from that of the original basic elements, **it is known as a compound**.

Salt is a compound, made of Na and Cl. Chlorine in its basic nature is a light yellow gas and sodium is a shiny solid. When both combine, we get a solid salt and its nature is very different from that of either of them.

Similarly, water is also made of H and O. In their basic state, they are both gases, whereas water is a liquid.

Look all around you - you will find lots of compounds. Even if you search hard for elements, you wont be able to find them.

Elements can be separated from their compounds only through chemical processes.

We can understand all these facts in the form of these points

1. Some basic elements are stable, that is, they are found in their pure form. Their numbers are very few. For example, the inert, non-reactive gases in column 18.
2. Most of the elements are found as compounds in nature, which are made of two or more than two elements. For instance, Iron - in the form of iron oxide, Sodium - sodium oxide and other forms, Phosphorous - in the form of Calcium Phosphate.
3. Compounds are stable as compared to elements.

Now we have found some more questions for which we need to find answers

1. Why are inert gases, which are also called noble gases, non reactive and stable?
2. Why are certain elements like Sodium, Calcium and Iron, reactive?
3. Reactive elements do not combine with any and every element to form compounds. Is there a logic/plan to the process of making compounds?

If we understand the logic/plan of making compounds, maybe we can make a new compound?

2.2 Need for an Atom-II

The need for an atom

You may have heard of an Atom.

Can you make it in your copy?

If we want to understand elements, compunds and chemical reactivity, we first need to understand an Atom.

A fact about it is - An atom is the smallest particle of an element. We cannot see it with the naked eye. And usually they do not exist in their free state.

Take Hydrogen gas for instance. If we imagine that we have the smallest particle of gas, you will get two hydrogen atoms combined together.

When two or more atoms are combined together, we call it a molecule.

Why is it that under normal temperature and pressure, we find molecules of Hydrogen and Oxygen - not atoms?

Atoms do not combine only with atoms of their own element.

Take Salt for instance - if we take the smallest particle/unit of Salt, we will find an atom of Sodium and an atom of Chlorine combined in it.

If we talk of Water - the smallest particle of Water will have two atoms of Hydrogen combined with one atom of Oxygen.

The smallest particle/unit of Water and Salt will also be called a molecule. Since it has more than one atom combined in it.

There are several such examples which we will discuss later.

Looking at things from the point of view of Atoms, we have two major questions in front of us -

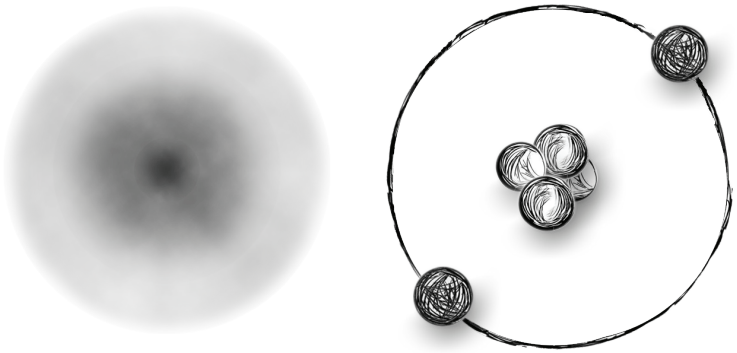
1. **Why cannot atoms of most of the elements exist independently?**
2. **When an atom combines with atoms of other elements, what is it able to achieve?**

If we find answers to these questions, we can also get the information behind elements being chemically reactive and the idea and reason behind formation of compounds.

Moreover, we can also understand a very big secret of Nature.

Atom and Atom Factory

3.1 Atom



Atoms are made of three basic particles. At the centre of the atom, there are neutrons and protons. Whereas Electrons revolve around it.

The electrons move with such speed that it is impossible to tell where exactly an electron is at what time.

Scientists have prepared a model of the atom to make it easier for us to understand and visualise the atom and its various parts. So don't mistake this model for the actual atom.

About the Atom

At the centre of the atom are the protons. These carry positive charge.

Also present in the centre are neutrons. They carry no charge. The centre including the proton and neutron is also called the Nucleus.

The number of protons in any atom is known as the Atomic Number of that element. The Atomic number of every element is different as the number of protons in every element varies. You will

notice that the elements have been arranged in increasing order of their Atomic numbers in the structure of the Periodic Table.

Protons and Neutrons are the heaviest part of the atom. They are almost equally heavy.

When we talk about the mass of an atom, this is roughly the mass of protons and neutrons in the nucleus of that atom. In the total mass of the atom, the contribution of the mass of electrons is negligible.

Electrons orbit around the nucleus in their different energy levels with the speed of light and every electron is spread/diffused all around the nucleus in a particular pattern. These are also known as electron clouds. In reality, it is very difficult to predict/say where a particular electron will be at which point in time. In fact, one can only guess the probability of finding an electron in the vicinity of the nucleus.

Just for simplification, we show the electrons revolving around the nucleus in orbits.

In scientific terms, this is referred to as the model of an atom and not the actual form of it.

So lets try and make the model of an atom from what we have learnt till now.

3.2 Atom Factory

The Atom Factory An introduction to the App (Build an Atom)

In order to build an atom you will use an App.

You have some Electrons, Protons and Neutrons in the baskets given below. With the help of these you will build Atoms.

Along with this you have also been given the Periodic Table. As you keep making the elements, their place in the periodic table will also get highlighted.

But before you start, think about the questions given below. While making Atoms in the Atom Factory, observe the following as well.

Points of Observation

1. When you get the protons to the nucleus, is any kind of charge formed?
2. How many electrons do you ned o add to make this atom neutral or charge-free?
3. If the number of protons are changed, what happens?
4. If the number of neutrons are more or less, what indication is given in the Simulation?
5. In between, you also alternate visualisation of energy levels between the orbital and electron cloud models

In the ***computer lab***, to enter the atom factory please click on the button given below

3.3 Atom factory again!

Come, let us visit the Atom Factory again!

Now we will again try and make an Atom - keeping certain things in mind.

Rules

You have to build a stable atom. In this atom, the number of electrons should be equal to the number of protons. This way, the atom will not have any charge.

In certain elements the number of neutrons are more than the number of protons. While making the atoms, you will come across such an element as well. If the number of neutrons are more or less than the protons, the atom will be unstable.

Now look at the Electron

You must have noticed that the Electron can be established at various energy levels. Perhaps you have filled in only the first or second energy levels. However, there can be more than two energy levels as well.

How many electrons can a particular level have - is there any limit to that?

How many electrons were able to go to the first level? Two or four or eight?

How many were able to go to the second level? Two or four or eight?

In the Atom Factory App you will be able to make atoms of only ten elements. Once you have made them, do not forget to answer the following questions.

In the ***computer lab***, to enter the Atom factory click on the button given below

3.4 Review Atom

Reveiw what you have learnt!

We hope that you have enjoyed building atoms in the factory. Surely you must have taken some notes too. Now try to answers questions given below.

Just remeber that here when we talk about a stable atom we mean that the atom has no charge on it.

1. **How many energy levels does a stable Hydrogen atom have and how many electrons are there in a stable Hydrogen atom?**
2. **How many energy levels does a stable Helium atom have and how many electrons does it have in all?**
3. **How many energy levels do the electrons of a stable carbon atom have? How many electrons are there in its outermost energy level?**
4. **How many energy levels of electrons are there in a stable Oxygen atom and how many electrons are there in the outermost energy level?**

3.5 Electrons and chemical reactivity of an element

Chemical reactivity of an element

A chemist would first of all like to know how many electrons there are in the outermost energy level. This tells them about the chemical nature of the element. So while studying chemistry, pay

attention to how many electrons there are in the outermost energy level.

How does it help to know how many electrons there are in the outermost?

You have seen the use of Sodium - its shiny surface becomes clouded when kept exposed to the air. But why?

We do not find the element Hydrogen as an atom on Earth. We get it in the form of a H_2 molecule. We find this H_2 in air in the form of a gas. H_2 means two atoms of hydrogen combine together. Similarly, Hydrogen exists in the form of other compounds as well, in which it combines with atoms of other elements, for example - HCl, H_2O, NH_3, etc.

Why is it so?

Oxygen is also not found in the atomic form either on Earth - that is, only in the form of O. That too is found in the form of O_2. It combines with various other elements and is also found in the form of compounds, for example, H_2O, SO_2, Na_2O, CaO, etc.

Now take water, H_2O, for example. As you can see, it is a compound made of Hydrogen and Oxygen.

We find Sodium in the form of (natural salt or table salt) NaCl or in the form of other compounds. In NaCl too, the Sodium atom is combined with the Chorine atom. **Why are Sodium or Chlorine not able to stay independently?**

Iron also is not found in the form of pure Iron. It is mostly found as Iron Oxide.

The same is true of Aluminium - Aluminium is mostly found as Aluminium Oxide.

Why is this so?

In order to understand the answer to this question, we need to understand the chemical reactivity (chemical nature) of elements vis-à-vis one another. Chemical Reactivity depends on the number of electrons present in the outermost energy level of the atom of an element. Lets try and understand it a bit more.

The rule of 8

4.1 The rule of 8

The rule of 8 !

Let us take a look at the Periodic Table once again.

Look at Helium and Neon

In the periodic table the elements found in the 18th or 0 group are in the gaseous form, under normal temperature and pressure conditions. They are called Noble or Inert Gases. Why are these gases given this name? We shall see the reason as we read further.

Helium is a Noble gas and Neon is also a Noble gas.

In the atom factory, you have also made the helium atom.

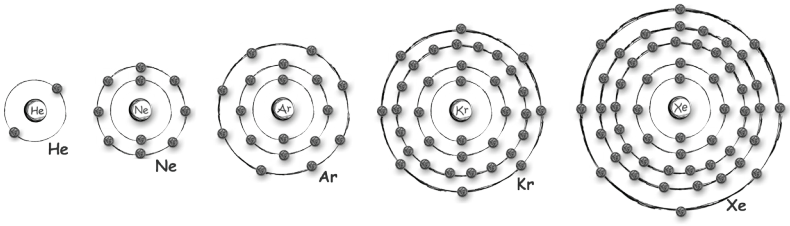
The helium atom has only two electrons and both of these fill up in the first shell (energy level). The capacity of the first shell is also actually that of only two electrons.

You have also made the Neon atom.

Neon has a total of ten electrons. Out of these, two fill up the first energy level which has a capacity of two only and the remaining eight completely fill up the second energy level which has a total capacity of eight electrons.

Take a look at the atoms of the other Noble gases shown below. Also observe the number of electrons in the outermost shell.

In these too, you will find the number of electrons is - eight!



We find these gases naturally in their atomic form: Helium - in the form of helium atom, Neon - in the form of neon atom.

In nature, it is very rare to find these elements combined with some other element in the form of a compound.

They do not combine with any other element. If you specially try to combine these gases with some other element in a laboratory, it is still not easy to do so.

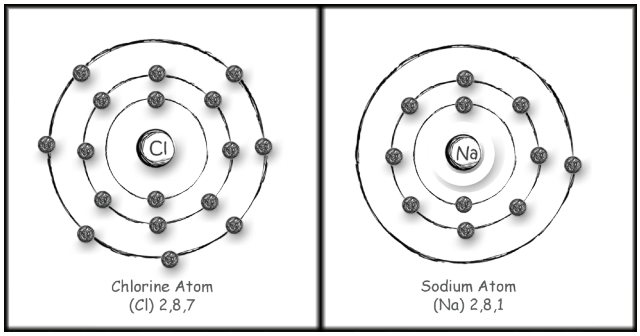
Keeping these studies and research in mind, scientists came to the conclusion that if the outermost shell of an atom is full, the atom/element is inert and it is not easy to make it react with any other element. This is also known as the Octet Rule, since all inert gases, except Helium, require eight electrons in the outermost shell for it to be full.

The outermost shell requires eight electrons for the shell to be full. This is called the Octet Rule.

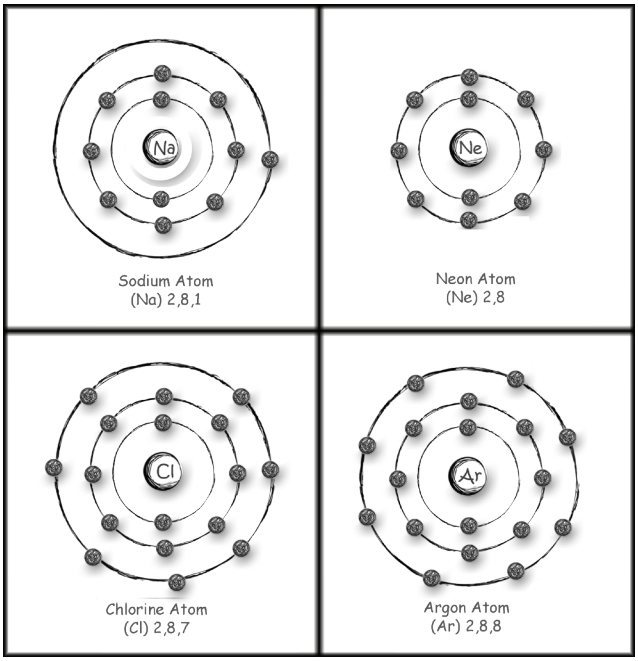
Is there any link between the total number of electrons in the outermost shell and the chemical reactivity of the element?

4.2 Na and Ne- Cl and Ar

Na & Ne - Cl & Ar and Ionic bond



We know that the sodium atom has 11 electrons. Thus the first two shells fill up completely with two and eight electrons respectively and the eleventh electron comes into the third shell. So the electronic structure or configuration of a sodium atom becomes (2,8,1). Now lets take the chlorine atom. A chlorine Atom has a total of 17 electrons. These fill up in the first, second and third shell in the electronic configuration 2,8,7. In this way, we get one electron in the outermost shell of sodium and seven electrons in the outermost shell of chlorine.



If, in some way, sodium and chlorine get 8 electrons in the last shell, they will both become inert/non-reactive and chemically stable like the noble gases.

That is what happens - all elements in the Periodic Table want to get an electronic structure like the Nobel gases and become chemically stable.

For that to happen they require eight electrons in their outermost shell.

Now, the number of electrons cannot be changed so easily. After all, nature does not work like our App!

So generally : in nature elements are ready and willing to combine with those elements with whom they can either share or give or take a specific number of electrons in such a way that in every outer orbit there are eight electrons.

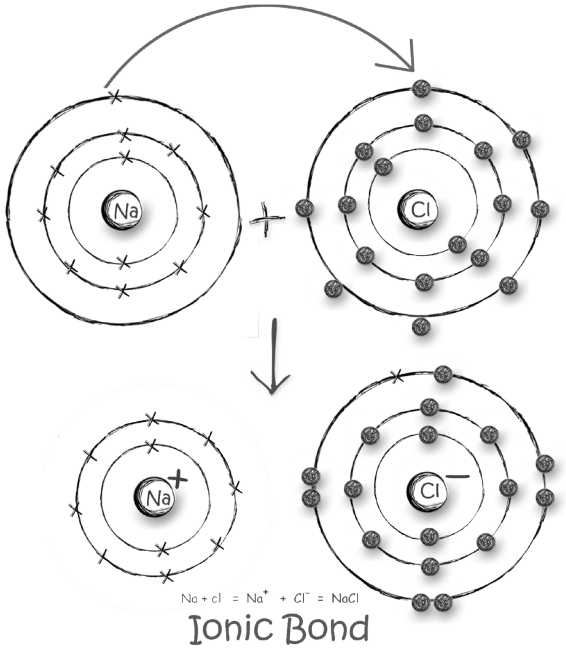
Apparently, this is also the reason for their chemical reactivity.

So when sodium and chlorine are brought together, the sodium atom immediately gives its outermost electron to the chlorine atom. This way the sodium atom is now left with an extra +1 charge and its electronic configuration becomes (2,8) which is like the structure of the inert gas, Neon, which is closest to it. Now instead of calling it a sodium atom, we will call it a sodium ion. Its chemical nature is very different from that of a sodium atom. In the same way, after accepting an electron from sodium, chlorine has one extra (-1) charge and its electronic configuration becomes (2,8,8) which is the like the electronic structure, (2,8,8) of the inert gas, Argon, closest to it. Now we will call it the chlorine negative ion instead of the chlorine atom. Its chemical nature is very different from the chemical nature of the chlorine atom.

In the end, the sodium positive ion and the chlorine negative ion get attracted by the electronic force and form Sodium Chloride (NaCl) or Salt which is a compound.

So the bond that is formed between the Sodium ion and the Chlorine ion to form NaCl compound, is called an Ionic Bond.

Sometimes, electrons in the outermost shell of an atom are shown by big dots and sometimes by crosses. Whenever we make a new molecule, we should be clear about which electron is from which atom and how many electrons are shared by which atoms. What matters for you is the number of electrons.



As we have seen in the earlier paragraph how the atoms of Na and Cl have a tendency to change their electronic configuration to that of the atoms of the inert gas closest to them. This tendency respectively converts them to Na+ and Cl- ions and finally the electronic (or electrostatic)? Interaction between these positive and negative ions results into a molecule of NaCl.

As a result of this entire process we can see that the atoms of Na and Cl elements combine with one another and form a new particle of a new substance, NaCl. This new particle which is made by the combining of two or more atoms is called a molecule. In this example of NaCl given above, we will call the kind of bond formed between Na and Cl as Ionic Bond.

There are other common examples of substances being formed as a result of this Ionic Bond; Sodium Flouride (NaF), Potassium Chloride (KCl), Calcium Chloride ($CaCl_2$)

Just like NaCl, can you draw the process of making the above mentioned substances from their basic elements, in your copy?

4.3 H & He - O & Ne

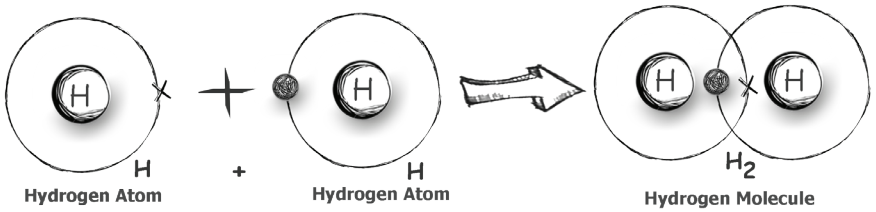
H & He - O & Ne and co-valent bond

Now we will learn another method by which atoms of elements combine to form molecules of a new substance. Come let us understand this with the help of an example given below.

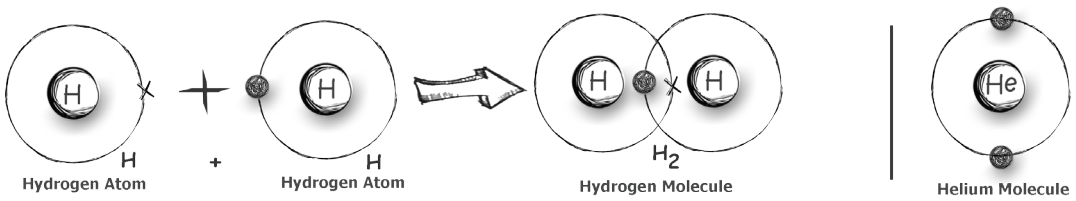
Making of an Hydrogen atom

We know that the Hydrogen Atom has only one Electron which orbits in the first shell. Observe that the closest Inert gas to Hydrogen according to the Periodic table is Helium. We have learnt earlier that the two electrons of Helium totally fill up the first shell. (Remember, that the first shell of an atom has a capacity of a maximum of two electrons). So the two atoms of Hydrogen, each having one electron, share these two electrons in such a way that both electrons stay in between both atoms and are attracted by both positively charged nuclei.

Due to this sharing of electrons, there are two electrons around each hydrogen nucleus and their configuration resembles that of the Helium atom. So the Hydrogen element is chemically more stable as a molecule H_2, as compared to the atom H. That is why, on earth, under normal temperature and pressure conditions, the element hydrogen is mostly found in the form of H_2, a molecule. The bond that is formed between the atoms by sharing of electrons is known as a Covalent Bond.



Formation of an Hydrogen Molecule: an atom shares an electron with another atom. the formation is a molecule, which is more stable than an atom.

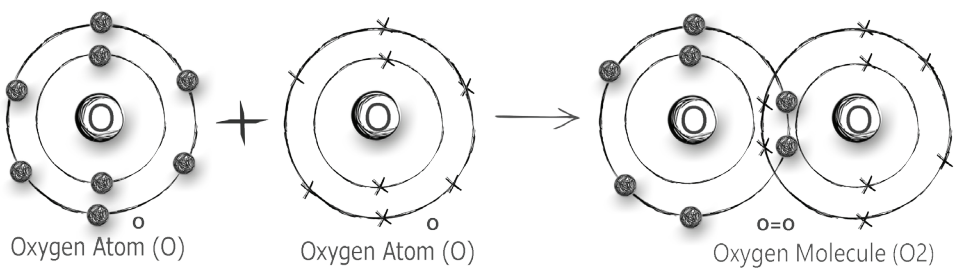


The electron configuration around each molecule of Hydrogen is like that of the Helium atom.

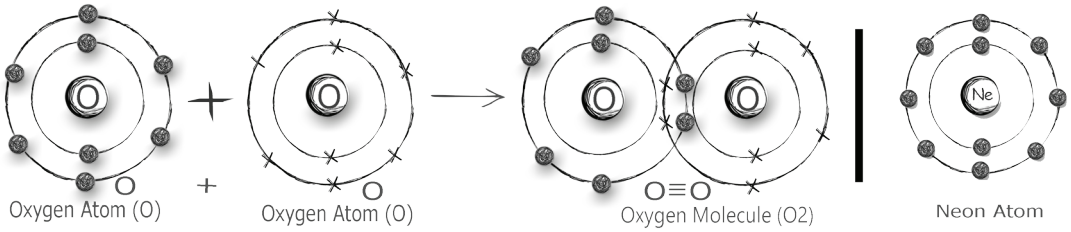
Other examples of elements formed by Covalent Bonding are O_2, Cl_2, NH_2 etc.

Making of an Oxygen atom

Every atom of Oxygen shares two electrons with another atom, which forms the Oxygen molecule. The outermost shell of this molecule has the same number of electrons a Neon. Neon has eight electrons in the outermost shell. Now we can say, when a molecule of Oxygen is formed, its outermost shell gets eight electrons and it's electronic configuration resembles that of Neon.



Formation of an Oxygen molecule: sharing of two electrons by each atom with each other.



Electronic configuration of the Oxygen molecule is like that of the Neon atom.

Note: *Sometimes, electrons in the outermost shell of an atom are shown by big dots and sometimes by crosses. Whenever we make a new molecule, we should be clear about which electron is from which atom and how many electrons are shared by which atoms. What matters for you is the number of electrons.*

Molecule Factory

5.1 Molecule Factory

Molecule Factory

In the previous section we learnt about atoms combine to make a molecule. Now we will go to a molecule factory. In this factory you can make many kinds of molecule - some of known compounds and some unknown compounds.

Unlike 'Atom Facotry' , here you will get the whole atom as a building block to your molecules. these atoms lie in baskets. You will have to drag and drop the right number of atoms in the empty area to make molecules that you are expected to make.

if your construction is right, the place where you have to place this molecule will get highlighted. you will have to drag and drop your molecule in the empty area.

Here you will also learn that it is not just about the right numbers but how do you place atoms vis a vis other atoms that also matter. Atoms joins other atoms in a unique way sometimes.

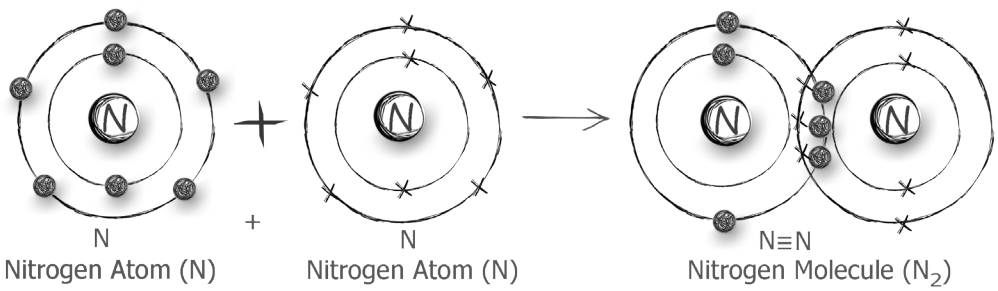
<u>let the play start!</u>

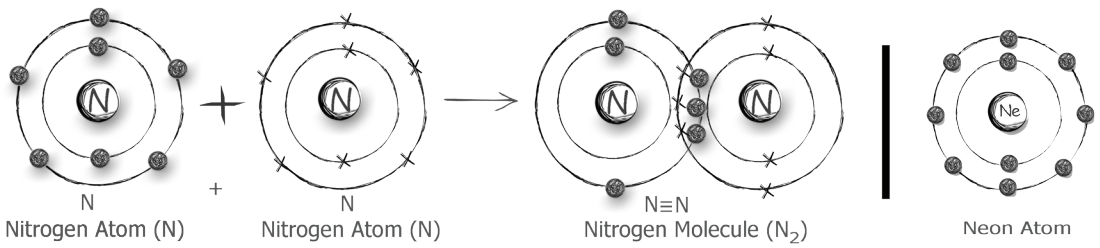
In the ***computer lab***, click on the button to enter the factory

5.2 Some more molecules

Lets make some more molecules

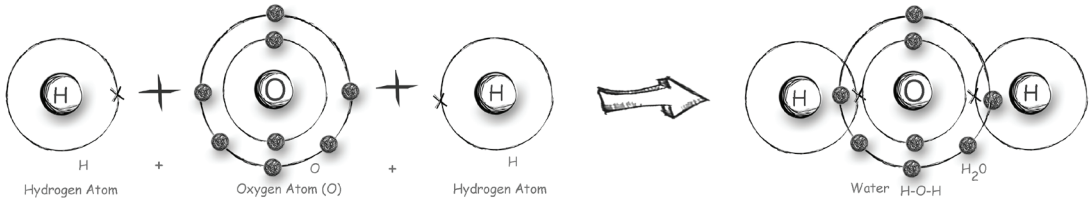
Nitrogen Atom





The electronic configuration of a molecule of Nitrogen which is like the electronic configuration of a Neon atom.

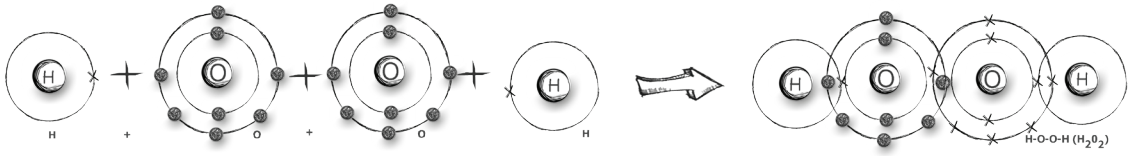
Water molecule



Formation of water molecule

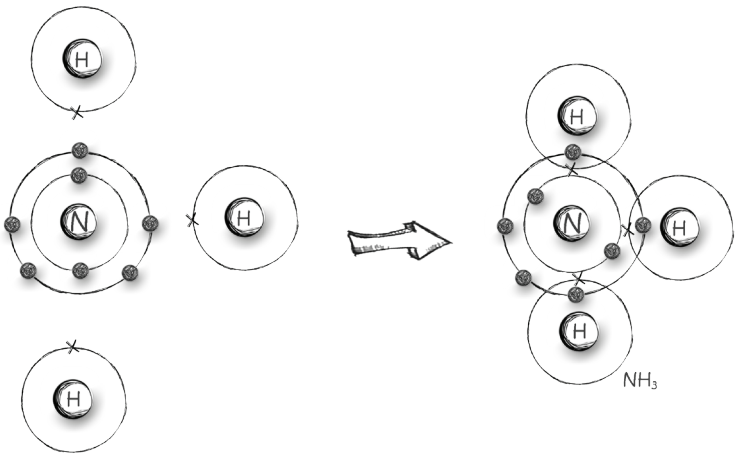
Hydrogen Paraoxide molecule

When two hydrogen atoms, which have an electron each in their outermost shell, come close to two atoms of Oxygen, one atom Hydrogen gives its single electron to one atom of oxygen and completes its electronic configuration and the other Hydrogen atom also gives its single electron to the other atom of oxygen. Now these two atoms of oxygen which already have a hydrogen atom, share an electron each and complete their outermost shell with eight electrons. As a result we get one molecule of Hydrogen Peroxide (H_2O_2).



Ammonia Molecule

Now let us talk about the Ammonia molecule. We know that the nitrogen atom has 5 electrons in the outermost shell. It requires three more electrons to get the total of eight in the outermost shell. It fulfils this requirement with three electrons from three Hydrogen atoms - that is, one from each. It shares one electron each with each atom of hydrogen, which makes two electrons in the outermost shells of the



Amonia Molecule

hydrogen atoms. The outermost shell of Nitrogen also gets eight and a molecule of Ammonia is formed.

To do

Similarly, you all can make molecules of Flourine, Methane, Carbon Tetra Chloride. While constructing them, you need to think which inert gas' electronic configuration are the molecules resembling? You need to keep in mind that whenever you make molecules by sharing, the outermost shell should have eight electrons (Hydrogen should have two).

Now you all can try and make bigger molecules like Methane (CH_4), Carbon Tetra Chloride CCl_4), Ethane (C_2H_6)with the help of these dot or crosses diagrams. This will strengthen your understanding of sharing of electrons.

***Note:** Sometimes, electrons in the outermost shell of an atom are shown by big dots and sometimes by crosses. Whenever we make a new molecule, we should be clear about which electron is from which atom and how many electrons are shared by which atoms.*

HEALTH AND DISEASE

Through Scientific Lens

Students know about various aspects of health through personal experiences or through experiences of others. There are also awareness campaigns and health programs are at the school level which contribute to students' information about health. The module encourages students to reflect on their existing knowledge and ask questions about things that they would like to know about. This module is designed for students to explore the concept of health and a few diseases through short independent projects which will include surveys within their community and some hands-on experiments.

The module consists of:

1. Student driven project work
2. Case study
3. Hands-on experiments by collecting samples from their surroundings
4. Thought experiments
5. Digital interactives

Through this process, students will have the opportunity to make observations, investigate hypotheses and present to the class.

We have four units in the module

1. Concept of health

2. History of malaria through scientific lens

3. Let's investigate!

4. What does data tell us? (Only on CLIx platform)

In first unit, we will talk about students' perception of social, physical and mental well-being.

There will be a survey conducted by students within their community to get better understanding of the overlap of the three aspects of health.

In next unit, we will talk about the discovery of Malaria. It will be in form of scientific story with thought experiments and hands- on experiments in between the narrative. This can be considered as a template for investigations to be carried out for the students in the last unit.

In the third unit, the students will work on one of the four investigatory projects suggested in the module. At the end of this unit the students will have to present their project work to their entire class. The project work will be done in group.

Our last unit of this module talks about the importance of data in public health. It is essential to look at the disease data and try to see patterns in order to predict and prevent hazardous outcomes. Students will try to observe why do we need to take large population sample to conclude anything about the data with confidence.

We imagine role of the teachers to be that of a facilitator in the process of scientific investigations that the students will do. Encouraging students to ask questions, helping them formulate strategies to answer questions, facilitate

discussions and guiding students to present their work in the class would be key responsibilities of the teacher.

The expected outcome of the module is that it will help students to think about health, causation, cure and prevention of disease as a scientific process and not mere things that happen to someone. the module also encourages students to apply the process of scientific inquiry in real world problems related to health and well being. Although the module discusses only a few diseases the expected outcome would be for students to apply the same process to think about other prevalent diseases and newly emerging diseases.

Content

Concept of Health

1.1.What is health?

'Health' is a very familiar word to all of us. We hear about healthy habits from our parents and teachers, we read about how to stay healthy in books. There are so many things we watch on the television which also tell us about what is good for our health and what is not good for our health.

Activity 1: Health and its various aspects

Classroom activity

Requirement: *Student workbook*

What are the things that come to your mind when you think about a healthy person?

Use the space below to write all the things that you would associate with a healthy person:

_____

_____

_____

Now you have a list of things which indicate that a person is healthy. We can call these "our health indicators".

An organization named WHO (World Health Organization) also came up with pointers to define health. After studying various situations they defined health as :

" A state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity."

In simpler words it means that health is not only the absence of any disease.

It is the state where our body is able to do the day to day work properly (physical health) , we are able to understand our strengths, we can cope with the normal tensions of life (mental health), our surroundings are clean and hygienic, we have friendly interactions with family, friends and neighbours and we have concern for other people around us (social health).

Can you use the indicators that you have listed and classify them as indicators for Physical health, Mental health and Social health?

Mental	Physical	Social
---	---	---

1.2. Overlap of the three aspects of health

We studied 3 aspects of health. **But are these 3 aspects of health independent of each other? Does one health aspect affect another one?**

<u>Activity 2 : Are the 3 aspects of health mutually dependent or independent of each other?</u>

Group Activity (Group of 3)

Requirement: Computer lab

Watch story of Chanda on CLIx platform

Based on the Story answer following questions.

1. How did moving to a new place affect Chanda's life?

2. What according to you was the reason for Chanda falling ill?

3. Can you think of physical problems that make you feel sad?

4. Can you give an example where your mood affects how you talk to others?

You saw in this story that mental health can affect the social and physical health. Similarly, physical health can also affect mental and social health.

We can be truly healthy only when we are physically, mentally and socially healthy.

1.3. Overlap of the three aspects of health

<u>Activity 3: Let's talk!</u>

Not a classroom activity (field activity)

Requirement: Go out and interact with people

Talk to at-least one person around you and write the story of his/her health.

While talking to anyone about their health remember to

1. *Be polite.*
2. *Listen to the person and make notes*
3. *Do not ask questions that can be hurtful.*
4. *If they don't want their name to be used in your story, you can change it to something else to keep the identity of the person secret.*

You can ask them about

- *Have you ever been unwell for many days. For example, admitted to hospital for some days or you had to stay in bed because you had some disease.*

- *How did this affect you?*
- *Did you feel sad because of it?*
- *Were you able to meet your friends during that time?*
- *Have you ever been tense for many days because of something? For example: worried because of family problem, worried because of school or office work.*
- *Did you interact normally with people around you during that time?*
- *Did you have any other problem like headache or stomach problem during that time?*
- *Did you eat and sleep properly during that time?*
- *Did you feel excessively tired during that time?*
- *Have you ever felt isolated (lonely) in school or home or in your community: for example you were not able to interact with friends and family.*
- *Did you feel upset about it? Did you eat properly during that time?*
- *Has it ever happened to you that feeling healthy in one way made you feel healthy in other aspects also? For example: being with friends and family or in neat and clean surroundings made you forget your worries.*
- *---------- (you can add more questions after classroom discussion)*

Use space below to write the story of health of the person you talked to

Title of your story :

_____

_____

_____

Discuss in the classroom

Q1. Did you see that three aspects of health overlap in the person's life?

Q2. Did you come across any example where a person makes efforts to become healthy in one aspect of his/her health and the other aspects also get affected?

1.4 From health to disease

Sometimes our health gets affected because of things that happen around us and we suffer from diseases.

Diseases can be classified in different ways. They can be classified based on - What causes them, what they do inside the body, their symptoms and many other things.

Some diseases are caused by organisms which enter our body (infectious diseases), many others due to environment (Asthma due to air pollution or inhaling smoke from stove while cooking food). Some others are caused by our lifestyles (tension ridden lifestyle tend to cause high blood pressure). Some diseases are caused by deficiencies of important nutrients (one such example is anemia). The cause of some diseases are not known – eg, cancer

Here we will talk about diseases that are caused by external agents.

1.5 How do disease reach us?

First let's think, how do these external agents reach us? Do all external agents enter our body through the same route or do they take different routes?

To understand various routes of disease let's do a small activity.

Activity 4: How do diseases that are caused by external agents reach us?

Classroom Activity

Requirement: Student workbook

Make a list of diseases that are mentioned in your textbook. Now, think about how these diseases reach us?

Use the body outline given below to write the names of the diseases near the body part through which they reach us.

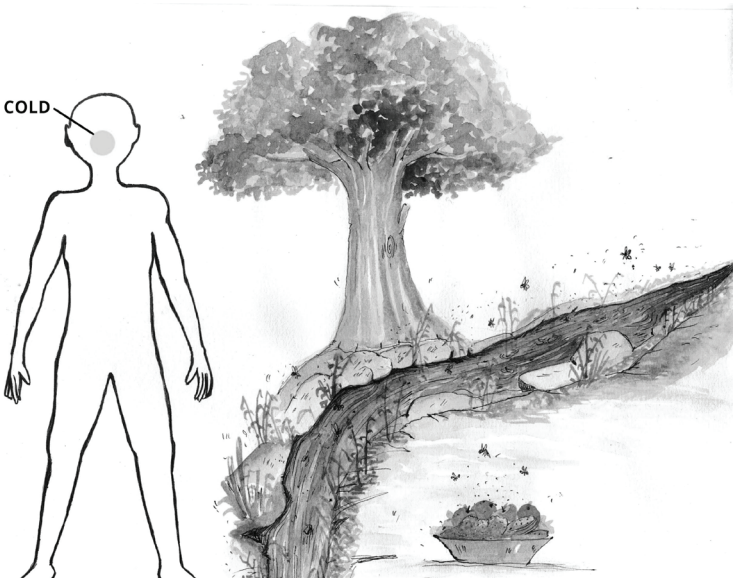
Let's take 'cold' as an example. Through which body part does it reach your body?

We can get cold if someone sneezes or coughs near our nose or mouth. Hence we can say that it reaches us through our nose or mouth.

Similarly think of routes of all the diseases in your list. You can use your textbook for help.

Are there some diseases that you have not been able to mark on the body outline?

Discuss in groups to think how do we get these diseases.



1.6. Preventing ourselves from diseases

Some diseases are mild and very common like cold, so we either do not have to take special measures to protect ourselves from them or sometimes need to take very simple measures to protect ourselves. Others like measles can kill a baby, so we protect the baby by vaccinating it.

Let's try to think of ways to protect ourselves from diseases.

Activity 5 (optional): Think about it!

Classroom activity

Requirement: Student Workbook

How can we prevent ourselves from getting these diseases?

Let's suggest a way based on the route of the disease.

Let's take nose (route) as an example. To prevent getting a disease through our nose we can wear mask.

In this unit we looked at health in an overall manner not just the physical health. We also saw ways in which we can protect ourselves from getting some diseases. to effectively protect ourselves from diseases it is sometimes important to understand what causes the disease.

In the next unit we will look at the story of discovery of the organism that causes malaria.

The Story of Malaria

2.1 Malaria Discovery

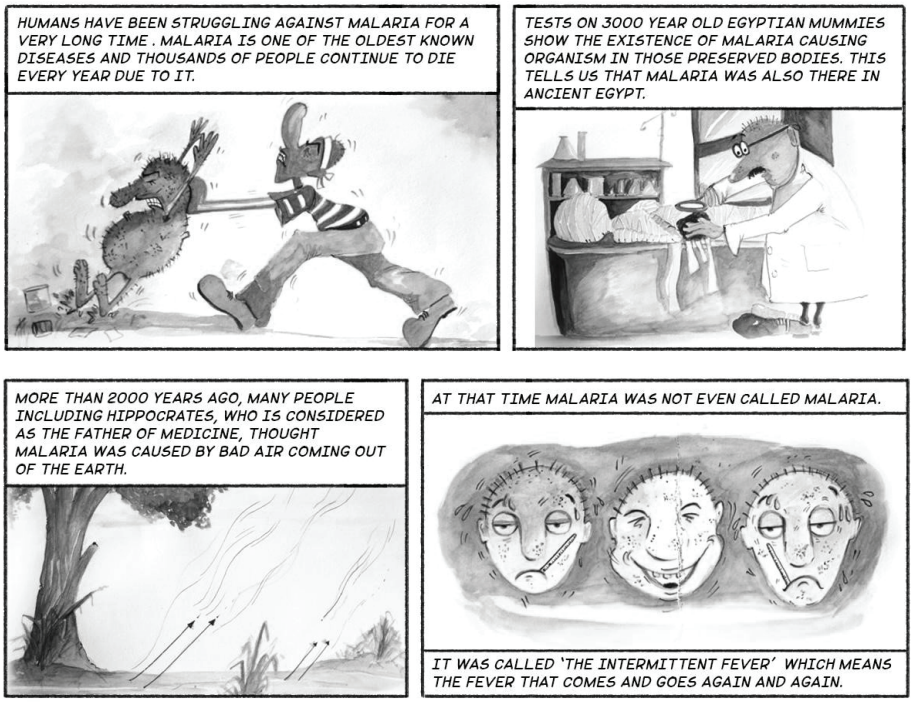
In the previous unit we looked at health in an overall manner not just the physical health. We also saw ways in which we can protect ourselves from getting some diseases. To effectively protect ourselves from diseases it is sometimes important to understand what causes the disease.

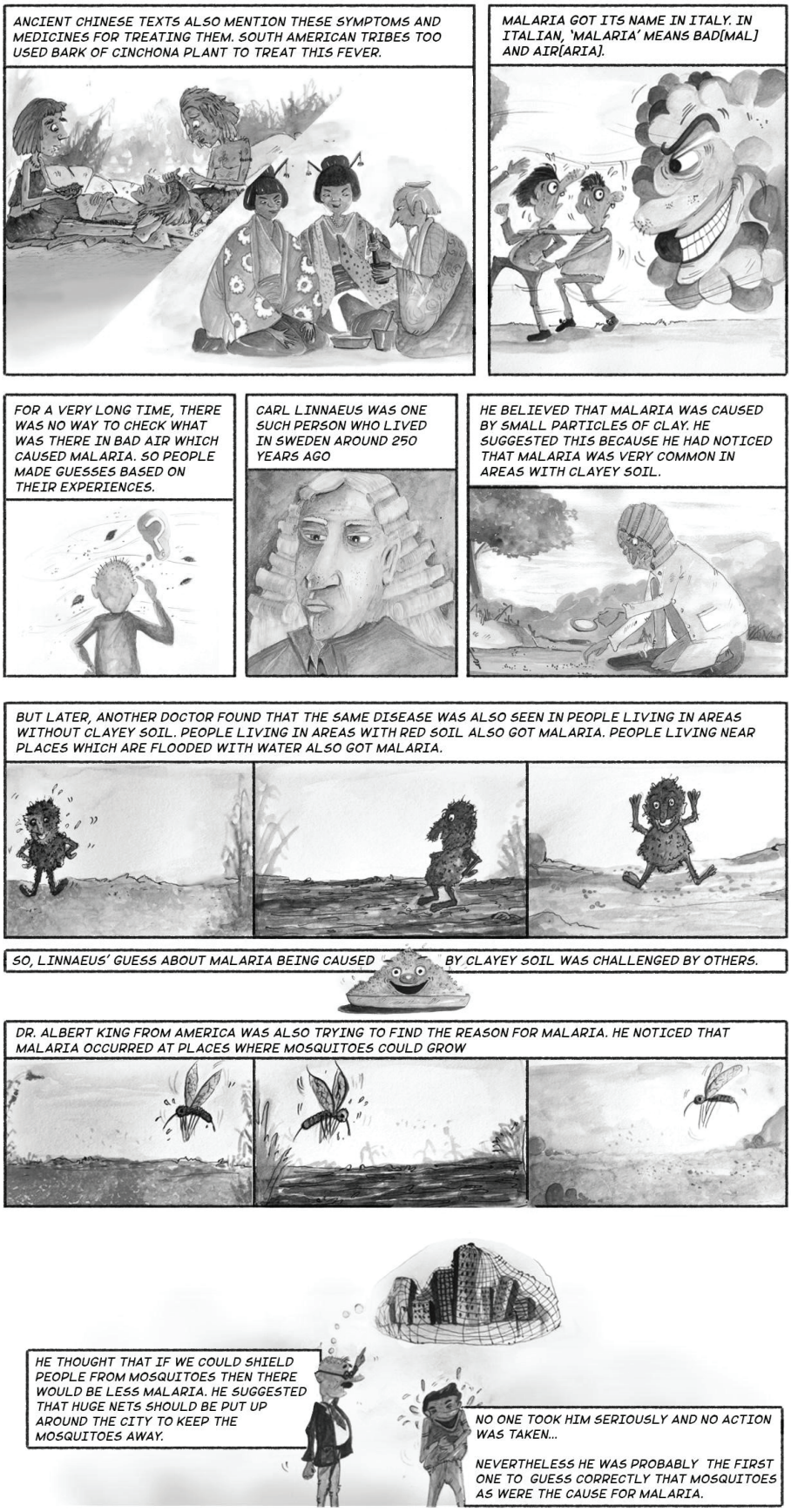
In this unit we will look at the story of discovery of the organism that causes malaria.

Malaria is one of the deadliest diseases in the world today. Every year many people die from this disease in our country.

When a person suffers from Malaria he/she gets high fever after every 48 hours. This rise in fever on alternate days weakens the patient. We now know that female anopheles mosquitoes can carry the organisms which cause malaria. But it took humans many many years to identify what causes malaria. People all over the world contributed to what we know today.

This is the story of discovery of malaria…





Activity 1

Can you guess places in your school and its surroundings where mosquitoes can be found?

Draw a sketch map of your school and mark the places where you think you will find mosquitoes.

(Tip: Do not worry about drawing everything exactly, use squares, circles to mark the places where you think you will find mosquitoes)

Go around your school campus and check whether you really find mosquitoes there. Observe the kind of places they prefer.

Based on your notes can you say what are the places they prefer?

Activity 2

Mosquitoes lay eggs which become mosquito larvae (baby mosquitoes) and then become adult mosquitoes. ***But where do these larvae live?***

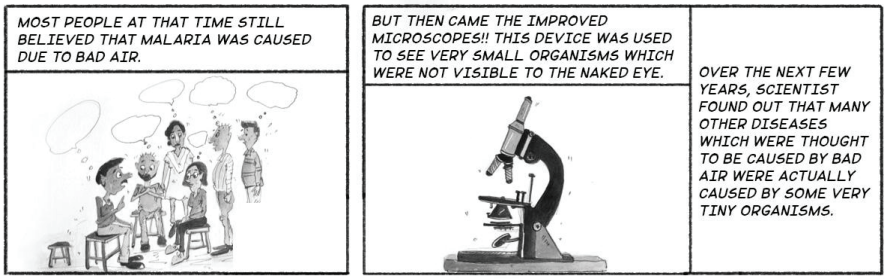
Mark the places on your map where you find larvae.

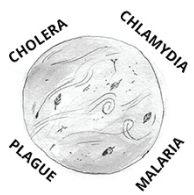
What are the similarities that you find in the places where larvae is found?

Collect mosquito larvae from different places in your neighbourhood.

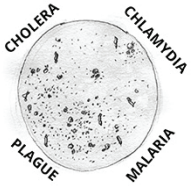
You can use a transparent cup to collect the larvae along with water from the place you found them. Cover the mouth of the cup with a piece of cloth or a sieve to let air pass through.

Observe them for next 15 days.

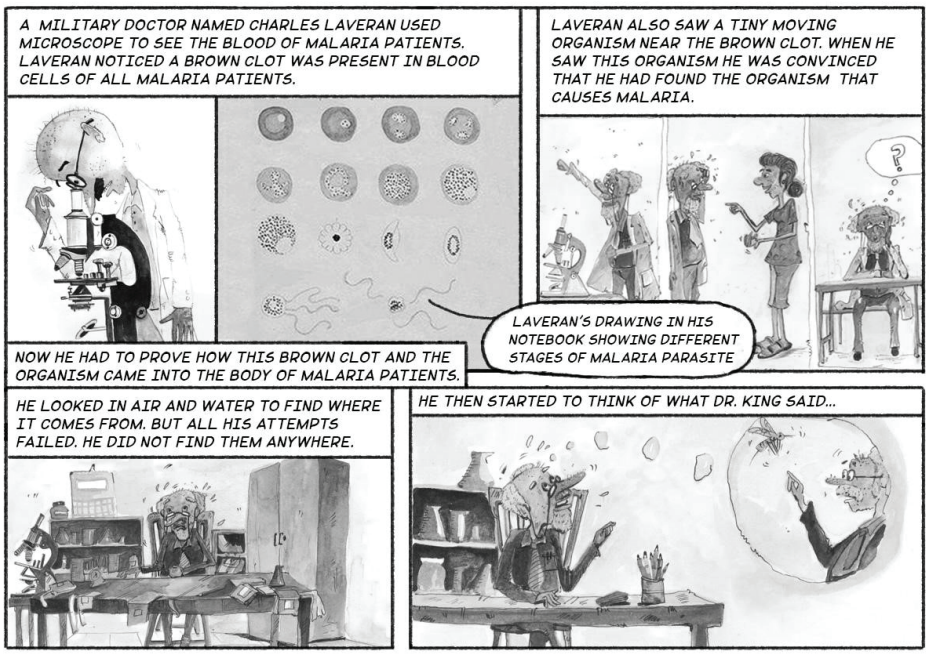


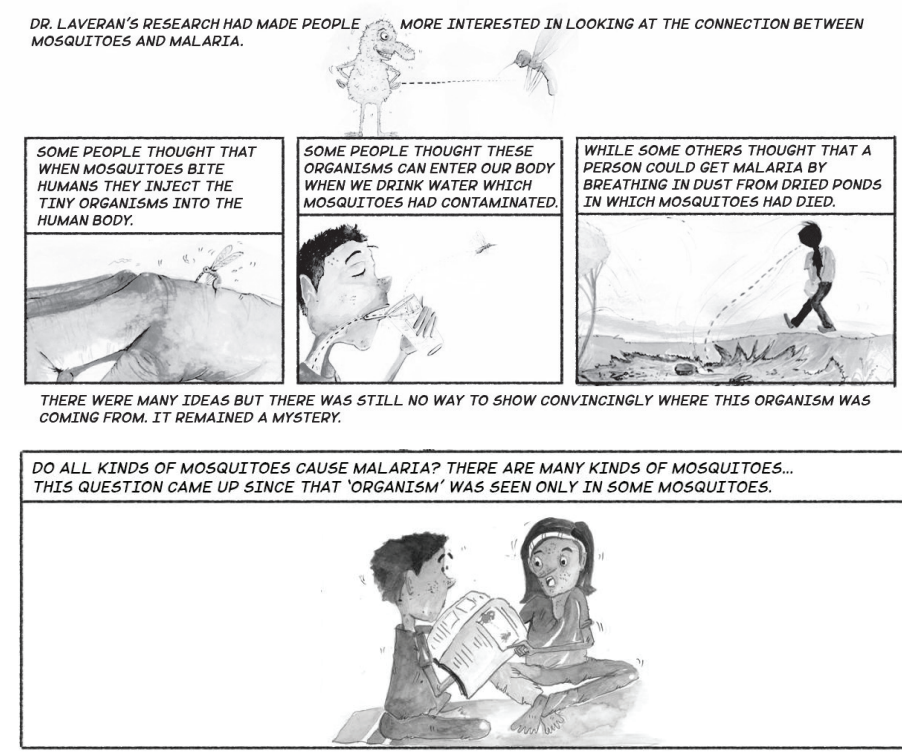


Air



Microorganism





Activity 3

Discuss in your groups and guess how they would have found out which mosquito causes malaria.

Activity 4

Work in groups to collect some mosquitoes from your school or home.

You can kill them if you are not able to collect live mosquitoes.

Keep the mosquitoes on a white background and look at them carefully

Think of the following things and complete the following table using as many mosquitoes as you can catch.

Q1. What time of the day did you catch it (night/daytime)?

Q2. Is it completely black or does it have stripes or spots on it?

Q3. Where did you find it?

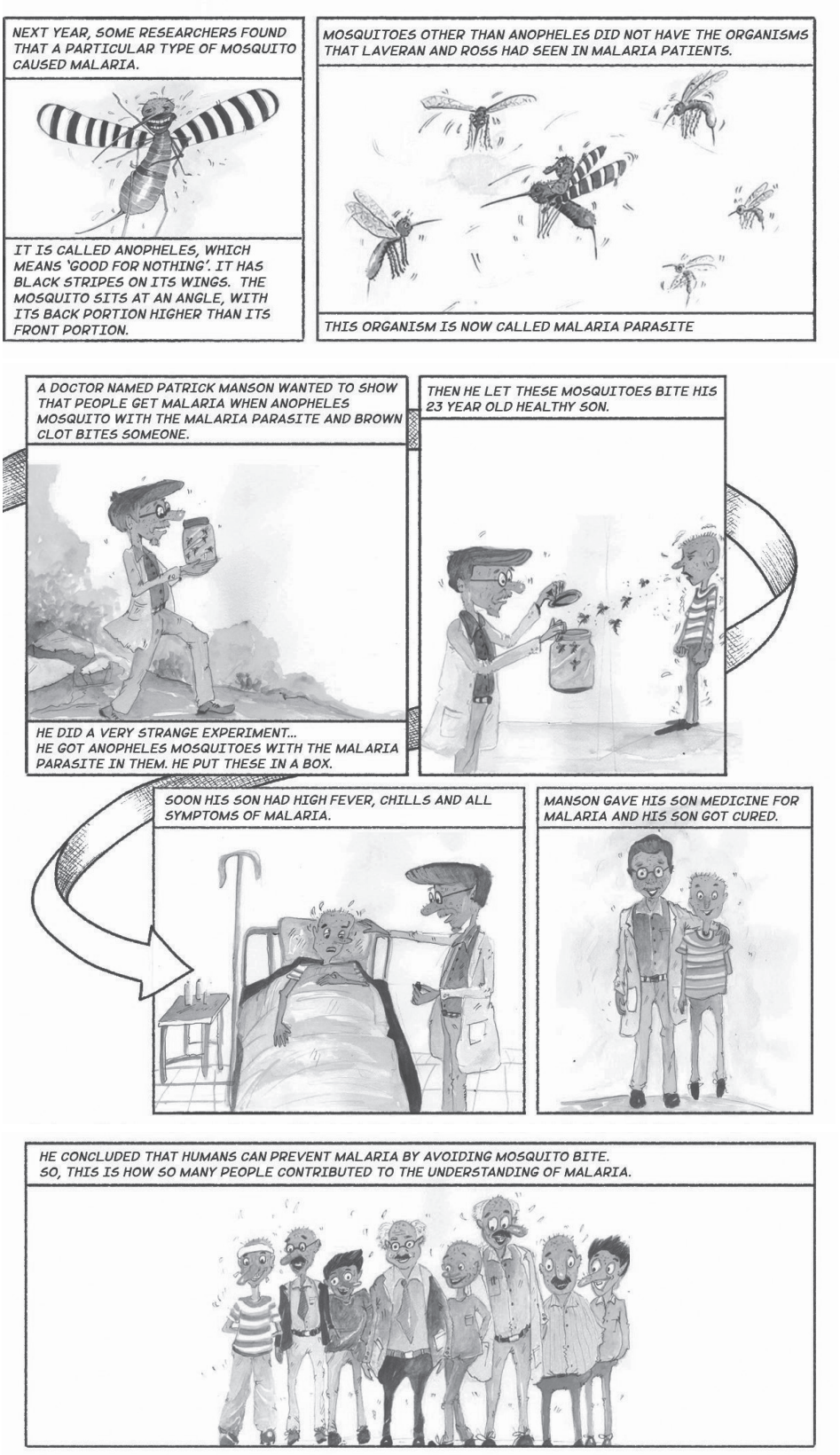
You can make a table like the one given below to note your observations

Serial number	***Time (Night or Day)***	***Black completely (yes/no)***	***Stripes on wings***		
(yes/no)	*Spots on legs*	*Location*			
1.					
2.					
3.					

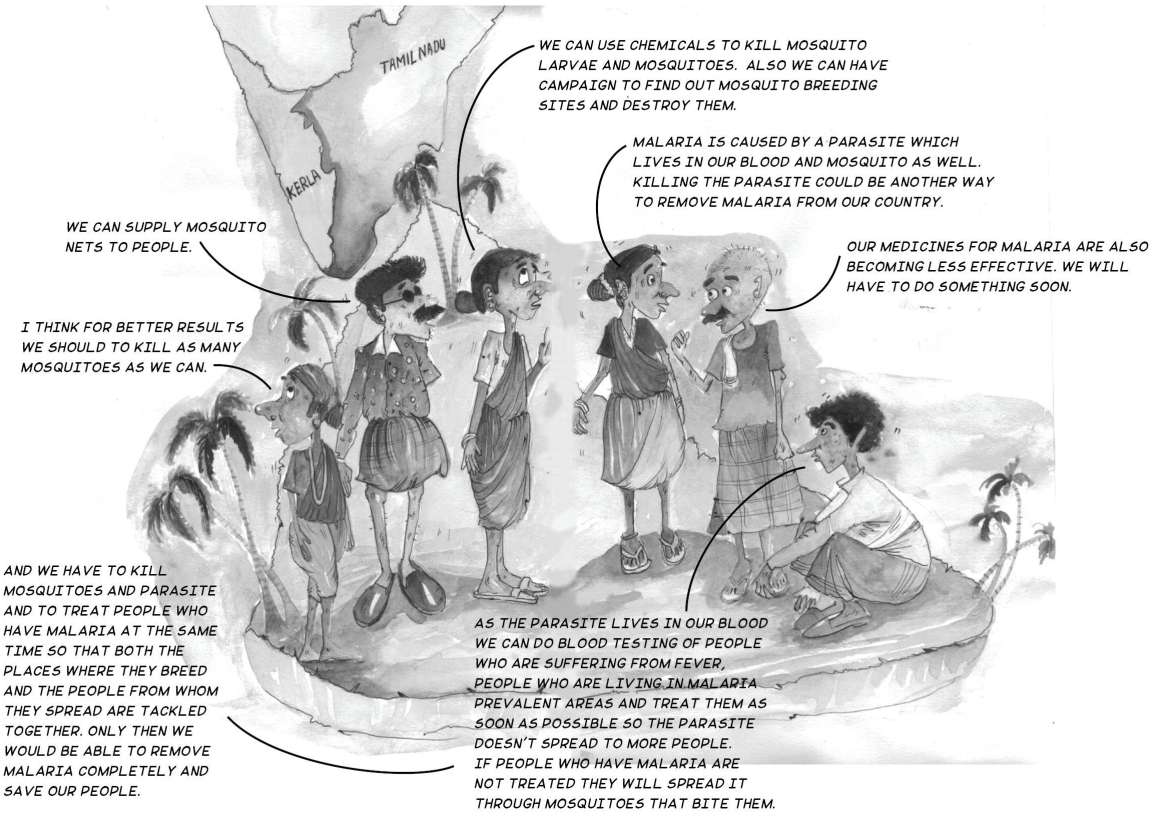
Compare your tables with other groups.

There are 3 main types of mosquitoes that you will find in your neighbourhood. The ones that are completely black are called Culex. The ones which have stripes on wings are called Anopheles.

Anopheles mosquitoes are also usually smaller than the other types. These are the ones that can carry malaria. The ones which have black and white spots are called Aedes. Aedes mosquitoes can carry the dengue just like anopheles can carry malaria.



The fight against malaria has come a long way since that time. Some countries using the knowledge we have today have been able to completely remove malaria from their region. Let us see how one such country – Sri Lanka did this



Let's Investigate

3.0 Finding answers to some questions

In the previous unit saw that many people were trying to answer the question " how is Malaria caused? ". Many people had different ideas and suggestions about how malaria is caused. The scientists and doctors had to do some experiments to prove to everyone else that what they were saying was not wrong.

In this unit, you are will be investigating some questions yourself. There are 3 parts in this unit - High blood pressure, Smoking and Anaemia. Each of them discusses one health issue. You can select any one of them.

You have to work in groups to complete these investigations. After completing the activities, you will also have to tell your friends about what you did and what did you find.

3.1. High Blood Pressure

Blood pressure of a person depends upon various factors. Blood flow through the pipes is one of the factors. When blood flows through the pipes in our bodies, they exert pressure on the walls of the pipes. The ease with which blood flows is indicated by our 'blood pressure'. The flow gets affected by the diameter of blood pipe and any obstruction in them. Our food habits, stress level and exercise also affect our blood pressure in complex way Blood pressure is also influenced by hereditary factors. If both or either of the parents have high blood pressure then the chances of their son/daughter having high blood pressure increases.

3.1.1. What causes high BP?

Let's read a story about hypertension or high blood pressure

Sunita's mother had not been feeling well for a few days. She was feeling tired and having headache for nearly 2 weeks but she was hesitant to go to see a doctor. She thought that these are not very serious symptoms. Sunita managed to convince her and took her to the hospital to consult doctor Mahi. After waiting for their turn for half an hour they went to the doctor's cabin. Sunita's mother told Dr.Mahi that she was not feeling good for last few days. She was getting tired very soon. The doctor told her that she will check mother's blood pressure.

Sunita saw the doctor open a box like instrument. The lid had a scale containing some liquid

substance, while inside the box was kept a rubber bag with cuff and rubber pump. The doctor kept talking to Sunita's mother while wounding the cuff tight around her arm. She also used a stethoscope. She asked her, 'what is your age? She also asked about food habits and stress. She then said that the blood pressure is currently higher than normal and we need to keep checking it regularly.

"Blood pressure? What is that?" Sunita asked.

Doctor Mahi told her, "This is the pressure exerted by blood on the pipes that carry blood in our body. Every time the heart beats, it pushes the blood with some pressure in the blood vessels. The blood pressure meter is used to measure the pressure in blood pipes. The stethoscope is used to hear the sound produced inside the body by the heartbeats."

All this was surprising for Sunita.

"Blood pressure or 'BP' of most of the people varies within a certain range during most of the day" the doctor continued. "That range is called normal. Sometimes for a person, blood pressure becomes constantly higher or lower than the normal range and this can be dangerous for our body."

He prescribed some medicine and asked her to come after one week. He advised Sunita's mother reduce salt and oil in her food and told her to get her B.P checked from time to time.

Let's investigate how blood flow can be affected.

Heart pumps blood into the blood pipes and these pipes carry blood to different organs. Blood pressure is different in different people and also varies during a day for the same person. There are different factors that affect our blood pressure. One of the factors is blood flow i.e., amount of blood that flows in the blood pipes at a time.

Question: What will reduce flow of blood through blood pipes?

Let's make a guess

3.1.2. Effect on the blood flow- How to check it?

Suppose our hypothesis is - "Pipe with a narrow diameter will reduce the blood flow"

How can we test this?

One way to check this is following -

For this you will require

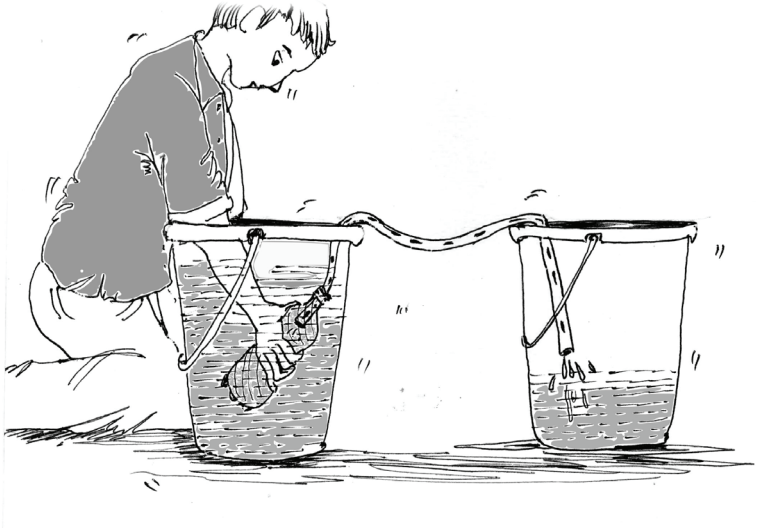
- 2 buckets
- An old plastic bottle like a cold drink bottle, water bottle etc that can be easily pressed.
- Two pipes about 2 meters with different diameters

1. Fill one of the buckets with water. There should be enough water in the bucket to submerge the plastic bottle.
2. Take the pipe and the plastic bottle and put one end of the pipe inside the bottle.
3. Now put the plastic bottle and the pipe inside the bucket filled with water.
4. Keep an empty bucket nearby.
5. Take the free end of the pipe and hang it in the empty bucket.
6. Now hold the plastic bottle with one hand. Make sure the bottle is inside the water.

7. Squeeze the bottle repeatedly. You will see that water will start flowing from the pipe into the empty bucket.

This is how heart pumps blood into blood pipes which then carry the blood to different organs.

8. Measure the water that flowed into the empty bucket in 1 minute.
9. Repeat the procedure for second pipe with different diameter
10. Measure water that flowed into the empty bucket.



3.1.3 Effect on the blood flow- Observations

Was the quantity of water pumped out more when you used the pipe with -

- smaller diameter
- larger diameter

Did your initial guess match with the result of our activity? What does it say about the effect of diameter of pipe on the flow of blood? Write it down in your notebook.

What are the conditions that can make the pipe narrow? Write down your ideas.

For further investigation we can take these two factors

- Narrowing of pipe at specific position using clothespin
- Obstruction in the pipe

Can you think of way to check the effect of obstruction in the pipe?

(You can introduce an obstruction in your experimental pipe using chewing gum or dough.)

Write down what changes you made in the initial setup and your observations in notebook.

What is the effect on the flow of water?

Suppose bottle is pumping same amount of water in 2 pipes - one with large diameter and one with small diameter. As the pipe with smaller diameter gives lesser space for water to flow the pressure in the pipe is more.

In this activity we have seen that flow of water is affected by the diameter of the pipes. Similarly, blood flow in the blood pipes of our body get affected by their diameter. This in turn affects our blood pressure.

Depending on various factors like the above, blood pressure can be low or high. Both low blood pressure and high blood pressure are not good for our health. Often high blood pressure does not show any specific symptoms in a person. Hence it is advised to check it regularly after age of 30. Regular check-ups would be able to detect if the range is not normal. Keeping the blood pressure in normal range is very important to avoid complications like heart attack and stroke.

3.1.4. Your question, Your investigation! - Blood Pressure

Do you have any other questions related to blood pressure that you would like to investigate into or find about?

Do you have any idea how you can find out the answer?

3.2. Smoking

Smoking and tobacco chewing are harmful habits that many teenagers start because of influence of either their friends or people around them. These habits are also very hard to leave. Many people who once start either smoking or tobacco chewing are not able to leave the habit. It is addictive and requires effort to give up.

Tobacco use can have very adverse effects on health. Smoking has harmful effects not only for the people who smoke but also for their family members who inhale the smoke. This is called passive smoking.

3.2.1. Lungs of people who smoke

Let's read a story about smoking and investigate how it can affect the health of people who inhale tobacco smoke.

I am 30 years old. I have been smoking since I was 16 years old. Most of my friends at school smoked. I tried my first cigarette with Kamal bhaiyya. He was my neighbour. I looked upto him for everything. He was good at sports and in studies too. He even played for our school hockey team.

For the first few years I smoked 4-5 cigarettes every day. I never smoked at home. While coming back from school I would stop at the bus stand before my house and smoke with my friends.

I started smoking more when I moved to city for work. It became a part of my life, a habit just like eating food and sleeping.

When my mother found out that I smoked she told me that I would get addicted. She tried to convince me to leave smoking. I knew that some people tried to quit smoking but were not able to. But I never thought that smoking was a problem for me. I thought that I would be able to leave the habit whenever I wanted.

Last evening I took my 5 year old daughter to the doctor. She has had difficulty in breathing and bad cough for many days. Doctor told us that she has asthma, possibly because of inhaling smoke. On the way back home. I decided that I would never touch a cigarette again. It is proving harder than I imagined. I never thought that my habit of smoking would cost so much to my daughter's health. Maybe I was wrong, smoking is a problem for me.

The writer's daughter in this story had difficulty in breathing and would cough regularly. Inhaling smoke can often cause people to have breathing problems. You might have noticed that smokers usually start panting (getting breathless) after even a little bit of exercise. **Do the lungs of smokers function as well as the lungs of nonsmokers?**

Let's try to answer this question through an experiment.

To answer this question first let's make a guess.

Write your guess in your notebook

3.2.2. Lung Capacity of smokers and non-smokers

Suppose our guess is

" the lungs of smokers do not function as well as the lungs of nonsmokers."

Now we will have to test if our guess is right or wrong.

To test the functioning of lungs in smokers and non-smoker we can do a test.

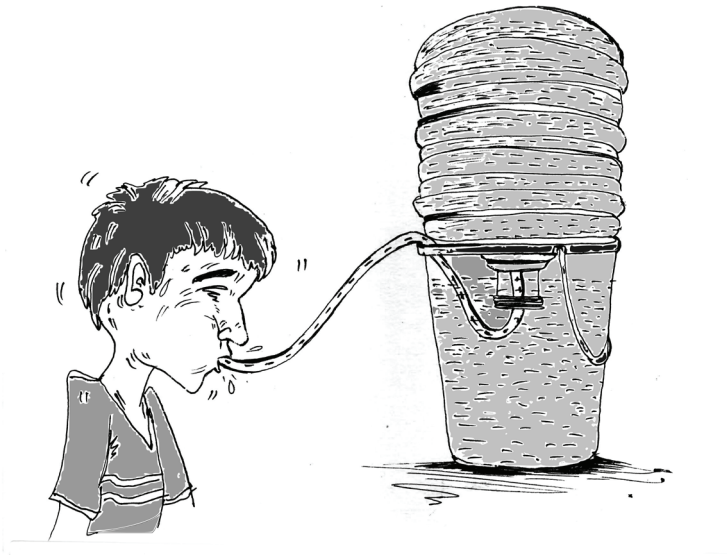
For this test you will require

1. *water*
2. *One large (5 litre) plastic bottle or container,*
3. *A bucket in which the plastic bottle can comfortably fit.*
4. *Rubber or plastic pipe of about 2 metre*
5. *250 ml cylinder or beaker (to measure)*
6. *Small strips of paper*
7. *Tape*

To do this test

1. *Take the 5 litre bottle and the measuring cylinder. Fill up the measuring cylinder with 250 ml water. Pour the water into the plastic bottle. Mark the water level with a marker and write 250 ml near it. If you don't have a marker you can write 250ml on a small piece of paper and stick it on the bottle near the water level. You can use tape to stick the paper on the plastic bottle.*
2. *Use the measuring cylinder to add 250 ml water again, and mark the new water level just like you had done previously. Write 500 ml near the water level.*
3. *Continue adding water and marking the water level in the same manner till you fill up 5 litres of water (5000ml)*
4. *Fill a bucket with water. Keep in mind that it must have enough room left to accommodate the added water from your plastic bottle*
5. *Hold your hand tightly over the mouth of the bottle and turn it upside down in the bucket. Remove your hand when the mouth of the bottle is below the water. Note that the plastic bottle should be completely filled when you put it in the bucket. If some water goes out of the bottle when you are putting it inside the bucket, tilt the plastic bottle a little so that water can go inside it.*
6. *Place one end of the plastic tubing into the mouth of the bottle*
7. *Clean the free end of the tube.*
8. *Now to test how much air can your lungs hold, take a deep breath- as deep as you can and hold your nose closed, and exhale as much as you can into the tube in one go.*
9. *As you start exhaling in the pipe, you will see that the air goes into the plastic bottle.*
10. *After exhaling note the mark to which air is filled in the plastic bottle.*

11. *The value near the mark will represent the your lung capacity.*
12. *You can ask some people who smokes to take this test and note their lung capacities. Then you can some people who do not smoke to do take the test and you can note their lung capacities also.*



Note your observations here. You can make a table to note your results.

3.2.3. Lung Capacity of smokers and non-smokers (contd.)

Based on your observations try to answer the following questions.

Was there a difference between lung capacities of people who smoke and who do not smoke?

Was the lung capacity same for all people who smoke?

Was the lung capacity same for all people who do not smoke?

Based on your observations can you say that our guess was right?

You can also use this test to find out the difference in lung capacity of people who exercise regularly with people who don't exercise regularly.

The air we inhale goes through our nose or mouth into our lungs. Lungs have small balloon like sacs were exchange of gases takes place. Every time we breathe these small balloons in our lungs inflate. When a person smokes, the inhaled smoke goes through mouth or nose and enters the lungs. The particles of smoke can get deposited in the lungs. These particles can cause damage to the balloon like sacs. Sometimes mucus can also be filled in these sacs. So when a person with damaged or mucus filled sacs breathes in sacs do not inflate completely.

3.2.4. Your question, Your investigation! - Smoking

Do you have any other questions related to smoking that you would like to investigate into or find about?

Discuss and decide questions with your group. Write down the questions in your notebook.

Now, make a guess about the answer.

Remember the guess doesn't have to be correct. You can make any guess that seems reasonable to you!

Now, think of an experiment to test whether your guess is right or wrong.

What did your experiment tell you?

Can you say whether your guess was right or not?

3.3. Anaemia

Not getting enough to eat is a major reason why many people in our country suffer from a deficiency of blood in their bodies, especially girls, women and children. Another reason is the absence of those kinds of items in the diet that help the body in making blood. Let us see what is meant by deficiency of blood.

Red blood cells found in blood help in delivering oxygen to different parts of our bodies. When these red blood cells are not sufficient, our blood will not be able to deliver properly oxygen to different organs; then we start feeling weak, and get tired quite easily. This condition is called‘anaemia’.

Iron-deficiency anaemia is a major health problem in India especially among children, adolescent girls and women.

3.3.1 Iron-deficiency can cause Anaemia

Let us read a story about anaemia and try to find out how it affects us.

Sowmya is 13 years old, and lives in Pipaliya village. She studies in the 7th standard in the village’s middle school. Her parents work as farm labourers. She takes care of a number of household chores before going to school – filling water, dusting, washing utensils, etc. When it’s time to go to the school she eats a roti or just drinks a cup of tea and runs to the school. She is good in sports and often comes first in running. But for a few weeks she has been getting tired easily. She doesn’t feel hungry too. She doesn’t feel like doing any work after waking up in the morning. She has also not been able to concentrate on her studies in the class. Her head started to spin while playing one day and everything became black in front of the eyes. She couldn’t play any longer and sat down. One of her friends fetched some water and another went to call the teacher. Sushila madam checked the colour of her eyelids and tongue. They looked really pale. The teacher suspected that Sowmya has anaemia.

Sushila madam arranged for a discussion on anaemia after a few days. She checked the eyelids and tongue of every student in the class. Nearly 12 of the 30 students in the class had a pale colouration on their eyelids and tongues. These could be signs of blood deficiency.

Afterwards the teacher described other signs of blood deficiency. Several students shared their experiences. Najnin said that her waist and shins ache in the morning. Ajay said that her mother works a lot and eats less, thus she is weak.

The teacher said that these are all signs of blood deficiency. Protein and iron are necessary in our diets for our body to make blood. The students gave quick replies to the question of where we can get protein from – pulses, legumes, milk, meat, eggs, fish, etc. But they didn’t know which food items contain iron.

Then the teacher asked the students to bring some raw food items on the next day, whose list is given below. They would do an experiment to find out which of these contain iron.

Guess: Make a guess as to which of these items will contain more iron.

Serial number	Name of the edible item and its quantity	Observation after the experiment
1.	Jaggery 5 grams	.....
2.	Spinach juice	
3.	Iron tablet	
4.	Lemon juice	
5.	Salt	
6.	Distilled water	
7.	Tamarind	
8.	Beetroot	
9.		
10.		

Note:

1. If you can't get a complete solution for an item, then you can grind it and then dissolve it in water or get its juice out and then do the experiment.
2. You can find filter paper in a store selling laboratory ingredients or in your school laboratory.
3. If there is no distilled water then you can store rain water in a clean vessel.

3.3.2. Food sources of iron

Experiment:

1. *Add 3 to 4 spoons of tea leaves in one litre of water and boil it.*
2. *Filter this tea water and store the water in a container.*
3. *Take one cup of this tea water from this for the first experiment.*
4. *Make a separate solution of the item whose iron content is to be tested, and then filter it using a strainer so that there is no solid part in it. For example, mix 5 grams of jaggery in 10 ml of water and then filter it.*
5. *Mix this solution with one cup of tea water.*
6. *Keep it aside for 40 to 45 minutes. Is there any change visible in the tea water solution?*
7. *After 45 minutes strain this mixture through a filter paper (Whatman number 1)after fitting it in either a funnel or a plastic tea strainer.*
8. *It may take 30 minutes or more to strain this mixture. Let the filter paper dry completely once the process is complete.*

What did you see on the filter paper?

If there is any black residue on the filter paper, then it indicates the presence of iron.

3.3.3. Food sources of Iron

Which items contain larger amount of iron? How did you decide whether the amount was more or less?

You can do this with water collected from different sources like wells, hand-pumps, tap water, just like you did with distilled water? Write down your observations.

From this experiment, we can only discover whether an edible item contains iron or not. But this does not end the discussion on anaemia, because it is not necessary that our bodies can digest or absorb iron from all types of sources. Absorption of iron in our bodies requires helping elements like vitamin C. It is more difficult to absorb iron from a vegetarian diet, thus it helps a lot in such cases to eat foods containing vitamin C. With regard to absorption it can be said that iron is more easily absorbed from a non-vegetarian diet. Vitamin C and other absorbing elements are incorporated in iron tablets in any case to ensure its proper absorption in our bodies, so it is certainly beneficial to consume them. Including more iron-containing items in food in addition to that can help in reducing anaemia.

3.3.4. Your question, your investigation! - Anaemia

Other than signs, what other reliable methods are there to determine whether someone has anaemia or not? Discuss and find out.

Questions for the future:

If we drink tea while eating, then what difficulties can be there for our bodies to absorb the iron contained in the food items? Discusson the basis of the results of the experiments done above.

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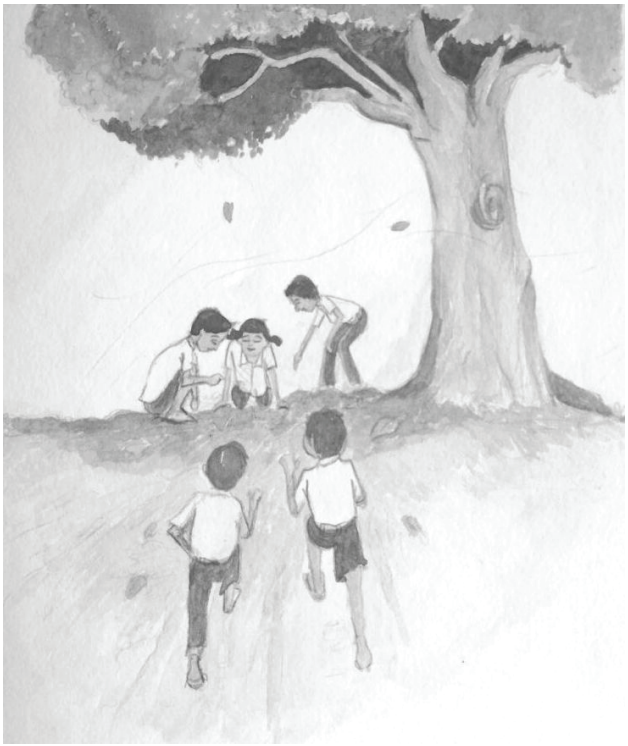
ECOSYSTEM

Content

Exploration of an ecosystem

1.1 Exploration of an ecosystem



While walking in your school complex you may have noticed that all corners/ areas do not look the same. Some areas have grass, bushes and weeds, while some are rocky and without any vegetation. During the rainy season, there may be plants growing up new on concrete walls. An area that is moist may have mosquitoes and bugs/ insects in abundance.

If you look close you may be surprised to find out that not only do the places and corners look different, they are home to different kinds of vegetation, insects and animals.

Are the diversity of living and non-living things you find on your school campus different from the diversity that you will find in the pond? What do you say?

Does there appear to be a relationship between the non-living things and living things of any specific area?

<u>Field Trip/Walk - a walk around the field</u>

Let us go for a walk around the school to discover Diversity (both living and non-living) and their interrelationship. Excursion means observing the world outside your classroom, gathering information about non-living and living things. Then coming back to class and organizing the information collected.

The room you are in, the walls, ground/field, roof, lawns, observe everything during your Walk.

Precautions:

1. Do not touch any insect or other organisms. Observe them from a distance under the

supervision of your teacher.

2. Do not venture out alone towards the pond, lake or river.

3. Do not play with any water collected outside. Mosquitoes may be present near the water bodies. So be fully covered - wear full-sleeved clothes, pants, salwar-kurta etc.

Observation

Whatever you observe outside, should be noted in your table (see the table given below).

For example, if you see a spider - is it on the wall or in its web?

- Which insects are stuck in that web?
- From where do you think these insects came?
- Why did the spider choose a corner for making its web?

Similarly, look at the soil, the stones

- Are there any insects in the soil?
- What kinds of plants are growing in the soil?
- What are the kind of stones and pebbles you see there?
- Can you also see rotten or dry leaves, grass etc in the soil?
- Of what use will they be there

If you can see water around	**If you see a honeybee**	**If you see trees**
Is the water clean or dirty?	Where was it seen?	The soil around it be like?What will
Which insects/germsdo it have?	While flying where does it stop and rest?	Are there any birds living in the trees? Which ones?
Why are they breeding and flourishing there? If you see a honeybee	Why does it rest there?	Are there also insects on the tree?
	Where is its hive?	Is the tree also getting something from the air and soil?
	Does it get some kind of help from the tree? If you see trees	

Perhaps you will also see some organisms that live under the surface layer of the soil; write about them too in the table.

The information above is only to help you make the observations. You have to collect more information.

This table will help you organize the information you have collected during the Field Walk.

Serial number	**Where it is found**	**Living or non-living**	**If living**
where/ from what does it get food			
Ants			
Pieces of rock			
Grass			
Plastic			

Wherever you stand, if you observe carefully you will find an entire ecosystem which will have living and non-living things depending on each other - there is an interrelationship between them. You can find this connection at the global level or just a single tree is enough to understand it. If you wish, you can take the pond or lake as a system and look for interrelationships within it.

These ecosystems appear to be different and far away from each other, the organisms living in it can be different from each other but these systems are connected to each other as well. In these systems, there is an interaction between living and non-living. There is an atmosphere of interdependence between them. A change in one system can impact/affect another system as well. For example, if the pond dries up, not only will the life within it die, the plants around it will also dry up.

In any Ecosystem, there can be two types of living things - one which can be seen with our eyes (e.g. birds, insects, animals) and second microorganisms which cannot be seen with naked eyes (e.g. bacteria, virus etc.).

In one square cm soil, there can be thousands of kinds of microorganisms. In the category of non-living, we have sunlight, air, soil etc.

In an Ecosystem, we see the interrelationship and interdependency between the living and non-living components.

1.2. Activity

Once you complete the exploration segregate your observation as given below

Serial number	Living	Non-living

While exploring the surroundings did you notice any linkage between living and non-living things?

1. Are trees and grass taking anything from the soil?

2. Do plants get anything from the soil?

3. Are dry leaves contributing anything to the environment?

4. Are grass and insects connected together?

5. Are human beings connected with soil and tree?

6 Can you make a diagram connecting soil, water, plants and insects

Understanding an ecosystem

2.1. Understanding an ecosystem

The previous day, we had explored our schoolyard and found biotic and abiotic components.

Just to help you revise - Biotic components mean all components that have life and Abiotic components are non-living in characteristics. All plants, animals and microorganism existing in a specific area and the non-living

things such as soil, air, water etc. present in their environment together form an ecosystem.

In an ecosystem, biotic and abiotic components are involved in interaction with each other. For e.g. plants utilize sunlight, minerals and water from their environment to survive and grow. Meanwhile, animals get their food, nutrition and energy by eating plants or animals. Plants, animals and microorganism need water and air for maintaining their life; they take it from their environment.

We, humans, are also a part of the ecosystem. Like other animals, we also get our nutrition from biotic and abiotic components.

The Ecosystem could be very large such as ocean or forest, while a hole in a tree or a discarded pot filled with rain water is also an ecosystem. The study of the ecosystems is called ecology and the scientists who conduct such studies the ecologist.

Now we know that although different regions of our planet look different, they are actually connected with each other. Any disturbance happening in one part of the world is not restricted to that region. The air from one continent travels to another continent. The pollution in one ocean can reach other oceans over time and influence the organisms living there. The forest fire from one country can create a haze in another country.

Yet we found that many areas of our environment are with the unique identity as far as the biotic and abiotic factors are concerned and function as a distinct ecosystem.

Let’s study a few of them.

2.2 Aquatic ecosystems

Aqua means water. Water bodies - big ones like oceans, rivers, lakes and small ones like ponds and your own fish aquarium comes under this category. Many aquatic ecosystems are

surrounded by the land and the water it holds is stagnant in nature (e.g. pond). Meanwhile, the water present in the ecosystems such as stream and river keeps flowing. The stagnant ones are called Lentic ecosystems and the flowing ones the Lotic ecosystems.

The water present in rivers, streams, inland ponds, dugout wells etc. generally contain very less salt (known as Freshwater ecosystems) compared to the largest aquatic ecosystem - the oceans (Marine Ecosystem)

2.3. Terrestrial ecosystems

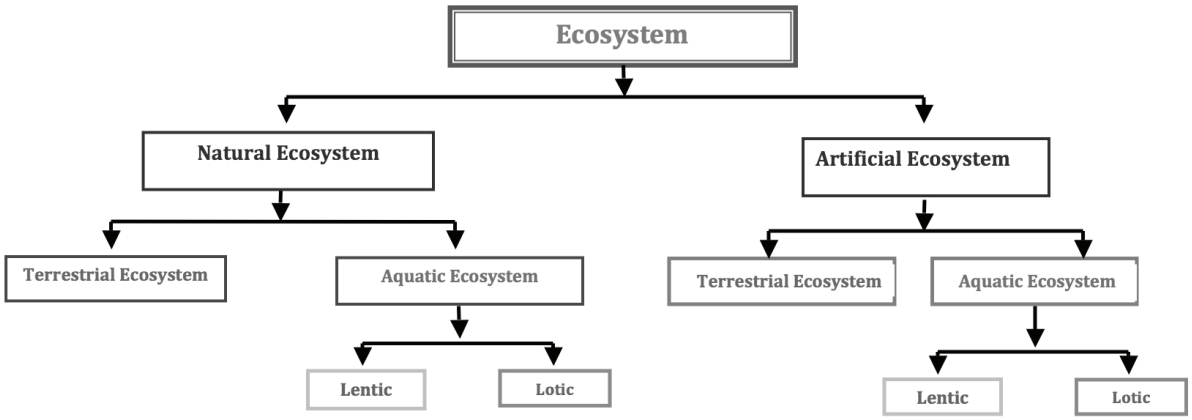
Forest, grassland, desert etc. come under this category. The place on which your school is located is also a part of the terrestrial ecosystem. They exist only on the landmass.

2.4. Man-made ecosystems

Many items constructed by human beings also attain the status of an ecosystem in the due course of time. If we have to call any man-made item as an ecosystem, it should contain biotic and abiotic components and exhibit interaction between them. The major difference between the man-made and natural ecosystems (such as forest, ocean etc) is that the artificial ecosystems disintegrate once humans stop taking care of it.

Some man-made ecosystems are crop fields (such as paddy field), aquarium etc. The cities and towns are also man-made ecosystems.

2.5. Activity



Let's make a list of ecosystems that you all know. Give your reasons to call it an ecosystem and write biotic and abiotic components of the systems?

Name of the ecosystems	Type of the Ecosystem	Reason to term it as an ecosystem	Biotic components of the ecosystems	Abiotic components of the ecosystem
Wheat field	Terrestrial			

Let's make an ecosystem

3.1. Let's make an ecosystem

The next hour and so we will spend on setting up a small aquarium. It will slowly turn it into an artificial aquatic ecosystem.

This activity will be done in a group. Your teacher will help you break into groups.

Material for set up

Transparent plastic bottle : *one per group (empty water or cold drink bottles can be used for this purpose)*

Scissors or a thick cutter : (to cut the plastic bottle)

Measuring cups : *you can collect small measuring cups that come with children's medicine and syrup.*

Artificial Manure : *solutions will be provided to your school.*

Important : *make sure that every team uses the bottle of the same volume.*

Most important : *to avoid any accidents, your teacher will cut the bottle for you.*

Steps

1. Wash the bottle properly so that no dirt or any material remains there. Measure the bottle 17 cm from the bottom and make a round mark at this height.
2. Take the help of your teacher to cut the bottle at the mark.

Preparing your aquatic ecosystem

Please fill the bottle up to 12 cm of height using tap water.

As you already know you need biotic and abiotic components in an ecosystem. You already have an abiotic component in your bottle.

Which is that?

Get a cup of water from pond, stream or puddle. Measure just 50 ml using measuring cups and pour it into your bottle.

Why have we got this water?

Team A	This team will use paper (you can also use newspaper, black chart paper etc.) to cover your bottle from outside so that no sunlight reaches the water.
Team B	Will add a pinch of artificial manure or urea solution to the water.
Team C	Will not add any manure to the water or cover the bottle with paper.

Water from the natural water bodies such as pond, stream or puddle will contain many biotic components such as different kinds of micro organism and help in setting up of our system.

Once you have done that please mark the name of your team on the bottle.

Please keep your ecosystem near a window where there is enough sunlight. Now you need to go for long-term observation.

What to observe

As you know in order to call your bottle an ecosystem it needs to have both abiotic and biotic factors. You already have abiotic factors - Water, Sunlight, Air, Urea or Manure. You need to wait till biotic factors appear in it. Make observation as given in activity 3.1

Discussion

Could you call this an ecosystem? If so Why?

Will you call it a man-made ecosystem or a natural ecosystem?

3.2. Activity

Days	Observation
Day 1	Water is clear, no organism found….
Day 2	
Day 3	
Day 4	
Day 5	
Day 6	
Day 7	
Day 8	

Day 9	
Day 10	
Day 11	
Day 12	
Day 13	
Day 14	
Day 15	

Watch out for the following changes in your ecosystem and record it in your notebook

Make the table given below in your notebook and record your observations daily

Please find out

Date on which the water of your ecosystem became pale green in color - due to the growth of algae

When did you notice the presence of the zooplanktons in your ecosystem - they may be visible as tiny white or brown dots moving in the water of your ecosystem

Date on which the insect larvae, such as mosquito larva, was seen in your ecosystem.

Time is taken by your ecosystem to become greenish in color - meaning that the number of algae has increased.

Any other changes or organisms you noticed in your ecosystem

Discussion

Every third day you should compare your observations with other groups.

Did all the teams get the same observation?

Measuring an abiotic factor: Oxygen

Oxygen is an abiotic factor essential for all organisms (except some bacteria) for their survival. Terrestrial organisms get oxygen from the air they breathe. Although oxygen is a gas it could dissolve in water and aquatic organisms such as fishes utilize the oxygen dissolved in the water body in which they live.

We all know that if the content of oxygen reduces in the environment the organisms will feel suffocation and they may die. In an aquarium, the pump producing air bubbles helps to maintain the level of oxygen and saves fish from suffocation. (Please watch the video of the aquarium given in the lesson 2.1)

In the following experiment, we will measure the amount of oxygen dissolved in the water.

Generally, this kind of an experiment requires a sophisticated laboratory. However, we simplified it for you and you could make a laboratory in your classroom. The method we are using to measure the oxygen dissolved in the water is called “Winkler’s method”.

Material required

In order to conduct this activity, you need the following Items

Chemicals: Solutions of the following chemicals

Manganese sulphate

Alkaline potassium iodide

Phosphoric acid

Starch

Sodium thiosulphate

Water

2 liter of water collected from any natural water body

2 liter of water cooled after boiling for 15 minutes

Group Exercise

The whole class will be divided into a group of 6 students. Each team will choose the name A or B

Team A will choose the water collected from natural water body

Team B will choose the water cooled after boiling for 15 minutes

This way half of the total number of groups will use the water collected from a natural water body and the other half will choose the water that was cooled after boiling for at least 15 minutes.

Steps for water testing

Step 1	*Fill BOD bottle with water sample by dipping the bottle slowly into the water. Please make sure that no air bubble is trapped in the water sample. Presence of air bubbles can bring error. So close the lid inside the water itself.*
Step 2	*Open the lid carefully and add 4 drops of manganeses sulphate solution*
Step 3	*Then add 4 drops of alkaline potassium iodide solution*
Step 4	*Close the lid tightly and shake the water very well. You might have noticed that water in the BOD bottle is full of brown colored materials, allow it to settle down.*
Step 5	*Now add 10 drops of phosphoric acid. Close the lid tightly and shake the bottle. Make sure that all the brown materials are dissolved.*
Step 6	*Using your 5 ml syringe transfer the 5 ml of solution from the BOD bottle into the test tube.*
Step 7	*Add 2 drops of starch solution to the test tube. Now your solution will become blue.*
Step 8	*Take 1ml of sodium thiosulphate solution in 1 ml syringe.*
Step 9	*Slowly add the sodium thiosulphate solution drop by drop into the test tube till the blue color just disappears. Then note down the amount of sodium thiosulphate solution used for making the solution in test-tube colorless.*
Step 10	*Put back the sodium thiosulphate solution remaining in the syringe after the experiment.*
Step 11	*Please watch the videos given below carefully to understand the method*

Calculation

of water litre = ……milligram oxygen per

Oxygen dissolved per one liter of water = Volume of sodium thiosulphate solution used (in ml) X 20.

Please use the formula given below to calculate the oxygen present in the water

Now calculate how much oxygen will be present in the water (400 ml) of your ecosystem.

4.2 Can oxygen dissolve in water?

You are familiar with the fact that oxygen could dissolve in the water. But if somebody asks you to prove that oxygen can dissolve in water, how will you do that?

Let us do this experiment and see whether you could add more oxygen to the water

Step 1	*Fill one plastic bottle (60%) with water from the same source from which you collected water for testing oxygen.*
Step 2	*Close the lid tightly and shake it well for 6 minutes vigorously*
Step 3	*Measure the amount of oxygen present in this water sample following Winkler's method*
Step 4	*Now add the value of oxygen you got in the first and second experiments (before and after shaking the water) into a spreadsheet and make a graph and compare.*

From where organisms get energy and nutrients: Producers

5.1. From where organisms get energy and nutrients: Producers

It is a well-known fact that every organism (microbes, plants theand animals) requires energy and nutrients to survive. Sun is main source energy for biotic factors living in any ecosystem.

Plants and algae could use sunlight as a source of energy with the help of chlorophyll present in their body through the process of photosynthesis. They use abiotic factors such as carbon dioxide, water and minerals absorbed from the environment for building their body parts. During photosynthesis, they absorb the carbon dioxide present in the atmosphere (produced by other organisms during respiration) and release another essential abiotic factor oxygen in return.

Since plants and algae could utilize abiotic factors directly for getting energy and nutrients they are known as Autotrophs (auto = self, troph = nourishment; meaning self-nourishment). The biotic factors, which could produce the energy and food themselves, are also called as producers.

5.2. From where organisms get energy and nutrients: Consumers

Many bacteria, animals and human beings eat various kinds of plants or animals to get energy and nutrients. They are called consumers since they consume body or body part of other organisms.

Consumers cannot use abiotic factors directly as the food materials and all organisms that are dependent up on other organisms for getting energy and nourishment are also known asHeterotrophs (hetero = others, troph = nourishment). Some of them use only plants as the food materials (Herbivores) while others eat other animals (Carnivore). In many ecosystems, you could see animals, which consume both plant materials as well as animals (Omnivores).

5.3. From where organisms get energy and nutrients: Decomposers

The biotic factors that use dead bodies of other organisms or waste materials produced by them for the energy and nutrients are called decomposers. Mainly fungus and bacteria work as the decomposers in every ecosystem and their activity is essential to avoid the degeneration of the ecosystem. They break down the dead materials into the abiotic factors and make it available to the producers.

5.4. Activity

Now take the list of biotic components present in the surroundings of your school, prepared during your field trip.

Are they getting energy from the same source?

Are they using same nutrients for survival and growth?

Divide them into autotrophs (producers) and heterotrophs (consumers)?

No.	***Producers***	***Consumers***			***Decomposers***
		Herbivores	*Carnivore*	*Omnivore*	

Human and ecosystems

6.1. Human and ecosystems

We human beings are dependent up on various biotic and abiotic factors available in different ecosystems for our day-to-day needs. Such useful materials, which we take from ecosystems for direct use (e.g. water) or making materials are called natural resources. Some of them are abiotic in origin while others are obtained from living things.

Water, sunlight, oxygen, metals etc. are called abiotic natural resources. A normal person requires around 11000 liters of air (550 liters of oxygen) and at least 2 liters of water per day to keep her/ him alive. We extract various minerals and metals also from the ecosystems for making various materials required for our day-to-day needs.

We need the support of various biotic factors (known as biotic natural resources) also to survive on the earth. Various kinds of crop plants (food grains, vegetables) and livestock (goat, sheep, cow, pig) provide us with the food materials. Bees pollinate our crops with and help the flowers to develop into fruits.

We also get various medicine (e.g. medicinal plants, antibiotics obtained from fungus), clothing material (sourced from cotton plants, wool) etc. also from different organisms. Although coal and petroleum, which is used for generating energy, required for various needs of humans are abiotic in nature, they come under the category biotic resources. This is because these fuels are formed from the plants and animal materials deposited under the soil for millions of years ago.

Renewable and non-renewable natural resources

Some of the natural resources such as water are refilled naturally. A natural resource that could be replenished is known as renewable resources. However, the recovery of certain renewable resource also may take long years (e.g. forest). Although trees are renewable resource it takes many years to grow.

However non-renewable resources such as minerals, petroleum coal etc. cannot be replaced once we use that. Non-renewable resources are those resources, which either do not form naturally or takes very long time to form.

We need to keep the balance between various biotic factors and abiotic factors present in our environment; if it is changed we human beings also will be affected. Hence the judicious use of natural resources is essential to make sure that they are available to us in future also.

Discussion

Could we humans live without the ecosystem?

Are we a part of it or do we control it?

Where will you put humans - as producers or consumers and why?

6.2. Activity-1

Let us check how many types of biotic and abiotic resources we need to prepare our meals



Pick up the meal plate of your region. Identify the food item given in the plate and fill up the table given below

No	***Food item name***	***Source***	***Abiotic factor used to prepare this food item***
1	*Rice grains*	*Plants (paddy plant)*	*Water, gas, wood,*

6.3. Activity-2

Ecosystem services

We get various kinds of natural resources from different ecosystems. For instance, forest ecosystem provides us timber, medicinal plants etc. while the major share of our fisheries and many minerals we get from marine ecosystems. Along with providing the natural resources (called provisional service) ecosystems silently give other services also. It regulates the abiotic and biotic factor to make life possible in a specific area. Maintenance of the temperature and production of oxygen by the plants, removal of waste materials by microbes through the process of decomposition etc. are the examples of regulatory services provided by the ecosystem. Additionally, we use certain ecosystems for recreation, religious purposes etc. Such service given by ecosystems is called cultural service. The recreational benefits given by the mountains, beaches, usage of river banks for conducting religious rituals etc. are some examples of cultural service we get from different ecosystems. Here we may not be taking any resource from the ecosystems but the activities conducted in the ecosystems are essential to make humans happy and peaceful

L*ist out the resources and services we are drawing from this kind of ecosystem.*

Ecosystem	***Natural resource***	***Service***
River	*Water, fish*	*Transportation, irrigation, water sports*

Agriculture and ecosystems

7.1. Agriculture and ecosystems

Human beings have learned the art and science of cultivating plants and animals over several thousands of years.

In agriculture actually, we are applying the knowledge of ecosystem, i.e. the relationship between the biotic and abiotic factors as well as the interaction between biotic factors.

However differing from a natural ecosystem where various types of organisms live and grow naturally, in agriculture fields one or a few selected plants or animals only are grown.

For any given crop farmers maintain favorable conditions in the ecosystems made by them (crop field) for a period of time during which seeds are sown, plants grow, pollination takes place, fruit or grains come and then the crop matures.

Like you know in paddy field the only paddy is allowed to grow and all other plants present are removed. In crop field ecosystems where the plants such as rice, wheat vegetables etc. are cultivated farmers exploit the relationship between the abiotic factors and producers. For instance, when they add manure to their farm they increase the abiotic factors (nutrients) required for the growth of their plants. Similarly, when they remove pest insects they are eliminating the consumers that will eat the plants (producers) and reduce its growth. Cropland ecosystem like all other artificial ecosystems requires constant intervention by humans. Otherwise, it will degenerate and crop loss would be the result.

7.2. Activity-1

The Fish farm

Let's talk about a fish farm.

There are fish farms, which grow those varieties of fish that eat algae. For instance, a fish known as tilapia. It consumes a good amount of algae along with the artificial food given in the farm ponds.

Farmers introduce cow dung, guano etc. to the pond. Decomposers break down these materials into abiotic components and release nutrients. With the help of these abiotic components and light algae grows in the pond.

Eating these algae, Tilapia fish will grow and increase in the number.

If the fish are hungrier they will consume more algae. When the number of fish increases in the pond they will need more algae to eat, which in turn will reduce the number of algae present in the pond. Lack of availability of food will lead to the starvation of fish and even their death.

In order to avoid such a disaster farmers constantly check their pond and make sure that enough food is available for the fish they grow. They learn to maintain the delicate balance between algae and fish in the pond.

Producers and consumers exist in natural water bodies also. For instance, in a stream or pond ecosystems number of fish, which eats algae, increase with the escalation in algal population. If the number of fishes which eat algae increases uncontrollably the availability of the algae would come down and these fishes will die due to starvation in the due course time. However, the consumers, the carnivorous fish that eat other fish would control the population of the former. Such cycle of interaction between abiotic factors, producers and consumers maintain the balance in any ecosystem.

7.3. Activity 2: Earthworms and agricultural ecosystems

Earthworms play a very important role in the agricultural ecosystems. They eat decaying plant and animal materials and helps in decomposing it.

Their burrowing activity enhances the aeration of the soil and brings minerals and other nutrients from the deeper levels of the soil to the surface that the plants could use it. Their excretion, called earth worm casts, contains a good amount of phosphorus and nitrogen, which are essentials for the plant growth.

It is a well-known fact that if the soil has a good population of earthworms productivity of the crop increases in a great way. People culture earthworm to produce worm casts, which is used as manure for plants in the garden and crop fields. Cultivation of earthworms is called vermiculture.

Please talk to a gardener/ farmer or people who prepare vermi compost and collect the following information.

How they prepare the compost?

Why are earthworms not seen in dry soil?

Will adding of organic manure (e.g. cow dung) increase the growth of earthworms?

Will the addition of artificial manure (e.g. urea) affect the earthworms negatively or positively?

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