

Indira Gandhi  
National Open University  
School of Education

Block

# 4

## **CONTENT BASED METHODOLOGY-II**

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**Moving Things, People and Ideas** **5**

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February, 2017

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ISBN-

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Further information on the Indira Gandhi National Open University courses may be obtained from the University's Office at Maidan Garhi, New Delhi-110068.

Printed and published on behalf of the Indira Gandhi National Open University, New Delhi by Director, School of Education, IGNOU, New Delhi.

Laser Typeset by Tessa Media & Computers, C-206, A.F.E.-II, Okhla, New Delhi.

Printed at:

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## **COURSE: BES-141 Pedagogy of Science**

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## **BLOCK 4 CONTENT BASED METHODOLOGY-II**

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### **Introduction to the Block**

Similar to Block-3, we have selected some content from secondary curriculum of science as exemplars in this block too. This block focuses on content enrichment and instructional methods. This is about the knowledge of the subject matter as well as how it is organized and used. In other words, the block discusses how teachers' knowledge of Science can be organized and used for helping learners to understand specific concepts. Our objective is to equip you as a science teacher with necessary skills and ideas so that you can organize teaching-learning experience in your class effectively. It is expected that you will try to organize various suggested activities while dealing with related concepts and your learners will get benefited. The Units in this Block are organized around themes and not along disciplinary lines. This block consists of three units.

**Unit 14: Moving Things, People and Ideas** discusses the concepts related to theme "moving things, people and ideas". In this unit, discussions will be organized on how a body is at state of rest or in motion, and different kinds of forces. This unit will explain Newton's laws of motion along with conservation of momentum. Unit will discuss about frictional force, pressure and different kinds of energy. Unit also discusses about sound and role of Human ear in hearing process.

**Unit 15: Natural Phenomenon** discusses issues like conservation of water bodies, natural disasters and waste management along with pedagogical inputs. This Unit starts with discussion on an important natural phenomenon i.e. light. It will discuss concepts like refraction and reflection in details so that you can help your learners to understand these concepts. These concepts are explained with the help of simple activities which may be conducted in the class during discussion.

**Unit 16: Natural Resources**, is covering the concepts organized under theme "Natural resources". The topics like physical resources; their utilization by humans has been covered under it. As a science teacher you have to explain the ways to manage natural resources judiciously. Unit will discuss about the biogeochemical cycles. Along with these concepts, the legal perspective will also be discussed.

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# UNIT 14 MOVING THINGS, PEOPLE AND IDEAS

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## Structure

- 14.1 Introduction
- 14.2 Objectives
- 14.3 Force
  - 14.3.1 Concept of Force
  - 14.3.2 Balanced and Unbalanced Force
- 14.4 Newton's Law of Motion
  - 14.4.1 Newton's First Law of Motion
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  - 14.4.3 Newton's Third Law of Motion
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- 14.9 Kinetic Energy
- 14.10 Potential Energy
- 14.11 Let Us Sum Up
- 14.12 Unit End Exercises
- 14.13 Suggested Reading and References
- 14.14 Answer to Check Your Progress

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## 14.1 INTRODUCTION

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In previous blocks of the course, we have already discussed various dimensions of science pedagogy including methods and approaches as well as assessment and evaluation techniques. Present Unit will deal with the concepts related to theme “moving things, people and ideas”. In this unit, we will learn how a body is at state of rest or in motion, the different kinds of motion, forces. This unit also deals with the Newton's law of motion and also the conservation of momentum. Unit will also discuss about frictional force, pressure and different kinds of energy. Unit will end with the discussion on sound. Our objective is to equip you as a science teacher with necessary skills and ideas so that you can organize teaching-learning experience in your class effectively. It is expected that you will try to organize various suggested activities while dealing with related concepts and your learners will get benefited.

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## 14.2 OBJECTIVES

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After going through this unit, you will be able to:

- help your learners in distinguishing between balanced and unbalanced forces;
- explain the Newton three laws of motion in your class;
- facilitate learners in defining the terms like inertia and momentum;
- explain the force of friction and analyze the factors in which force of friction depends;
- explain the concept of pressure and citing an example from day to day life;
- explain the concept of atmospheric pressure;
- demonstrate how does sound propagate through different medium; and
- explain the concept of kinetic energy and potential energy for your learners.

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## 14.3 FORCE

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### 14.3.1 Concept of Force

Learners are well aware that any push or pull upon any object or body is force. Force changes the position of a body. It depends on mass and acceleration of a body. Learners may ask that what cause a body to move. Let us try to answer this question.

If we place a bottle in a table, it will remain there unless we don't disturb it. It will move only when we push it or pull it. Similarly, when we open the door we have to push the door and when to close the door we have to pull it the push or pull on a body is called a **force**. Learners may have rough idea about force. Here is an example which you can use in your class.

Ask few learners to hold the sponge in their hands, and to apply force on it by pressing. They will observe that the shape of a sponge change, similarly they can change the speed of a moving car by applying brakes on it.

Thus on the basis of above examples they can infer that the force applied on an object:

- Make the object move from rest
- Change the speed of an object
- Change the direction of moving object
- Change the shape of an object

### 14.3.2 Balanced and Unbalanced Force

Learners should understand the difference between balanced and unbalanced forces. They should know that if all the forces acting on a body is zero then the force is known as balanced force. If all the forces acting on a body is not zero is unbalanced force. An unbalanced force acting on an object brings it in motion. You can explain it with the help of an activity:

Push the book towards left with your right hand; again move the book in the left direction. Now push the book from both the sides with equal forces. Learners will observe that the book does not move in any direction. In this case the two forces balance each other; such forces are called balanced forces.

What would you observe when the two forces acting in a body are of different magnitude. In this case the book begins to move in which force is applied or we can say that the book moves in the direction of greater force. Such forces are called unbalanced forces. Unbalanced force changes the position of a moving object.

### Activity 1

Ask learners to observe the see-saw activity in the play ground:

- Two children of same weight and height are sitting on the see-saw.
- Two children of different weight and height are sitting on the see-saw.

What will happen? Ask them to note down the situations and results. Now ask learners to give more examples of balanced and unbalanced forces. They can relate examples with their daily life. Also discuss how and why it happened with the learners in the class.

### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

- 1) What are balanced and unbalanced forces? Explain with the help of example.

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- 2) Can a balanced force produces velocity in a body?

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## 14.4 NEWTON'S LAW OF MOTION

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In the previous section, we have discussed about force and what cause a body to move. Also we have discussed about balanced and unbalanced forces. You have studied in your school days that Newton has given three laws of motion of bodies. These laws are known as Newton's laws of motion. According to Newton's first law, "a body in rest will be stay in rest until some external force is not applied". Second law implies that "the rate of change of momentum is directly proportional to the applied force". "In every action there is equal and opposite reaction" this is Newton's third law of motion. Learners also knew about the momentum and the law of momentum, it states that Momentum is never created nor destroyed. Let us discuss how you will introduce these laws in your class.

### 14.4.1 Newton's First Law of Motion

An object in motion stays in uniform motion in the same direction and an object at rest stays at rest until or unless acted upon by an external force (*some push or pull from outside*).

You can start with an example of a glass is lying on the table, it is at rest. The glass will not move by itself, it cannot change its state of rest itself. It can't change its position from rest until and unless we do not compel by the force with our hands we can't lift the glass from the table. Similarly you can ask learners, what will happen if they push the table or an almirah to change its position of rest? It cannot change its position by itself some force is required. They must have observed while travelling in a bus or a car when brakes are applied, they jerk forward or when a car or a bus starts they fall in backward direction.

This is due to the fact because we are at rest, so according to Newton's first law a body at rest will remain at rest and a body is in motion remain in motion until and unless an external force is not applied to them.

Newton's first law of motion is also known as **law of inertia** where inertia is defined as that property of a body due to which it resists the change in the its state of rest. Greater the inertia of a body, greater will be the force or if a body has more mass, it has more inertia. Let us consider an example – when a tree is shaken vigorously the leaves or fruits fall down, this is because the leaves or the fruits are in rest due to their inertia and hence they fall.

### 14.4.2 Newton's Second Law of Motion

The first law of motion indicates that when force is applied to an object, body changes its motion and its velocity changes, its acceleration also changes. Let us see how the acceleration of an object depends on the force applied.

You can consider some examples from your daily life. Like you observe that car is at rest when no force is applied but in a moving car you can change its speed, similarly a solid thing thrown to a person can hit that person, if it has larger mass. With such examples, you can say that to accelerate an object force is required, greater the velocity greater is the force and greater the acceleration, if the body has large mass, large force is required, so from these above velocity and mass combines form a property, called **momentum**.

**Concept of Momentum** was introduced by Newton and he defines it as the product of mass and velocity.

$$P = mv$$

Every moving object possesses momentum. You can take one more common example.

Ask learners what will happen when they throw a cricket ball which is not very heavy?

When they throw it with a high speed, it acquires a very large momentum and it sometimes hurts the batsman. Similarly, a bus or a truck does not move with high speed can hurt a person because of its heavy mass. So we can say that change in momentum is not often determined by the force but also the mass of the object.

With help of many such examples, you can motivate your learners to infer that the force is necessary to change the momentum.

At secondary level, only introduction of concept is not enough. Learners should be engaged in acquiring higher order skills. You can engage them in mathematical formulation of Newton's second law.

### Mathematical Formulation of Newton's Second Law

Ask them to consider a body of mass  $m$  having an initial velocity  $u$ , then the initial momentum of the body is  $mu$ . By the application of a constant force throughout the final momentum of this body is  $mv$ .

The change in momentum in time  $t = p_2 - p_1$

The rate of change of momentum =  $\frac{p_2 - p_1}{t}$

According to the Newton's second law of motion the applied force  $F$  is

$$F \propto p_2 - p_1 / t$$

$$F = k (p_2 - p_1) / t$$

Where  $k$  is the constant of proportionality

We know  $P = mu$  and  $P = mv$  substituting the value in the above equation

$$F = km (v - u)/t$$

As we know that  $(v - u)/t$  is the rate of change of velocity and this is known as acceleration 'a'.

Therefore we have,  $F = k m a$

We choose the value of force in such a manner that the value of  $K$  becomes one, for this we can define one unit of force as the amount which produces an acceleration of  $1\text{m/s}^2$  in an object of  $1\text{kg}$  of mass. So  $1 \text{ unit of force} = k (1\text{kg}) \times 1\text{m/s}^2$  thus the value of  $k$  becomes 1.

$$F = m a$$

The unit of force is  $\text{kg m s}^{-2}$  or Newton.

Thus, the second law of motion gives us a method to find out the force which is the product of mass and acceleration of the body.

It is not easy for a science teacher to involve learners when they are introducing such mathematical formulation. It is suggested that learners should be involved by asking continuous questions and deriving simple relationship between various units. Continuous discussion and questioning will keep your class alert and they will get involved in deriving such relationships.

### 14.4.3 Newton's Third Law of Motion

Learners know that when we hit a ball to the wall it bounces back. They must have experienced in their childhood that when a filled balloon is released, the balloon moves in the forward direction.

Few of them may have experienced that when anyone jumps from a boat, the boat moves in backward direction. While jumping from boat, their feet exert backward force, this force is action force while in the same time, a force is also exerted on their feet by the boat which makes them move, and it is the reaction force. You have elaborated that both the forces are always equal in magnitudes having opposite direction; you push the boat in the backward direction and the boat pushes you in the forward direction.

In the example of a balloon, the air coming out of balloon exerts the action force while at the same time the forces pushes the balloon in the backward direction which is the reaction force.

Newton's third law of motion states that "***in every action there is equal and opposite reaction.***" The action and reaction are the two different forces; they act on two different bodies if the forces act on same body then the balanced forces occurs and it does not move. There are three significant features of Newton's third law of motion:

- 1) One cannot say that which force is action and reaction, they are interchangeable.
- 2) Action and reaction forces are always act on a different body.
- 3) These two forces are simultaneous.

#### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

- 3) How will you demonstrate Newton's Laws of Motion your class? Explain with the help of suitable examples.

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## 14.5 CONSERVATION OF MOMENTUM

According to this law if two or more objects collide with each other then momentum after and before collision will remain same as there is no external force acting on them.

Let us consider an example and derive an expression

Take two balls A and B of masses  $m_a$  and  $m_b$  are travelling in the opposite directionalong a straight line at different velocities  $u_a$  and  $u_b$  respectively let  $u_a > u_b$  and the two balls collide each other at time  $t$ . as shown in figure 1 A ball exerts a force  $F_{ab}$  on ball B and B ball exerts a force  $F_{ba}$  on ball A.  $v_a$  and  $v_b$  be the velocities of two balls A and B after the collision.

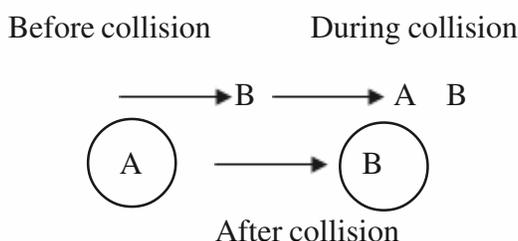


Fig. 14.1: Momentum before and after the Collision

The momentum of ball A before collision is  $m_a u_a$  and after collision  $m_a v_a$  respectively. The rate of change of momentum of ball A =  $m_a (v_a - u_a)/t$ .

Similarly the rate of change of momentum or ball B =  $m_b (v_b - u_b)/t$ .

According to the third law action and reaction forces are equal and opposite in magnitude so

$$F_{ab} = -F_{ba}$$

$$m_a (v_a - u_a)/t = -m_b (v_b - u_b)/t$$

This gives

$$m_a u_a + m_b u_b = m_a v_a + m_b v_b$$

$m_a u_a + m_b u_b$  is the total momentum before the collision and

$m_a v_a + m_b v_b$  is the momentum after the collision.

So by this we observed that the total momentum remain same.

### Activity 2

Derive an expression of conservation of momentum taking different examples. Discuss it with learners and help them to understand the concept more clearly.

### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

4) How a karate player does break a pile of tiles or a slab of ice with single blow?

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5) What is the acceleration produced by a force of 20N exerted on an object of mass 5 kg?

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## 14.6 FRICTION

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Learners must have observed many times that a moving ball stops after moving some distance; similarly rolling of pen on a table stops after moving some distance. They can tell you that this is because an opposite force acts on them which oppose the motion. This force is frictional force or friction, exists between the surfaces of all the bodies which are in contact.

The direction of friction is opposite to the direction in which the force is applied; if an object is moving with a constant velocity, a force equal to the opposing force of friction must be applied in that the two forces is a balanced condition. The net force on the body is zero.

The resistive force, before the body starts moving in the surface is called static friction. Once a body starts to move in a surface then the friction is known as sliding or kinetic friction.

The factors in which the friction depends:

- 1) The smoothness of the surface. This is due to the fact that the smooth surfaces offers less friction while rough surfaces offers more friction to move.
- 2) Friction also depends upon the normal reaction. As we know that more force is required to move a heavy object as compared to lighter object. This is because the heavy object has greater normal reaction (reaction of the surface on the body against the action of its weight).

### Advantages of Friction

- You cannot walk without the friction. As you try to step forward, you push your foot backward. Friction holds the shoe to the ground, allowing you to walk.
- Writing with a pencil requires friction. You cannot hold a pencil in your hand without friction. It would slip out when you try to hold it to write. A pencil eraser uses friction to rub.

- Rubbing the eraser on the lead wears out the eraser due to friction, while the particles worn off gather up the pencil lead from the paper.
- The car would not start moving if it wasn't for the friction of the tyres against the street. With no friction, the tyres would just spin. Likewise, you could not stop without the friction of the brakes and the tyres.
- You are holding a book due to the friction.

### Disadvantages of Friction

Friction can cause problems or be a nuisance that you try to minimize.

- Any time you want to move an object, friction can make the job more difficult. Excess friction can make it difficult to slide a box across the floor, ride a bicycle or walk through deep snow. An automobile would not move forward very well unless its friction was not reduced. Oil is needed to lubricate the engine and allow its parts to move easily. Oil and ball bearings are also used so that they can turn with little friction.
- The Law of Conservation of Energy states that the amount of energy remains constant. Thus, the energy that is "lost" to friction in trying to move an object is really turned to heat energy. You've seen how people try to start a fire by vigorously rubbing two sticks together. Or perhaps you've seen an automobile spin its wheels so much that the tyres start to smoke. These are examples of friction creating heat energy.
- There is the problem of losing energy to heat; there is also the threat of a part overheating due to friction. This can cause damage to a machine.
- Any device that has moving parts can wear out rapidly due to friction. Lubrication is used not only to allow parts to move easier but also to prevent them from wearing out. Some other examples of materials wearing out due to friction include the soles of your shoes and a pencil eraser.
- Forest burn is because of friction between the leaves.

#### Activity 3

- Ask learners to discuss with your friends how friction is a boon and curse.
- Ask learners to prepare a write up on Friction and its effect.

#### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

6) Give the reasons for the following:

A) Why do we slip when we step on banana peel?

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B) Why the sole of shoes wears out?

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C) Why does a fast moving car slow down when its engine is switched off?

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## 14.7 PRESSURE

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Pressure is not a new concept for secondary class learners. They know that Force per unit area is known as pressure. You have to demonstrate in class that the force acting perpendicularly on a body is called thrust so pressure is also defined as thrust per unit area. The pressure depends upon the force applied and the area over which force acts. Let us discuss more about pressure and thrust.

### 14.7.1 Pressure and Thrust

Learners must have observed that when they press their thumb on the drawing board, the thumb does not go into the board but when they press a drawing pin with same force the pin goes into the board. This is due to the fact the force of thumb falls on a large area in the wood while the pin has less area as compared to the thumb. The force per unit area is large in the drawing pin this force per unit area is known as pressure.

$$\text{Pressure} = \text{force/area}$$

Thus, learners can conclude that the pressure produced by the thumb is less that of pressure produced by the drawing pin. Thus, the effect of force depends upon the area of the object in which it is applied.

The weight of the body is also a force and it always acts in the downward direction. For example, a lying brick exerts less pressure on ground and a standing brick exerts greater pressure on ground. If the force acting on a body is perpendicular to its surface then the force is known as thrust. So thrust per unit area is also known as pressure

$$\text{Pressure} = \text{Thrust/area}$$

After discussion, ask your learners to derive the SI unit of thrust, which is N/m<sup>2</sup>ans Pascal.

### Pressure in fluids: Buoyancy

All liquids and gases come under fluids, solids exert pressure due to its weight and similarly fluids exert pressure on the base and walls of the container in which they are enclosed.

Most of the learners have experienced that when they lift a stone which is immersed in liquid, the stone feels lighter. Similarly, when a mug filled with water is lifted out from the bucket, it feels heavy while it appears light when the mug is inside the bucket filled with water.

From such examples, learners may be encouraged to conclude that the objects feel light weight when they are immersed in liquid. It is because every liquid exerts an upward force in all the objects which is immersed in water, this upward force in a liquid is **buoyant force**, the upward force or buoyant force is also known as upthrust. Learners should understand that it is due to buoyant force that we swim in water, the ship does not sink.

To understand the concept why objects sink and float, you can do following demonstration in the classroom:

Take a pin and cork and a jar filled with water. When you put pin and cork in water jar, learners can observe that the pin sinks while the cork floats. When a pin is immersed in jar, it exerts upward force. Also the gravitation force pulls it down. Learners can infer that the gravitation force is large as compared to the upward force that's why pin sinks in water.

In case of the cork, the upward thrust is more as compared to gravitation attraction. Also this difference arises due to the density difference of cork and nail. The density of an iron nail is more as compared to the density of cork therefore it can be concluded that objects having large densities sink and objects having less density float in water.

### 14.7.2 Atmospheric Pressure

Learners are well aware of atmospheric pressure; they know that air exerts pressure and it is defined as the force per unit area exerted against a surface by the weight of the air above that surface.

At secondary level you have to tell them that in terms of air molecules, if the number of air molecules above a surface increases, there are more molecules to exert a force on that surface and consequently, the pressure increases. The opposite is also true, where a reduction in the number of air molecules above a surface will result in a decrease in pressure. Atmospheric pressure is measured with an instrument called a “barometer”, that is why atmospheric pressure is also referred to as barometric pressure.

#### Activity 4

Perform an activity using a glass filled with water and with a cardboard. Covered the glass filled with water with cardboard. Ask learners to observe and organize a discussion on it in your class.

#### Pressure Detector

Pressure detectors measure pressure, typically gases or liquids. Pressure detectors are used for control and monitoring in thousands of everyday applications. Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. Pressure sensors can be alternatively called pressure transducers, pressure transmitters, pressure senders, pressure indicators, manometers, among other names. Example for applications of this type of sensor would be in the measuring of combustion pressure in an engine cylinder or in a gas turbine. These sensors are commonly manufactured out of piezoelectric materials such as quartz.

Some pressure sensors, function in a binary manner, i.e., when pressure is applied to a pressure sensor, the sensor acts to complete or break an electrical circuit.

#### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

7) Why does a piece of cork released under water bounce back?

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8) How pressure detectors works?

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## 14.8 SOUND

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All learners know that we hear sounds from various sources which surround us like birds, vehicles, humans, animal, television etc. You must have observed that when you come closer to speakers the sound is high. Also, in the game hide and seek we find where the players is running with the help of sound; similarly we hear the sound of ringing bell in school and notice that the period is over. You can easily define Sound as a form of energy which produces sensation in our ears. Sound is produced by vibrating objects. To and back forth motion of a body is known as vibration. You can discuss examples like; Learners take a steel plate and spoon, strike the spoon on the plate and observe the vibrations. Similarly, they can put their hands on the ringing bell of door to feel the vibration in the bell.

Thus you can introduce that if an object vibrates it produces sound.

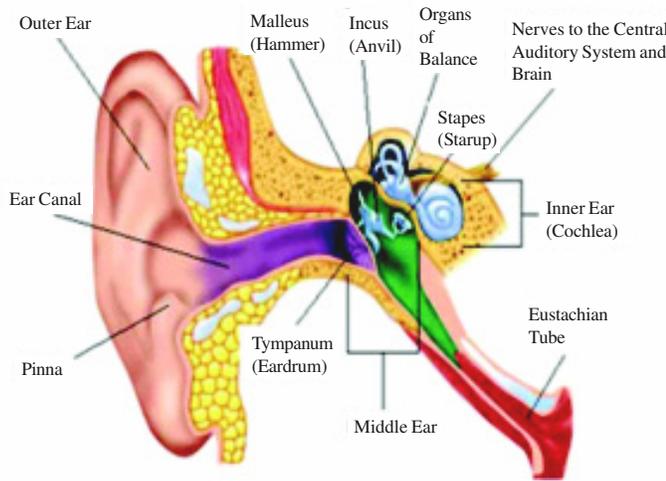
### 14.8.1 Sound Produced by Humans

Ask your learners to put their hand on their throat and speak loudly. They can feel the vibration on throat. In humans, the sound is produced by voice box or larynx. It is at the upper end of the **windpipe**. Two **vocal cords** are stretched across the voice box or larynx in such a way that it leaves a narrow slit between them for the passage of air. When the lungs force air through the slit, the vocal cords vibrate, producing sound. Muscles attached to the vocal cords can make the cords tight or loose. When the vocal cords are tight and thin, the type or quality of voice is different from that when they are loose and thick.

Learners know that we hear a sound with our ears. It is a very sensitive part. Human ear can hear a sound up to 20Hz to 20 KHz. Ear allows us to convert pressure variation in air with audible frequencies in that electric signals that travel to brain through auditory nerve.

The ear has external, middle, and inner portions. The outer ear is called the pinna or called external ear and is made of ridge cartilage covered by skin so that it keeps a particular shape but is also flexible. Sound collects through the pinna into the external auditory canal. It gives us the information about the direction

and source of sound and it ends at the eardrum.



**Fig. 14.2: Structure and Function of Human Ear.**

**Source:** Image Courtesy : [lyrichearing.com/sites/default/files/assets/cutaway\\_ear.jpg](http://lyrichearing.com/sites/default/files/assets/cutaway_ear.jpg)  
<http://www.yourarticlelibrary.com/ear/ear-useful-notes-on-human-ear-13270-words/9691/>

Middle part is eardrum and its tiny attached bones in the middle portion of the ear to vibrate, and the vibrations are conducted to the nearby cochlea. The spiral-shaped cochlea is part of the inner ear; it transforms sound into nerve impulses that travel to the brain.

The third part is fluid-filled semicircular canals attached to the cochlea and nerves in the inner ear. They send information on balance and head position to the brain. The auditory tube drains fluid from the middle ear into the pharynx behind the nose.

### 14.8.2 Characteristics of Sound

We all know that sound waves depend on different factors. The three main characteristics, on which sound depends, are:

- Frequency
- Amplitude
- Speed

Frequency tell us how frequently an event occur, it is defined as the number of complete waves that pass a point in one second. Let us consider an example-while stretching a rubber band the number of times it vibrates per unit time is the frequency of the vibrating rubber. As we know, sound needs a medium to propagate the density of the medium oscillates between a maximum to minimum value this change in density to maximum to minimum value and then again maximum makes one complete oscillation, the number of such oscillation is called frequency. It is represented by the symbol  $\nu$ .

The maximum height of a wave in amplitude

The third characteristic is speed of sound which is defined as the distance which point on a wave travels per unit time.

Speed = distance/ time

$$= \frac{\text{distance}}{T}$$

Also sound require material medium to travel. Sound travels more in solids than in liquids and then in gases.

**Activity 5**

Ask your learners to roll the paper into a cone. Stick tape along the edge to secure it, put the cone over their mouth and talk into it. Put the cone to other’s ear. Ask them:

- What happens when they put cone over their mouth and ear?

Ask them to write their observations and discuss it with other learners to understand the concept more clearly.

**Check Your Progress**

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

9) What is the approximate audible range of frequency for humans?

.....

.....

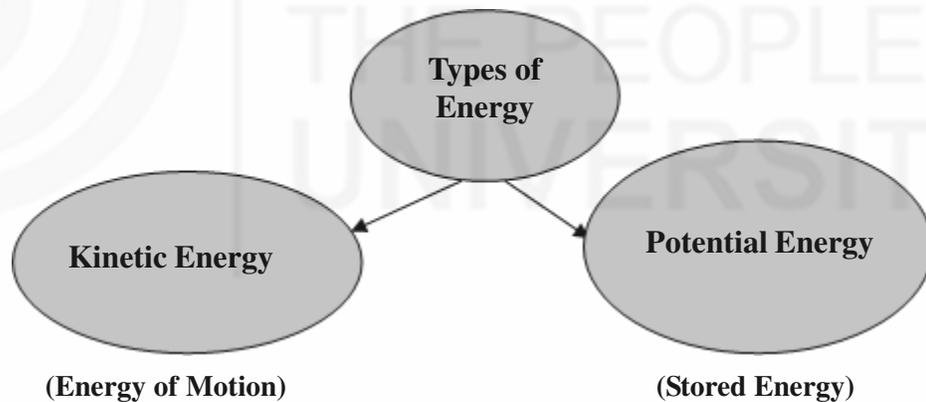
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**14.9 KINETIC ENERGY**

**Energy:** The capacity to do work is called Energy. It is of two main types: Kinetic and Potential Energy.



**Fig. 14.3: Types of Energy.**

Let us consider an ideal situation where a sledge is initially at rest and kept horizontal. Let us apply a constant force on sledge in horizontal direction. You must have observed that when force is removed the sledge moving continuously with a uniform speed.

The work done with constant force on a distance S is given by

$$W = FS \quad \dots\dots\dots 1$$

According to Newton’s second law of motion

$$F = ma \quad \dots\dots\dots 2$$

Where  $m$  is the mass of sledge and  $a$  is the acceleration.

So the distance travelled during the time  $t$

$$S = ut + \frac{1}{2}at^2 \quad \dots\dots\dots 3$$

Let us consider when sledge is in rest having initial velocity  $V$  and when force is applied the velocity attains at time  $t$

$$V = u + at$$

From Equation 1

$$\begin{aligned} W &= fs \\ &= ma \times (\frac{1}{2}at^2) \\ &= \frac{1}{2}mv^2 \end{aligned}$$

This is the expression of kinetic energy having velocity  $V$  and mass  $m$ .

## 14.10 POTENTIAL ENERGY

Let us consider a situation; a person lifts an object to a certain height. The work done in lifting a body to a certain height gets stored in the form of potential energy.

The amount of work done to lift an object having mass  $m$  to a particular height is given by

$$W = fs$$

$$W = mgh$$

Where  $g$  is acceleration due to gravity having value  $9.8\text{m/s}^2$

Here work is done against the gravity is known as gravitational potential energy.

### Activity 6

Ask your learners to draw a comparative chart on their note book, labeling one side *Potential* and other side *Kinetic*. Ask them to give some examples of potential and kinetic energy.

## 14.11 LET US SUM UP

Unit has started with discussion on force. If the force acting on a body is zero then the force is known as balanced force and if it is not zero then it is called as unbalanced force. While talking about Newton's law of motion, you should discuss definitions of inertia, momentum, and concept of conservation of momentum, etc. Newton's first law motion is also known as law of inertia where inertia is defined as that property of a body due to which it resist the change in its state of rest. Second law implies that the rate of change of momentum is directly proportional to the applied force. In every action there is equal and opposite reaction this is Newton's third law of motion. Momentum is never created nor destroyed. Activities have been suggested, which you can use to introduce these concepts. Demonstrations can be used to introduce thrust and pressure. Every liquid exerts an upward force in all the objects which is immersed in water this upward force in a liquid is buoyant force, the upward force or buoyant force is also known as upthrust. You can also use more interesting facts and

activities for Sound which can be used for making your topic interesting like human ear diagram and its function. Sound is form of energy which produces a sensation of hearing; Sound needs a medium to travel. Interesting stories can be used while introducing concepts energy and its types.

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## 14.12 UNIT-END EXERCISES

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1. When a carpet is beaten with a stick, dust comes out of it. Explain.
- 2) In what direction does the buoyant force on an object immersed in a liquid act?
- 3) Explain the functions of human ear.
- 4) Explain the functioning of pressure detectors.
- 5) Explain with help of example, how potential energy is converted to kinetic energy?

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## 14.13 SUGGESTED READING AND REFERENCES

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- NCERT (2011), Science Textbooks for Class IX-X, National Council for Educational Research and Training, New Delhi.
- NCERT, Pedagogy of Science, Textbook for B.Ed., National Council for Educational Research and Training, New Delhi.

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## 14.14 ANSWER TO CHECK YOUR PROGRESS

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- 1) If the resultant of all the forces is zero then this force is known as balanced force for e.g. a book is kept on the table and if the resultant of all the forces is not zero then this force is unbalanced force for e.g. if we move a book in any direction.
- 2) Balanced force cannot produces a velocity.
- 3) Answer based on your classroom experiences.
- 4) The karate player hits the piles of tiles or a slab of ice as fast as possible with her hand. In doing so that entire momentum of the hand is reduced to zero in a very short time. As a result, the force delimited on the tiles or slab of ice is large enough to break it.
- 5)  $F = m \times a$   
 $20 = 5 \times a$   
 $a = 20/4$   
 $a = 4 \text{ m/s}^2$
- 6) A) Because of less friction we slip on banana peel  
B) Due to friction  
C) Due to friction which opposes the motion of the body
- 7) Due to upward force
- 8) Answer yourself
- 9) 20 Hz to 20 kHz

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# UNIT 15 NATURAL PHENOMENON

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## Structure

- 15.1 Introduction
- 15.2 Objectives
- 15.3 Light as a Natural Phenomenon
  - 15.3.1 Reflection
  - 15.3.2 Refraction
- 15.4 Water Cycle
  - 15.4.1 Evaporation
  - 15.4.2 Condensation
  - 15.4.3 Precipitation
- 15.5 Conservation of Water Bodies
- 15.6 Natural Disasters
  - 15.6.1 Disaster Management in India
- 15.7 Waste Management
  - 15.7.1 Waste Water Treatment
  - 15.7.2 Basic Principles of Waste Management
- 15.8 Let Us Sum Up
- 15.9 Unit End Exercises
- 15.10 Suggested Readings and References
- 15.11 Answers to Check Your Progress

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## 15.1 INTRODUCTION

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Nature affects us in many ways. Human beings since the early times have been curious to understand the natural world around them. The curiosity of human beings to understand nature has resulted in the development of the discipline of 'Science'. Apart from the knowledge of why things happen, knowledge of science is also important. We all live in a world influenced by Science and its applications. We all are impacted by the changes in the natural environment around us. At the same time, we affect nature through our various activities. Many of the so called natural calamities are said to be the result of un-thoughtful harnessing of nature. It is therefore important for all of us to appreciate this complex relationship of nature with our lives.

The present Unit discusses all these issues along with pedagogical inputs. This Unit attempts to facilitate you as a science teacher so that you can help your learners to understand the place of earth in the universe, the existence of resources and the relationship of man with the environment and the need to avert natural disasters and manage waste. These concepts are explained with the help of simple activities which may be conducted in the class while discussing the same.

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## 15.2 OBJECTIVES

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After going through this unit, you will be able to:

- explain various phenomenon related to light like reflection and refraction to learners in your class,
- demonstrate processes like evaporation and condensation,
- develop a sense of responsibility towards conservation of our natural resources among learners,
- develop a basic understanding of natural disasters among your learners, and
- help learners in appreciating the need to manage household and industrial waste.

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## 15.3 LIGHT AS A NATURAL PHENOMENON

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In elementary classes, learners get well acquainted with the fact that light makes us see things around us and the objects that emit or give out light are termed as sources of light. They are also aware of sources of light which can be divided into natural and artificial sources of light. Natural sources include the Sun, the Moon, fireflies and some deep sea organisms and on the other hand, artificial sources of light include candle, bulb, tube-light, etc.

At secondary level, focus is on exposing learners with some common phenomenon of light like how image formation takes place? How lenses help in improving vision? What are the scientific phenomena which are associated with it? In coming subsections, we will discuss phenomenon like refraction and reflection. Discussion will also help you to deal with such topics in your classroom.

### 15.3.1 Reflection

Learners are well aware of the fact that mirrors are used for image formation. They must have experienced different type of image formation on a polished spoon, steel bowl, or on a polished floor.

Help them to recall laws of reflection, which are:

- i) The angle of incidence is equal to the angle of reflection, and
- ii) The incident ray, the normal to the mirror at the point of incidence and the reflected ray, all lie in the same plane.

You can use the following activity for this purpose:

#### Activity 1

- 1) Find a place in the school where there is a wall with plenty of space around it. Fix the mirror at the eye level of learners of your class on a wall with adhesive tape. Cover the mirror with a piece of paper.
- 2) Now, ask any two learners in your class to guess where they both need to stand to see each other's reflection in the mirror. When they both agree on the place, mark the place on the floor with the adhesive tape.
- 3) Remove the paper from the mirror. Ask the learners to stand at the place they have chosen to determine if they can see each other in the mirror.
- 4) If they cannot see each other, try different places until they can see each other. Mark the places where it is difficult to see each other with adhesive tape.

- 5) Next, place long pieces of masking tape on the floor from the place where the two children are standing to the wall straight under the center of the mirror. Make sure that these should be straight lines.
- 6) Look at the angles made by the taped lines on the floor and the wall to see if the angles are of the same size.

Ask learners to recall that according to law of reflection, “light bounces off a mirror at the same angle that it falls.” Therefore, when light from the face of one student travels to the mirror on the wall, it should bounce off the mirror at the same angle to the eyes of other learner.

### Reflection of Light from Spherical mirrors (Convex and Concave Mirrors)

After performing the activity of reflection of light on smooth or plane mirror, you can acquaint the learners with the reflection of light from spherical mirror surfaces. However, before this, you should essentially make the learners understand about concave and convex surfaces (two types of curved surfaces).

A concave surface is such which is curved like a segment of the interior of the circle or hollow sphere and have at-least one interior angle greater than 180 degrees. On the other hand, a convex surface is curved or rounded outward and have all interior angles less than or equal to 180 degrees. Concave surfaced and convex surfaced mirrors / lenses are shown below:

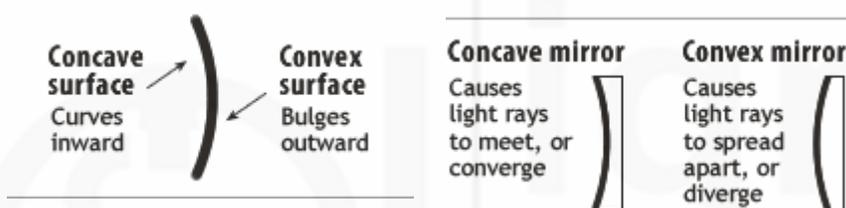


Fig. 15.1: Concave and Convex Surfaces

Give few concave and convex mirrors to learners and let them feel the reflecting surface and understand why one is convex and other is concave.

You should make it clear to the learners that light always reflects according to the law of reflection, regardless of whether the reflection occurs off a flat surface or a curved surface. Three simple rules of reflection of light from concave mirrors can be explained to learners with help of following ray diagram. These are:

- Any incident ray travelling parallel to the principal axis on the way to the mirror will pass through the focal point upon reflection.
- Any incident ray passing through the focal point on the way to the mirror will travel parallel to the principal axis upon reflection.
- Any ray incident parallel to principle axis is reflected passing through focus.

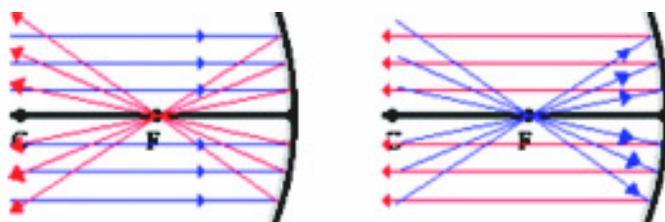


Fig. 15.2: Reflection of Light from Concave Mirrors

Further it can be explained that the image of any object placed in front of a concave mirror can be located easily by applying these rules. Concave mirrors can produce both real and virtual images, depending upon the location of object.

Learners should be given opportunity to do experiments of image formation by a concave mirror.

Learners can be asked to answer reflective questions like:

- Why concave mirrors are used in reflectors in torches, headlights of cars, scooters, etc.?
- What is the use of concave mirrors for dentists or for examining eyes, ears, nose and throat?

In a similar manner, the concept of reflection of light from convex mirrors can be illustrated. You can explain to the learners that a convex mirror is sometimes referred to as a diverging mirror due to the fact that the incident light will originate from the same point and will reflect off the mirror surface and diverge. The diagram given below shows four incident rays originating from a point and incident towards a convex mirror. These four rays will each reflect according to the law of reflection. After reflection, the light rays diverge; subsequently they will never intersect on the object side of the mirror. For this reason, convex mirrors produce virtual images that are located somewhere behind the mirror.

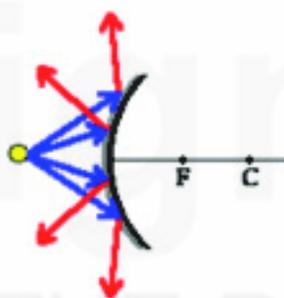


Fig. 15.3: Reflection of Light by Convex Mirrors

You can further elaborate uses of convex mirrors as side mirrors in cars, scooters etc. as they has a wider view to help drivers to see the traffic behind them.

While explaining the concept of reflection by convex and concave mirrors, you have to introduce the concepts like centre of curvature (C), radius of curvature of the mirror (R), principal axis, The principal focus (f), aperture, relationship between the radius of curvature  $R$ , and focal length  $f$  i.e.  $R = 2f$  through various activities and experiments. Let learners themselves explore all such relationships while developing ray diagrams for different image formations.

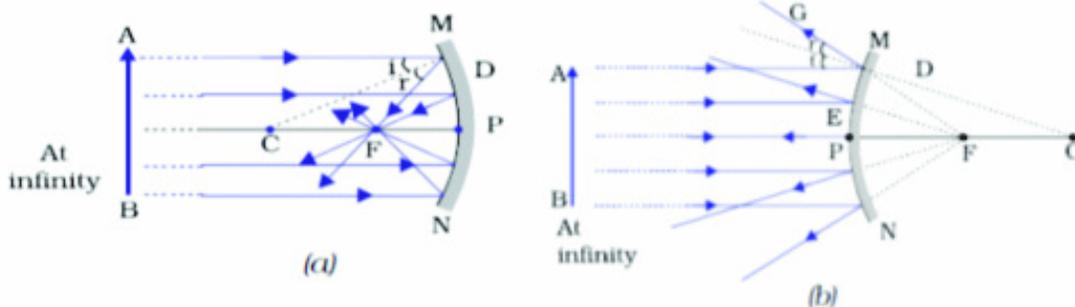


Fig. 15.4: Ray Diagrams of Image formation by (a) Concave Mirror (b) Convex Mirror

**Activity 2**

Ask learners in your class to perform following activity:

- Take a concave mirror. Find out its approximate focal length in the way described above. Note down the value of focal length. (You can also find it out by obtaining image of a distant object on a sheet of paper.)
- Mark a line on a Table with a chalk. Place the concave mirror on a stand. Place the stand over the line such that its pole lies over the line.
- Draw with a chalk two more lines parallel to the previous line such that the distance between any two successive lines is equal to the focal length of the mirror. These lines will now correspond to the positions of the points P, F and C, respectively. *Remember – For a spherical mirror of small aperture, the principal focus F lies mid-way between the pole P and the centre of curvature C.*
- Keep a bright object, say a burning candle, at a position far beyond C. Place a paper screen and move it in front of the mirror till you obtain a sharp bright image of the candle flame on it.
- Observe the image carefully. Note down its nature, position and relative size with respect to the object size.
- Repeat the activity by placing the candle – (a) just beyond C, (b) at C, (c) between F and C, (d) at F, and (e) between P and F.
- In one of the cases, you may not get the image on the screen. Identify the position of the object in such a case. Then, look for its virtual image in the mirror itself.
- Note down and tabulate your observations.

*Activity taken from Chapter 10, Light and Reflection, Class X, NCERT, p. 163.*

Facilitate learners in developing following table after various experiments on image formation:

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus F	Highly diminished, point-sized	Real and inverted
Beyond C	Between F and C	Diminished	Real and Inverted
At C	At C	Same size	Real and inverted
Between C and F	Beyond C	Enlarged	Real and inverted
At F	At infinity	Highly enlarged	Real and inverted
Between P and F	Behind the mirror	Enlarged	Virtual and erect

**15.3.2 Refraction**

You can demonstrate that when light falls on a transparent object, it travels or passes through it and bends or changes its direction. This phenomenon is termed as refraction of light. Learners can be asked to demonstrate that light normally travels in a straight line (referred as rectilinear propagation of light) but when it passes from one medium to another, it bends. For example, the speed at which

light is traveling, changes when light moves from a medium of one density into a medium of a different density. For example, light slows when it moves from air into water, a denser medium. The slowing causes the light waves to change direction, or bend. The bending of light as it passes from one medium into another is known as refraction.

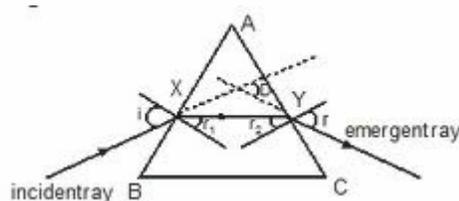


Fig. 15.5: Refraction: Bending of Light

You can undertake following activity to make learners understand about refraction of light.

### Activity 3

Place one rectangular paper card on a table. Use the ruler and marker to draw a vertical line down the centre of the card parallel to the long edges of the card. The line should divide the card into two equal halves. Now, place the bottom of the drinking glass on top of the line. Looking down into the glass, adjust its position so the line appears to divide the bottom of the glass in half. Ask one learner of your class to look down continuously into the glass and simultaneously pour water into the glass. Now, ask the learners, what happens to the line in the bottom of the glass as water is added. What caused the change in the appearance of the line? After getting learners' responses summarize that the line appeared to move to one side as water is poured into the glass. Make the learners understand that speed of light slows down when it moves from air into water, a denser medium. The slowing of speed causes the light waves to change direction, or bend, causing a change in the appearance of the line. This phenomenon is called as refraction.

### Refraction of Light from Concave and Convex Lenses

As you have explained reflection with help of image formation activities with mirrors, similarly you can familiarize your learners with the phenomenon of refraction of light through curved lenses.

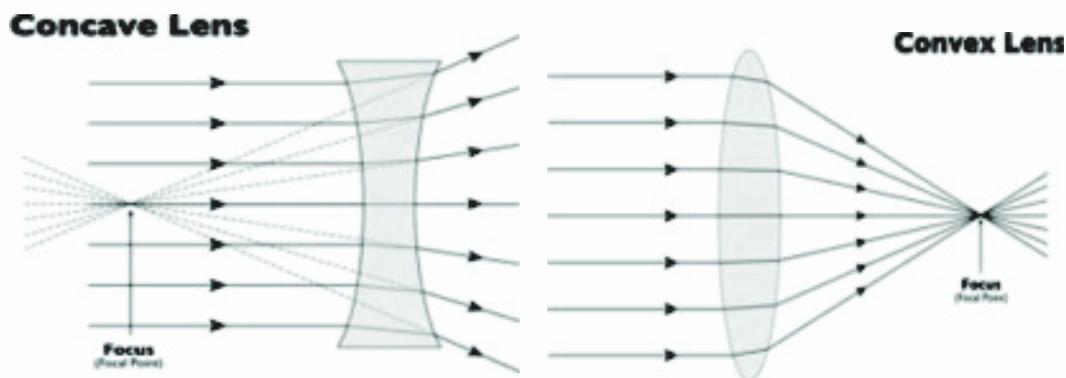


Fig. 15.6: Refraction of Light from Concave and Convex Lenses

You can help learners to understand that when light passes through a concave lens, it changes its direction in outward manner or diverges outside of the lens. On the other hand, when light passes through a convex lens, it bends inward or converges at focal point of the convex lens.

At secondary level, you have to expose your learners with certain concepts related to refraction. You have to give them opportunity to experience refraction of light from a rectangular glass slab as well as refraction through spherical lenses. You can use following activity:

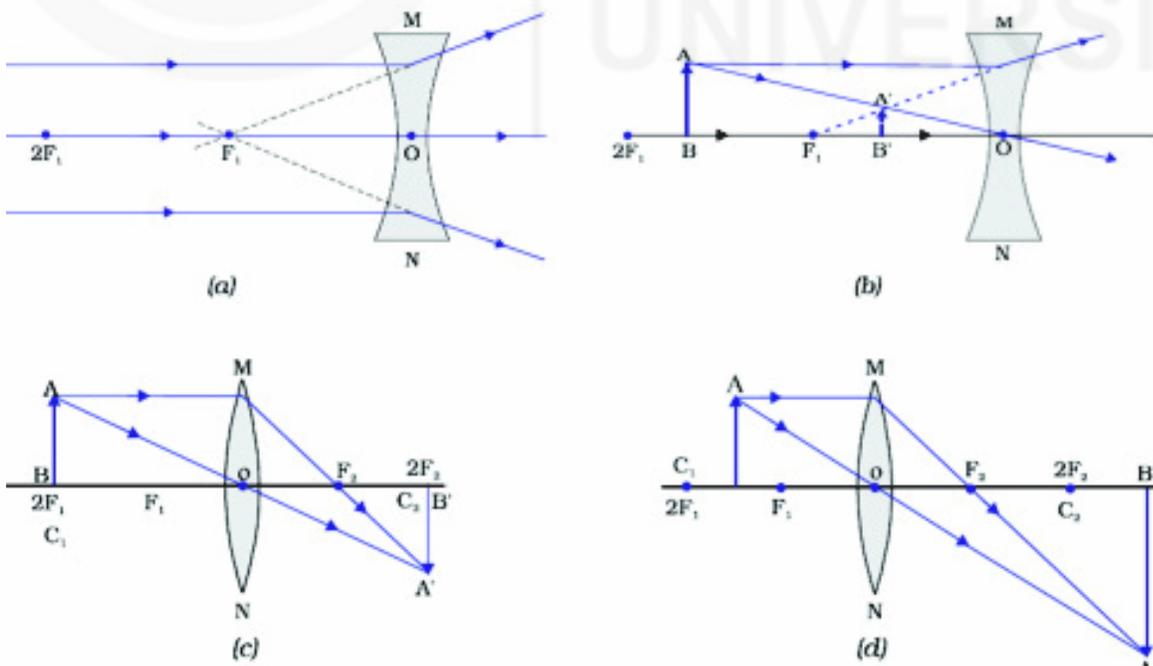
#### Activity 4

Ask your learners to perform following activity:

- Take a convex lens. Find its approximate focal length.
- Draw five parallel straight lines, using chalk, on a long Table such that the distance between the successive lines is equal to the focal length of the lens.
- Place the lens on a lens stand. Place it on the central line such that the optical centre of the lens lies just over the line.
- The two lines on either side of the lens correspond to  $F$  and  $2F$  of the lens respectively. Mark them with appropriate letters such as  $2F_1$ ,  $F_1$ ,  $F_2$  and  $2F_2$ , respectively.
- Place a burning candle, far beyond  $2F_1$  to the left. Obtain a clear sharp image on a screen on the opposite side of the lens.
- Note down the nature, position and relative size of the image.
- Repeat this Activity by placing object just behind  $2F_1$ , between  $F_1$  and  $2F_1$  at  $F_1$ , between  $F_1$  and  $O$ . Note down and tabulate your observations.

Activity taken from Chapter 10, Light and Reflection, Class X, NCERT, p. 178.

Ask learners to do image formation activities with different lenses and examine following ray diagrams:



### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

1) What are rules of reflection by spherical mirrors?

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2) What are the differences in image formed by a convex lens and a concave lens if the object is placed between F and 2F?

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## 15.4 WATER CYCLE

Water is one among most important natural resources for human life. Your learners are already aware of sources of water, forms of water, contamination of water, scarcity of drinking water, etc. at secondary level; you have to introduce some scientific phenomenon related with water like precipitation, evaporation, condensation, etc. which are the parts of natural water cycle.

When you will talk about water cycle, you can ask following questions to your learners:

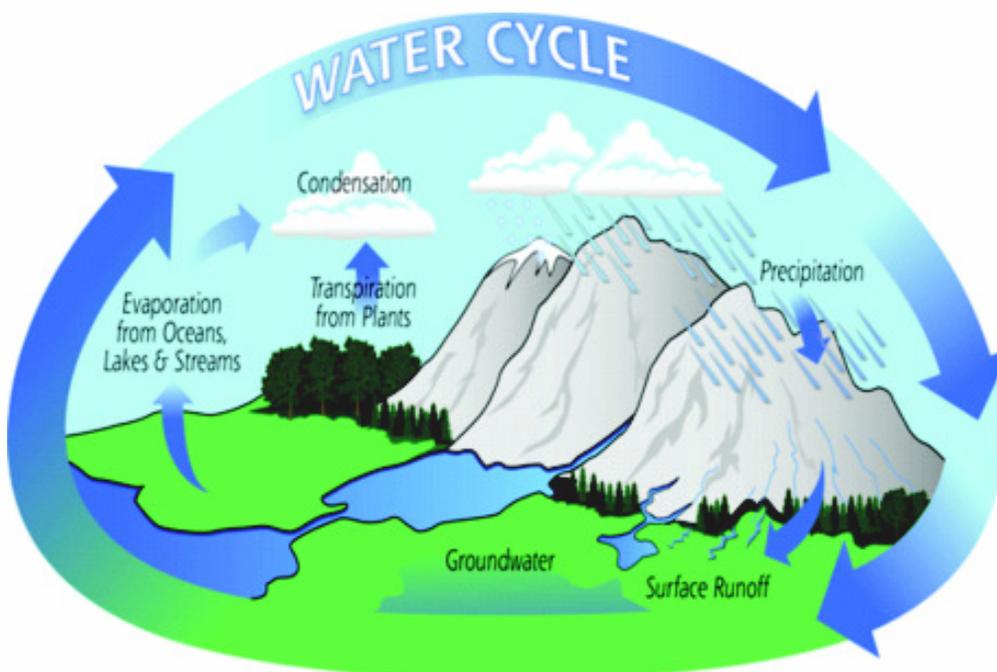
Water comes from where?

How snow fall takes place?

How clouds are formed?

How water moves from mountains to rivers, from rivers to seas? etc.

You will get answers of many questions right as learners have experienced and discussed these questions in their previous classes. You have to introduce processes like precipitation, evaporation, condensation in connection with these questions.



**Fig. 15.7: The Water Cycle**

**Source:** <https://www.flickr.com/photos/atmospheric-infrared-sounder/8265046380>

### 15.4.1 Evaporation

When you start discussion on water cycle with the help on figure 15.7, the first process which you need to discuss is the evaporation.

You can ask learners that what happens when water is boiled. They will respond that water converts into vapours. Here you can introduce the term “evaporation” as a process in which water is converted into water vapours.

Now you link this with vaporization of water from earth. Learners can thus understand that water from big reservoirs; sea, rivers, lakes, etc. get vaporized in presence of sunlight and enters in atmosphere in gaseous form. According to United States Geological Survey (the USGS), approximately 90% of the water vapour in the atmosphere comes from surface water, including oceans, lakes and rivers, with the rest coming from plants.

You can further explain that evaporation is also being used as a purifying process. You can explain it further when you introduce other related concepts.

### 15.4.2 Condensation

Learners must have seen clouds. They also know that clouds are essential for rainfall. At elementary level, they have learnt that sea water get vaporized and accumulate as clouds. The change of water vapours into liquid form is known as Condensation.

You can demonstrate in your classroom also. Boil some water in a transparent glass pan and cover it with lid. Learners can observe that vapours are going up and accumulating on lid. Slowly they will see that there are water droplets on lid, which is because of conversion of vapours into liquid again.

You have to differentiate between clouds and fog as they are both condensed vapours.

### Activity 5

Plan a demonstration in your class to differentiate between cloud and fog. Ask learners to observe and take notes. Discuss the role of clouds and fog in your class.

### 15.4.3 Precipitation

Precipitation is the third process of water cycle. When water falls from atmosphere on earth in form of rain, snow, freezing rain, this is known as precipitation. You have to explain to your learners that when condensation continues in clouds and vapours condense to form water droplets, it falls. If the atmospheric temperature is very low, falling droplets freeze and precipitation is in the form of snow or freezing rain.

#### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

3) How does rain occur?

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.....  
.....  
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## 15.5 CONSERVATION OF WATER BODIES

We all know including your learners that in India, surface water and ground water is not enough for all. Many parts of the country face problems especially in summers. You can see it in news articles, TV reports and as well as in real in many urban and rural areas of Marathwada, Rajasthan, etc. Let's see a classroom discussion as an example:

“Sir, why *Ganga* is drying?” one morning when Science teacher Amit Kumar entered in his class, faced this question.

Amita sked the learners that why are they asking this question? Where have they heard about it? The learners told that they have seen a picture in morning newspaper in which some people are on hunger strike with a banner “*Ganga bachao*” and when they enquired about it from their parent; they came to know that these people are fighting for saving the *Ganga* from drying.

Amit Kumar replied in yes and said they are right. He told that our Holy River *Ganga* starts from Himalaya. Amit Kumar shows them a small documentary video named “*The Journey of Ganga*”. Learners noticed in the video that *Ganga* River starts from *Gangotri* and ends at Bay of Bengal. They also noticed that there are various big and small cities, holy places, Ghats and factories near *Ganga*. They observed that at some place *Ganga* is quite narrow and at some Ghats, there is ample of garbage.

Learners told that they have seen some Indian and foreigners working for cleaning of *Ganga* on television. They were collecting garbage there on the behalf of an NGO.

Such discussion you must be facing in your class when issues of water conservations are very common in news. It is the duty of every citizen along with governments to protect all natural water bodies like lakes, ponds, rivers, etc. There are many schemes on water conservation in India, about which learners should be made aware of.

### Activity 6

You can give them a small group project to collect information on various schemes of water conservation in India. Few very common are as follows:

- National River Conservation Plan
- National Lake Conservation Plan
- National Wetland Conservation Programme

You can share many success stories of water bodies' conservation from India, which you can easily collect from newspaper articles or internet. This will make your learners aware of the issue and motivate them to participate and realize their role also.

## 15.6 NATURAL DISASTERS

Learners as secondary level are well aware of disasters. They understand the concept of natural and man made disasters also as they have studied these topics at elementary level.

### Flood

To discuss about floods and their impact on geography as well as society, you can use video clips, newspaper clips, images of flood affected areas or some real life experience in the areas, where flood hits almost every year like areas near Ganga in Bihar and West Bengal or near Brahmaputra in Assam, etc.

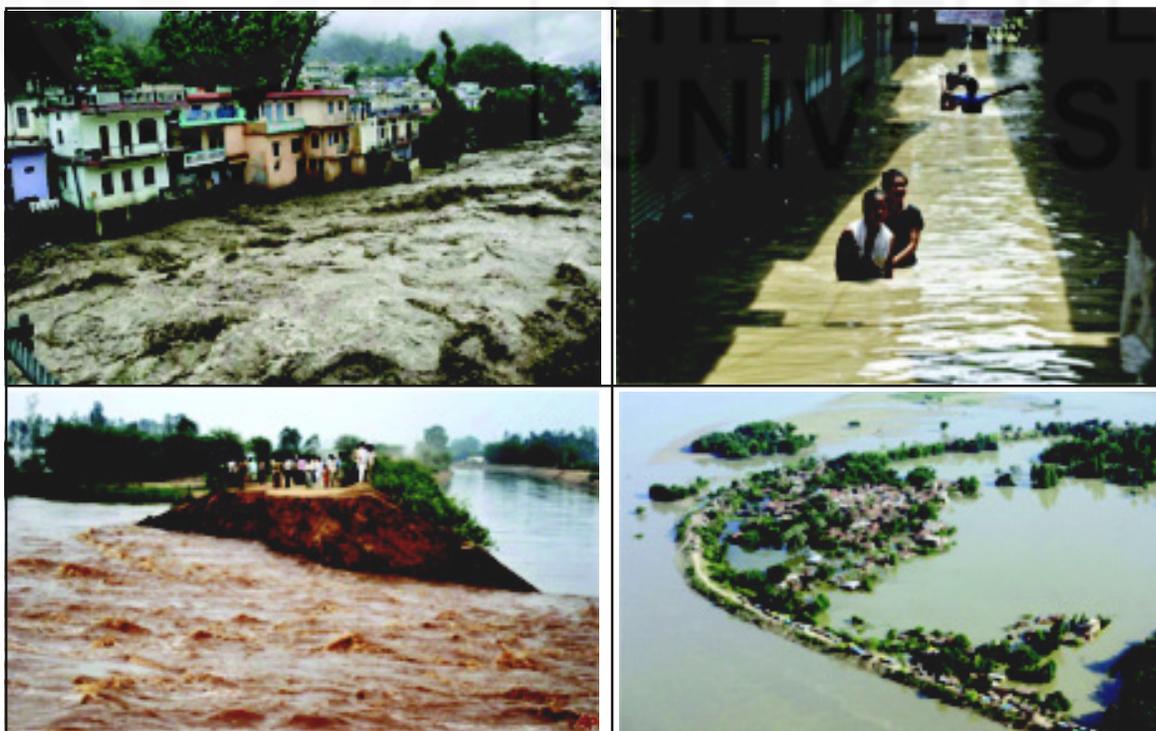


Figure 15.8: Some Flooded Areas in India

Usually floods occur in areas below the sea level. The rivers usually flow slowly in these areas and the volume of water is large. Due to heavy rains, the volume suddenly increases, causing floods in the nearby areas. Coastal areas experience floods due to storms, hurricanes or tsunamis.

Children should be made aware about effects of flood as well as measures to be adopted during flood.

### Draught

Draught is the other side of the coin as floods bring a lot of water all of a sudden and draught is a prolonged period of dry weather with very little or no rain over weeks, months and sometimes even years. In case of a drought, there is immense scarcity of water, the ponds and rivers dry up and the soil becomes so dry that no crops can grow. In our country, some parts of States of Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, eastern parts of Uttar Pradesh, etc. are more prone to droughts due to the lack of rains consistently.



#### Activity 7

Show a documentary video on flood and its impact or drought and its impact on human life. Organize a group discussion in your class and encourage learners to reflect on the causes of droughts and flood.

### Earthquakes

Learners must have felt some sudden vibrations in the surface of the earth without any apparent reason on more than one occasion or heard stories of violent shaking of the earth surface resulting in damage to houses and buildings. This is called

an earthquake and sometimes when the intensity is high it may result into massive loss of life and infrastructure. Children often ask questions to us whenever they hear about earthquakes happening in any part of the world. A lot of misconceptions and fears about earthquakes prevail amongst learners. As a science teacher, it is your responsibility to explain the right causes of earth quake to children and make them aware about the precautions to be taken during any such incident.

Tell learners about the measuring instrument used for measuring the intensity of earthquakes, which is known as *seismograph*. The vibrations caused by an earthquake travel in the form of waves called seismic waves. These seismic waves are recorded with the help of seismograph. The intensity of an earthquake is measured with the help of Richter scale. An earthquake ranging from 2-4 on Richter scale is not very damaging, 4-7 is moderate but more than 7 is very severe.

### Earthquake hazards

Some of the ways in which earthquakes can be a hazard are shaking of the earth resulting in collapse of infrastructures, buildings, landslides, avalanches and tsunamis, fires, Soil liquefaction and volcano eruption.

### 15.6.1 Disaster Management in India

India is among most vulnerable areas to natural disasters. Almost 85% of India's area is vulnerable to one or multiple hazard. Of the 28 states and 7 union territories, 22 are disaster-prone. Almost 57% of the land is vulnerable to earthquake (high seismic zones III-V), 68% to drought, 8% to cyclones and 12% to floods. India has also become much more vulnerable to tsunamis since the 2004 Indian Ocean tsunami in Chennai.

Government of India has taken up disaster management as a policy issue so that damage impact can be minimized due to any natural or manmade hazard. Learners must have idea about how Disaster Response teams work during flood, Landslide or Cyclone.

You have to explain the difference between the hazard and the disaster. You should clarify that *“a hazard is a natural or manmade damaging event which is beyond the effective control of human being, whereas the disaster is the sum total of consequences of natural hazard due to vulnerability of people or regions subject to hazard.”*

There are two major institutions set up by Government of India:

- National Institute of Disaster Management (NIDM)
- National Disaster Management Authority (NDMA)

### National Disaster Management Act 2005

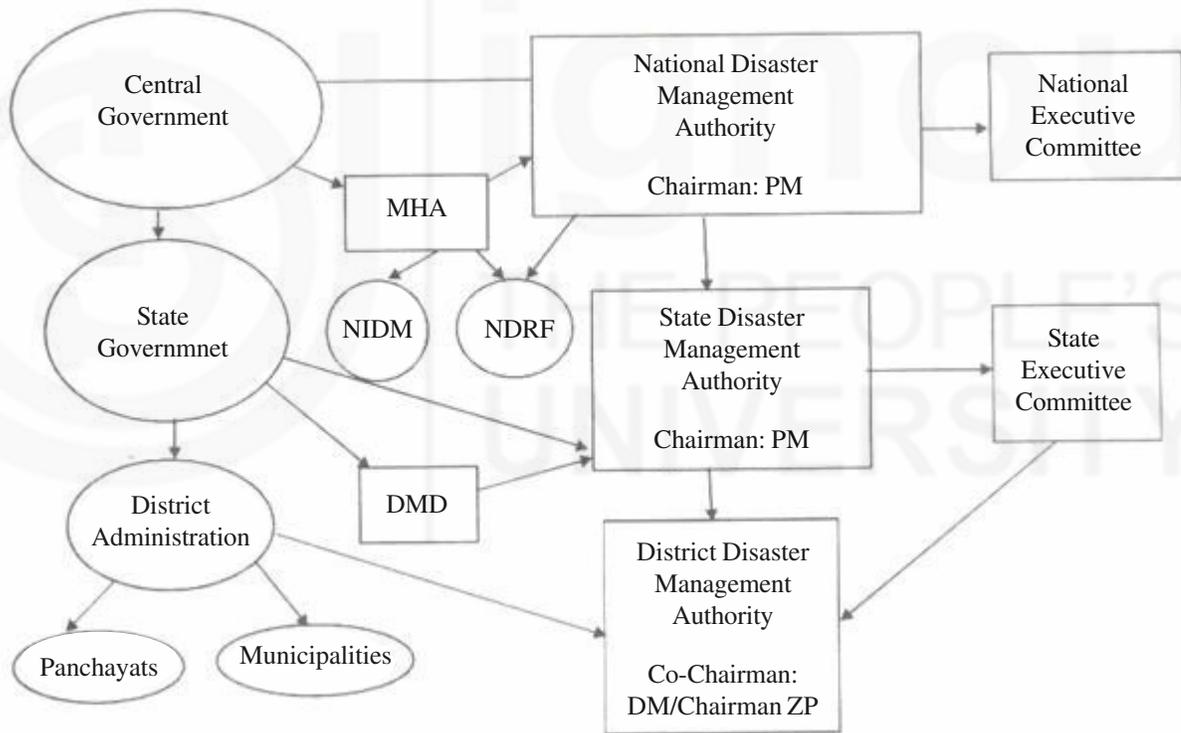
National Disaster Management Act, 2005 defines events that cause substantial loss of life, prosperity and environment. It reads, “Disaster means catastrophe, mishap, calamity or grave occurrence in any area, arising from nature or man-made causes, or by accident or negligence which result in substantial loss of life, of human suffering or damage to, and destruction of property, or damage to, or degradation of environment, and is of such nature or magnitude as to be beyond the coping capacity of the community of affected areas.”

Disaster management Act, 2005 defines Disaster Management as, a continuous cycle and integrated process of planning, organizing, coordinating and implementing, coordinating and implementing measures which are necessary or expedient for-

- Prevention of danger or threat of any disaster;
- Mitigation or reduction of risk of any disaster or its severity or consequences;
- Capacity-building;
- Preparedness to deal with any disaster;
- Prompt response to any threatening disaster situation or disaster;
- Assessing the severity or magnitude of effects of any disaster;
- Evacuation, rescue and relief;
- Rehabilitation and Reconstruction

The Act provides for three tier mechanism for Disaster Management that includes National Disaster Management Authority, State Disaster Management Authority and District Disaster Management Authority.

The Disaster Management Act, 2005 has created new institutions at the national, state, district and local levels. The new institutional framework for disaster management in the country is as under:



The National Disaster Management Authority (NDMA) under the Chairmanship of the Prime Minister is the apex body responsible for laying down policies, plans and guidelines for disaster management and for coordinating their enforcement and implementation throughout the country.

At the State Level the State Disaster Management Authority (SDMA), headed by the Chief Minister, lays down policies and plans for disaster management in the State. It is also responsible to coordinate the implementation of the State

Plan, recommend provision of funds for mitigation and preparedness measures and review the developmental plans of the different departments of the State to ensure integration of prevention, preparedness and mitigation measures.

DDMA is the planning, coordinating and implementing body for disaster management at district level. It monitors the implementation of the National and State Policies and the National, State and the District Plans.

### Activity 8

Give your learners small group projects to collect information on role played by Disaster Management Institutions of India during the following event:

- Flood and Landslide in June 2013 in Uttarakhand
- Cyclone *Hudhud*, September 2014 in Andhra Pradesh and Odisha
- Earthquake, April 2015, in Kathmandu

### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

4) Name the major agencies responsible for Disaster Management in India.

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## 15.7 WASTE MANAGEMENT

Commonly speaking, wastes are the substances that are no longer of use to us. For example children as well as adults often throw the vegetable and fruit peels, chocolate wrappers, packet of chips, soft drink cans and broken stuff in homes in garbage bins. What happens to this waste after the waste has been collected from the homes by the *safaikarmcharies*. Also, what about the dirty water that goes through your drains and flushes? Where does it go? Different agricultural and industrial activities also generate waste in solid, liquid or gaseous forms. If all this waste is not managed properly, we would face unhygienic and unhealthy living conditions and eventually our surrounding would not be fit for living.

It is also important for us to understand that all waste is not similar and hence we need to adopt different waste management techniques for different types of waste.

Let us first discuss the various types of wastes.

**Solid Waste:** Solid waste includes all wastes in the form of solid such as vegetable peels, discarded metal and plastic things, animal and plant feces etc. This waste is of two types: biodegradable and non-biodegradable. The substances which undergo decay easily by the action of tiny organisms (decomposers) come under

the category of biodegradable waste. Bio-degradable waste is easier to manage and does not harm the environment much. Some of the ways for managing solid waste are:

**Open dumps:** Open dumps are open pits where the waste is dumped but this practice is unhygienic and it may also contaminate the nearby water bodies.

**Landfills-** In this the solid waste is dumped into the pit and covered with soil.

**Incineration-** In incineration, the garbage that can be recycled is separated and the rest is burnt.

**Vermicomposting-** Vermicomposting involves use of earthworms for decomposing the waste. These worms eat biodegradable waste and convert it into compost that can be used as manure.

**Liquid Waste:** Waste water generated from the industries, construction of buildings, mining activities, drainage of pesticides and fertilizers and domestic sewage form the liquid waste. This kind of waste is often discharged into the water bodies and pollutes the water as already discussed.

The waste water released by the homes, industries, hospitals and offices contains lot of impurities called **contaminants**. This waste water is also called **Sewage**. The sewage consists of different types of contaminants. A few of these are:

- **Organic Impurities:** Human and animal faeces, urine, oil, pesticides, fertilizers etc.
- **Inorganic Impurities:** Nitrates, phosphates and metals
- **Nutrients:** Nitrogen and phosphorus
- **Bacteria and Microbes:** Such as those causing cholera, typhoid and dysentery.

If we dump all the waste generated from households or industries directly into the streams, this water will slowly become a threat to the animal and plant life there. The discharge of nutrient rich waste from the fields or industries increases the growth of algae and weeds in the water bodies. These consume the oxygen available to other plants and organisms leading to their death. This process is called **Eutrophication**.

When life forms in these water bodies die, bacteria and microbes begin to decompose them resulting in a foul smell. Mosquitoes and flies start breeding there. The place thus becomes a breeding ground for many diseases such as malaria and chikungunia.

### 15.7.1 Waste Water Treatment

The waste water is taken from its point of origin to the **treatment plant** through a network of pipes called **sewerage**. At the treatment plant, the waste water undergoes some physical, chemical and biological processes to remove the contaminants.

- 1) First, the waste water undergoes **primary treatment** in which the sewage is passed through rotating screens and huge sedimentary tanks. The heavy

waste that settles down at the bottom is called **sludge** whereas the lighter waste such as soap, oils, plastic etc. floats on the surface. This is called the **scum**. This waste is removed mechanically here.

- 2) After the primary treatment, the **secondary treatment** is done which is a biological process. The sludge generated above is transferred to a separate tank where it is decomposed by the anaerobic bacteria. The process generates biogas that can be used as fuel. The process can be speeded up by allowing water to pass through large aeration tanks where air is blown into sewage. The aerobic bacteria decompose the organic waste.
- 3) Water now undergoes the **tertiary treatment** which is a chemical process. This varies with the composition of water. This may involve treatment using filter beds, exposing the water to UV rays, addition of chlorine or addition of other chemicals like ozone. After this the water goes back to the distribution system.

### 15.7.2 Basic Principles of Waste Management

The basic principle of waste management is often referred as the **3Rs** of waste management:

**Reduce:** This means that you use less. You save electricity by switching off unnecessary lights and fans. You save water by repairing leaky taps. You do not waste food. Can you think of other things that you can reduce the usage of?

**Recycle:** This means that you collect plastic, paper, glass and metal items and recycle these materials to make required things instead of synthesising or extracting fresh plastic, paper, glass or metal. In order to recycle, we first need to segregate our wastes so that the material that can be recycled is not dumped along with other wastes. Does your village/town/city have a mechanism in place for recycling these materials?

**Reuse:** This is actually even better than recycling because the process of recycling uses some energy. In the 'reuse' strategy, you simply use things again and again. Instead of throwing away used envelopes, you can reverse it and use it again. The plastic bottles in which you buy various food-items like jam or pickle can be used for storing things in the kitchen. What other items can we reuse?

**Source:** Chapter 16, Management of Natural Resources, Class X, NCERT, p. 268.

#### Activity 9

- Arrange a visit to the nearby wastewater treatment plant to understand how sewage is treated there. Find out what happens to the sludge.
- Collect water from a puddle or a river. Observe its smell and colour. Put it under the microscope to observe the microorganism present in the water.

### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

- 5) Why is it harmful to release untreated sewage into rivers? Track the history of any river in your area to show how it has become polluted from being clean?

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## 15.8 LET US SUM UP

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In this unit, discussion held on phenomenon of light like reflection and refraction of light from mirrors and lenses. The Unit discusses about water cycle and role of processes like evaporation, condensation and precipitation in water cycle. Unit suggested importance of conservation of bodies and recommends sharing some success stories from India on water conservation. Unit also discusses various natural disasters like flood, drought, earthquakes, and measures taken by India for Disaster Management. Unit ends with discussion on waste management and its importance. Unit has attempted to discuss various issues with a range of simple activities to make learners aware about the issues and sensitize them about their roles as responsible future citizens.

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## 15.9 UNIT END EXERCISES

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- 1) Differentiate between reflection and refraction with suitable examples.
- 2) Discuss the importance of process like evaporation, condensation and precipitation in nature.
- 3) Discuss major provisions of National Disaster Management Act, 2005.
- 4) What are the processes involves in disposal of liquid waste?
- 5) Prepare a report on waste management system in your village/city.

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## 15.10 SUGGESTED READINGS AND REFERENCES

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- <https://www.millcreekurbanfarm.org/sites/default/files/Water%20Cycle.pdf>
- <http://study.com/academy/lesson/the-water-cycle-precipitation-condensation-and-evaporation.html>
- NCERT (2015). Science Text Book (s) for IX and X, NCERT.
- IGNOU (2013). Natural Phenomenon and Natural Resources, Unit 13, BES-019: Teaching of Science, SOE.

- Mondal, P. (2016). Disaster Management in India: Classification, Policies and other Details, retrieved from <http://www.yourarticlelibrary.com/essay/disaster-management-in-india-classification-policies-and-other-details/25006/>.

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## 15.11 ANSWERS TO CHECK YOUR PROGRESS

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- 1) Three rules are:
  - Any incident ray travelling parallel to the principal axis on the way to the mirror will pass through the focal point upon reflection.
  - Any incident ray passing through the focal point on the way to the mirror will travel parallel to the principal axis upon reflection.
  - Any ray incident parallel to principle axis is reflected passing through focus.
- 2) Compare image (b) and (d) in point 15.3 and answer.
- 3) Rain occurs due to precipitation of condensed water vapours in clouds.
- 4) National Institute of Disaster Management (NIDM) and National Disaster Management Authority (NDMA).
- 5) Waste water generated from the industries, construction of buildings, mining activities, drainage of pesticides and fertilizers and domestic sewage form the liquid waste. The waste water released by the homes, industries, hospitals and offices contains lot of impurities called contaminants.

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# UNIT 16 NATURAL RESOURCES

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## Structure

- 16.1 Introduction
- 16.2 Objectives
- 16.3 Physical Resources and their Utilization
  - 16.3.1 Air
  - 16.3.2 Water
  - 16.3.3 Soil
- 16.4 Pollution and Role of Human Being
  - 16.4.1 Air Pollution
  - 16.4.2 Water Pollution
  - 16.4.3 Soil Erosion
- 16.5 Bio-Geo-Chemical Cycles in Nature
  - 16.5.1 Water Cycle
  - 16.5.2 Nitrogen Cycle
  - 16.5.3 Carbon Cycle
- 16.6 Natural Resource Management
  - 16.6.1 Forests
  - 16.6.2 Water
  - 16.6.3 Coal and Petroleum
- 16.7 Legal Perspective in Conservation and International Scenario
- 16.8 Let Us Sum Up
- 16.9 Unit End Exercises
- 16.10 References and Suggested Reading
- 16.11 Answers to Check Your Progress

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## 16.1 INTRODUCTION

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The basic theme of this unit is “Natural Resources”. The topics like physical resources, their utilization by humans has been covered under it. Issues like human role in polluting the nature have been discussed here. As a science teacher you have to explain it to your learners along with the ways to manage natural resources judiciously. Unit also discusses about the bio-geo-chemical cycles, which learners observe around them. Along with these concepts, the legal perspective is also taken up. The focal objective of this unit is to help you as a teacher in getting acquiescence to the content being discussed. This unit will also guide you with suitable methods, techniques and strategies to be used while organizing teaching-learning for such concepts in your classroom.

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## 16.2 OBJECTIVES

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After going through this unit, you will be able to:

- introduce the learners to the natural world around us,
- enable learners to understand the various natural resources,

- give them conceptual understanding of resources and their management,
- explain through activities various concepts like causes of pollution and ways to control them,
- make the learners aware of the legal perspectives in resource conservation, and
- familiarize your learners with the international scenario regarding resource conservation and laws behind it.

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## 16.3 PHYSICAL RESOURCES AND THEIR UTILIZATION

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When we talk about physical resources, it includes water, air, soil, etc. Your learners are already aware of the fact that all life forms survive on this earth due to resources available here. If you ask them to make list of natural resources available here and necessary for us to live, they will give you responses like air, water, soil, plants, etc.

Before starting discussion on various such resources, you can ask them to complete the following table based on their previous knowledge and understanding:

Level	What comes in it?	How will you define it?
Lithosphere		
Hydrosphere		
Atmosphere		
Biosphere		

Such activities will set the tone of your class and you can move ahead to discuss the major physical resources.

### 16.3.1 AIR

Ms. Sunita, PGT Science in a secondary school in Lucknow, instructed her learners to inhale deeply and then exhale. She asked them, while inhaling, which component of air is used by body for respiration and which gas is exhaled as a product?

Learners responded correctly as they are aware of it, she further introduced concept of air as follows:

Air is a mixture of gases like nitrogen, oxygen, carbon dioxide, water vapour, other gases and dust. Oxygen is taken in during breathing and is used to breakdown glucose to release energy for various life processes. As a result carbon dioxide is exhaled out; this is used by plants for photosynthesis (preparation of glucose in presence of sunlight).

You can see that how well she connected the learners' experiences with a new concept and introduced it in her class.

#### Climate Control by Air

She introduced another important concept i.e. climate control by air. It is very essential to know that it is a pleasant truth that climate on earth is conducive for life forms. This conduciveness is brought about by air and its movement.

She asked her learners following questions:

- Have you ever observed smoke coming out when your mother cooks food?
- How does this smoke move?

She elaborated the same phenomenon can be seen when we light incense sticks during praying. Smoke rises up which is hot and the place left by this hot air is taken up by the cold air. This gives rise to convection current in air i.e. in afternoon land gets heated faster than sea but at night sea gets cooled faster than land. So we can feel the generation of land as well as sea breeze.

### Activity 1

You have to introduce the concept of wind in your class. Design an activity through which you will introduce the concept of wind and how is it affected with rotation of the Earth and the presence of mountain ranges.

## 16.3.2 Water

Learners at secondary level are well aware of water, its importance in human life. In their elementary classes, they have studied about various sources of water, water contamination, and importance of water in our life. They may be aware of the fact that 75% of Earth's surface is covered by water.

In a rural secondary school of Darbhanga (Bihar), a Science Teacher Mr. Jawed wants to introduce the process of rainfall in his class. Let us see how he started his class.

In his class, Mr. Jawed asked following questions:

- Name the months when we observe more rainfall?
- What is the importance of rainfall for farmers?
- What problems people face when rainfall is more?
- Which place in India has maximum rainfall?

After getting answers of these questions he asked, do they know how rainfall occurs? What are the factors responsible for rainfall? How do clouds form? He gave a small group project to the class to find out the answers of these questions.

When learners collected the information, they presented it in whole class and group discussion followed by a small video-clip on formation of clouds and rainfall took place.

The main source of water on the surface as well as underground water is rain. A large amount of water evaporates due to solar heat. As the water evaporates into air, it expands and when it cools it condenses. This condensation causes rainfall. Different places have different pattern of rainfall.

### Activity 2

Collect some satellite pictures of rainfall pattern or show the website of met department to your learners to explain how prediction of rainfall takes place.

If it is rainy season, you can ask your learners to observe daily weather reports on television news channel and share their observation.

### 16.3.3 Soil

All your learners know the importance of soil in life. The survival of plants is dependent on soil and in turn we are dependent on these plants. They also know that outermost layer of our earth is called the crust and the minerals found in this layer are essential for life forms.

Soil is a mixture of various types of substance e.g. fine particles, small pebbles, decayed and living organisms called humus, microscopic organisms etc. The top soil is that which harbours various plants consists of humus, fine soil particles and living organisms. The nature and quality of top soil decides the type of vegetation in that area.

There are various factors which help to form soil. They are:

**Heat:** The solar heat expands the rocks and the cold nights contract them, as a result cracks are formed which weakens them and breaks them into pieces.

**Water:** It helps to easily break the rocks by seeping into these cracks or by rubbing & wearing them by flowing over them.

**Wind:** It blows the eroded or broken rock pieces to different places.

**Organisms:** Lichens, mosses, humans and animals too wear the larger rocks into smaller particles of soil.

You can ask your learners to perform the following activity for comprehending the concept of soil.

Take two big earthen pots and fill them with soil. Leave one pot as it is and plant small saplings in second one. Put a pan in front of them. What do they observe? Ask them to note down their observations.

#### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

1) Give two basic components necessary for life on earth.

(i) ..... (ii) .....

2) Name two factors responsible for soil formation.

(i) ..... (ii) .....

## 16.4 POLLUTION AND ROLE OF HUMAN BEING\*

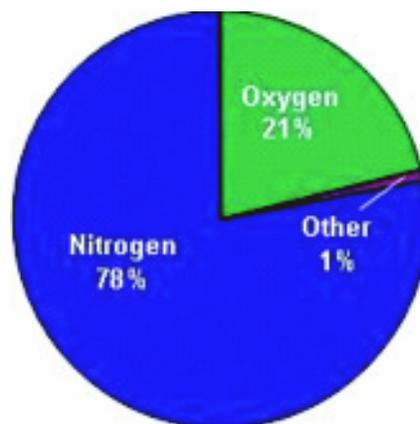
Learners at secondary stage are mature enough to understand that man is over exploiting the physical resources for his materialistic needs. This has led imbalance in ecosystem. Nature has enough for our need but not our greed has led to the overuse of these resources leading to the problem of pollution. This adverse condition has been created by human beings who have taken a shape of threat for himself as well as other living beings. The pollution is a necessary evil of all development.

\* This section has been adopted from BES-019, Teaching of Science, SOE, IGNOU

Learners are aware of the fact that “pollution is an undesirable change in the physical, chemical and biological characteristics of air, water and soil that may harm our life or create a potential health hazard of any living organism as they have studied it at elementary level. Pollution is thus direct or indirect change in any component of the biosphere that is harmful to living organisms and man, affecting adversely the industrial progress, cultural and natural resources. You can introduce in your class various types of pollution like air pollution, water pollution and land pollution with help of many activities.

### 16.4.1 Air Pollution

Every one of us is aware of the fact that our Earth is covered by a thin layer of gases called the atmosphere. In fact, there are four distinct layers of atmosphere namely the Troposphere, Stratosphere, Mesosphere and the Ionosphere. Troposphere is the layer in which we live. The air in this layer consists of various gases and water vapor. Typically it has 21 percent Oxygen, 78 percent Nitrogen and the 1 percent is all the other gases including Carbon-dioxide and water vapours.



In the previous Units, we have discussed that Oxygen is used by all life forms during respiration and Carbon dioxide is expelled out. The plants supply us with Oxygen by the process of Photosynthesis where they consume the Carbon-dioxide. This helps in maintaining the balance of various gases in the atmosphere. But, certain activities of human beings like cutting of trees, smoke released by industries and vehicles tend to disturb this balance. The contamination of air by the release of harmful gases is called air pollution.

#### Air pollution

Let us start the discussion with a simple activity, which you can take up in class for children to know that the air around them is polluted.

##### Activity 3

Ask learners to take three sheets of white paper and make them greasy by applying some oil on each. Find a suitable way of pasting them each in the corner of a traffic busy street, a quiet park and in the kitchen of her house.

Ask them to notice all the sheets the next day.

- What do they observe?
- Which sheet has turned more black and why?

These observations will help you to introduce the concept of air pollution.

Let us have a look on some of the common causes of air pollution.

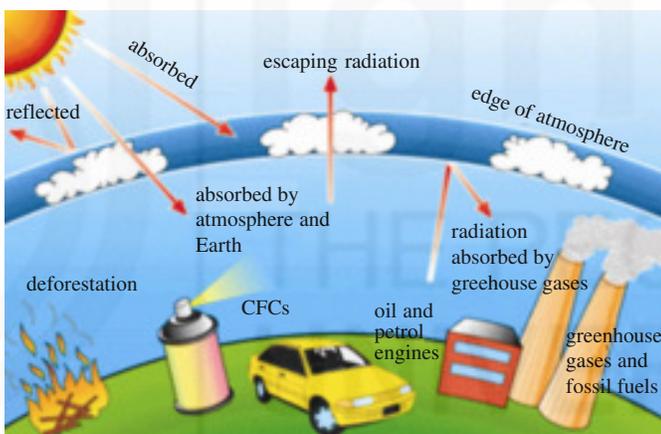
- Burning of fuels like coal and wood in household for the household activities. This releases harmful gases like Carbon-dioxide and carbon monoxide in the atmosphere. These gases are responsible for the increasing number of respiratory problems like asthma, cough and wheezing.

- Fuels used in the automobiles such as diesel and petroleum release oxides of Carbon, Nitrogen and Sulphur and Smoke. These gases are very harmful and may even cause complete lung damage, irritation in the eyes and skin allergies
- Burning of coal in power plants and industries is a major source of gaseous pollutants like Sulphur and Nitrogen. These are responsible for causing acid rain that damages buildings and monuments and also makes the soil more acidic making it unsuitable for the plants.
- The CFCs (chlorofluorocarbons) used in AC's, refrigerators and aerosol sprays damages the Ozone layer.
- Deforestation – Indiscriminate cutting of trees for building houses and other infrastructure affect the  $\text{CO}_2$ – $\text{O}_2$  balance in the environment.
- Suspended particulate matter such as soot and fly ash released by industries and automobiles form a blackish layer of air in the atmosphere.

*Ask learners to collect pictures of deforestation, industrial waste, allergies, etc.*

### Effects of Air Pollution

**Global Warming:** The sunlight penetrates the earth's atmosphere and heats the surface of the earth. This is responsible for maintaining suitable temperature for living and also for photosynthesis in plants. The earth's surface radiates this absorbed heat back to the atmosphere, some of which escapes to the space. The gases present in the atmosphere such as Carbon, Methane and Sulphur dioxide traps some of this so as to maintain a suitable temperature on earth.



However, due to increasing air pollution, the concentration of these gases called **greenhouse gases** is increasing and most of the radiated heat is trapped near the earth's surface. This results in an increase in temperature on the earth. This phenomenon is called global warming because of which there is also a fear of melting the glaciers and rise in the sea level. This may be a threat to life on earth in future.

**Acid Rain:** The Oxides of Sulphur and Nitrogen present in the atmosphere dissolve in rain making it acidic and hence the rain that comes to earth's surface is called acid rain. This rain corrodes monuments and buildings. This is also harmful to the plant and animal life on the earth. The white marble of Taj Mahal has turned yellowish due to the impact of acid rain.

**Deletion of Ozone layer:** The CFCs (chlorofluorocarbons) used in AC's, refrigerators and aerosol sprays damages the Ozone layer. Ozone layer protects

us from the harmful UV rays coming from the Sun and damage due to this may even cause increasing instances of skin cancer.

**Health hazards:** Air pollution is harmful for the growth of plants. Also it causes many diseases such as asthma, bronchitis, allergies and even lung cancer in human beings.

#### Activity 4

Take drinking water in two containers. Add any cold drink (it is a mild acid) to one of it. Now place some pieces of marble stones in each container. Observe after 2-3 days. Has the color of marbles in the container with cold drink turned yellowish?

Organize a discussion around this activity and explain the effects of acid on substances.

#### Reducing Air Pollution

There are many ways to reduce air pollution. Children should be encouraged to adopt those measures which they can promote and practice in their neighbourhood. Here are a few:

- Use clean fuels such as CNG (compressed natural gas)
- Try to use public transportation and car pools as far as possible.
- Use clean sources of energy such as solar energy, wind energy and water energy.
- Plant more and more trees.
- Ensure regular pollution check of your vehicles.
- Fumes released from the industries should be freed of Sulphur before they are released from the chimneys.
- Create an awareness regarding the environment so that everybody understands the responsibility.

You can plan and organize many activities to sensitize children towards air pollution. We are suggesting a few as exemplars but you can undertake many more like these ones.

#### Activity 5

- Organise a talk of a doctor from your area on the effects of air pollution on human health.
- Organise a visit to a pollution check centre at a petrol pump and ask children to note down the proceeding, which should then be basis for a classroom discussion.
- Organise a poster competition, debates and extempore/talks on Ozone Day, Earth Day and Environment Day.
- You can organise a street play/rally or awareness campaign on air pollution in a nearby area.

## 16.4.2 Water Pollution

We are familiar with the fact that water covers almost 75 percent of the earth's surface and is one of the most essential factors for life on earth. Water is present in the form of rivers, lakes, oceans, glaciers and ground water on earth. All these sources of water are important for sustaining plant and animal life on earth. These days, scarcity of drinking water and water pollution has become a burning issue. Let us discuss in brief about the causes of water pollution in order to refresh our memory, it will also help you to plan and practice related activities in the classroom.

### Causes of water pollution

- **Industrial Waste:** The untreated waste from the industries and domestic sewage is discharged into the water bodies making them unfit for use and also causing harm to the aquatic life.
- **Human cleanliness activities:** Bathing, washing clothes etc. pollutes the water bodies as the detergents used for cleanliness purposes have harmful chemicals.
- **Pesticides and Fertilizers:** The pesticides and fertilizers used by farmers drain into the water bodies and from there enter in the bodies of aquatic plants and animals. This eventually may reach human bodies through the food chain.
- **Oil spills:** Oil spills from ships, motor boats and accidentally through oil tankers are major sources of water pollution.
- **Nuclear waste:** Radioactive waste is sometimes dumped into the sea making it polluted.

What are the various effects of water pollution and steps to prevent water pollution? Let us discuss in following sub-section.

### Effects of water pollution

- Industrial waste discharged into water bodies contains poisonous chemicals and makes it unfit for drinking and other activities.
- Untreated domestic sewage is the source of many water borne diseases.
- The chemicals released by factories and fertilizers and pesticides used by farmers reach the water bodies and subsequently aquatic animals through the food chain and affect their health adversely.
- **Eutrophication:** The drainage of nutrient rich water from the fields may result in excessive growth of plants on the surface of water such as algae. This is called eutrophication. These algae and weeds use so much oxygen that other aquatic life dies due to the lack of it. They also block the sunlight reaching the submerged plants.
- Due to oil spills, a thin layer of oil is formed on the surface of water that blocks the sunlight. Also this makes the water becomes unfit for drinking. This is a serious threat to the aquatic life.
- Pollution of water affects the fertility of soil when it is used for irrigation.
- Water contaminated with toxic chemical may result in various diseases including blurring of vision, numbness of limbs and mental disorders.

### Steps for prevention of water pollution

- Avoid bathing and cleanliness activities near water bodies.
- Domestic and industrial waste should be treated before discharging it into water bodies.
- The fertilizers and pesticides should be used judiciously and in eco-friendly ways should be adopted.
- Religious activities that pollute water should be restricted.
- Creating awareness among people to stop water pollution.

#### Activity 6

- Organize a discussion on a Case study of Ganga/ Save Yamuna Campaign or any other local river which has become polluted..
- Show some pictures of historical monuments like Taj Mahal, Humaun Tomb, etc. and discuss about various steps have been taken by the Government to preserve them.

#### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

3) How does air pollution affect us? Take learners to any local industry visit and discuss how pollution can be minimized?

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4) What are greenhouse gases? How do they result in global warming? How can you demonstrate the concept of greenhouse to learners?

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5) How does water pollution affect the aquatic life? Collect some pictures of oil spill/offences of industrial waste to show harmful effects of water pollution on aquatic life.

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### 16.4.3 Soil Erosion

Learners at secondary level are well aware that soil is formed by weathering of rocks by natural forces such as wind, water and variation in temperature. Just like air and water, soil is very important natural resource that is useful for us in many ways. They also know that soil helps the growth of the plants by providing them support and essential nutrients. Plants are responsible for providing us not only with food but a lot of other products of human use like clothes, medicines, pottery items and construction material. Soil helps in the percolation and retention of underground water which is used for drinking and other purposes. Certain forms of life like earthworms, roundworms, microbes and fungi live in soil. Soil helps in decay of waste products and pollutants. Soil helps in maintaining environmental balance as it supports the growth of plants that are a major factor in influencing water cycle on earth. Soil also helps in retaining moisture. Experiences from outside the classroom should be provided to learners so that they can explore various aspects of soil formation.

To give experience of various types of soil and various components of soil, Jasmine asked children to bring some soil from their neighbourhood in a poly bag to the school. Next day, she asked them to first categorize the poly bag filled with soil into garden soil, road side soil, agriculture field soil, soil from river side/pond side etc.

As the next step, Jasmine asked children to analyze the soil in terms of its ingredients like plant parts, animal parts, type of sand, size of particles etc. and was able to make children aware that soil has different types of ingredients which make it different.

Jasmine also explained that analyzing the soil in different layers is known as **soil profiling**.

She discussed with children and concluded that different kind of soil is needed for different kind of crops.

Along with soil profile and types of soil, children should also be made aware about soil erosion. Let us discuss in brief about soil erosion.

#### Soil Erosion

Formation of soil is a slow process and it may take hundreds of years to produce a few centimeters of soil. However, certain natural process and human activities are responsible for carrying soil from one place to the other. This is called soil erosion. The top layer of the soil is rich in nutrients and its loss adversely affects the growth of plants.

#### Causes of soil erosion:

- Soil erosion is caused by high speed winds or water. The effect would be more prominent in areas with loose soil.
- Overgrazing
- Deforestation—large scale cutting of trees and plants leaves the soil bare which is easily carried away by wind and water.
- Natural calamities like droughts and floods are also responsible for large scale and sudden soil erosion.

- Tillage– The practice of preparing the farmland for agriculture often leaves the top soil loose and this increases the chances of soils erosion.

### How to prevent soil erosion

#### Activity 7

Divide children into two groups and provide them with the same amount of garden soil. Ask them to spread the soil in shallow trays and make mounds (hill) in the centre so that both mounds look the same. With the help of a pencil or finger one group can make steps from the top to the bottom and the other group can make circular contours. Now pour the same amount of water (1 glass) from the top of each hill (from same height and speed). Ask children to observe the amount of water collected in each tray. Ask them that, in which case do they observe more soil loss from the mound?

- Repeat the same activity by making mounds of different slopes.
- Also try the activity with small plants and grass on one mound.

Help them to draw conclusions about soil erosion from the above activities.

Planting more trees, contour farming, avoiding excessive tiling, covering the soil with leguminous crops between two crops seasons are some of the ways of preventing soil erosion. It is very important to be aware of and avoid soil erosion as the excessive run off of top soil to the rivers and other water bodies can spoil the ecological balance because the top soil is rich in fertilizers and pesticides.

#### Check Your Progress

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

- 6) What do you mean by soil erosion? How will you demonstrate soil erosion in classroom?

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## 16.5 BIO-GEO-CHEMICAL CYCLES IN NATURE

Our environment consists of both biotic and abiotic components between which transfer of matter and energy occurs. This interaction makes the biosphere system stable. We can say that cycling of material in the ecosystem and in the biosphere is called the bio-geo-chemical cycles. Let us discuss a few cycles in detail, it will facilitate in organizing teaching-learning experience in your class on such topics.

### 16.5.1 Water Cycle

Ask your learners to observe the water level of nearest pond or river of their respective areas and find out the answer of the following questions:

- At what time of the year is the water level minimum?
- At what time of the year is it at its maximum level?
- Can you think of a reason why does this occur?

The water content in nature is maintained by water cycle. You can go through the line chart given below:-

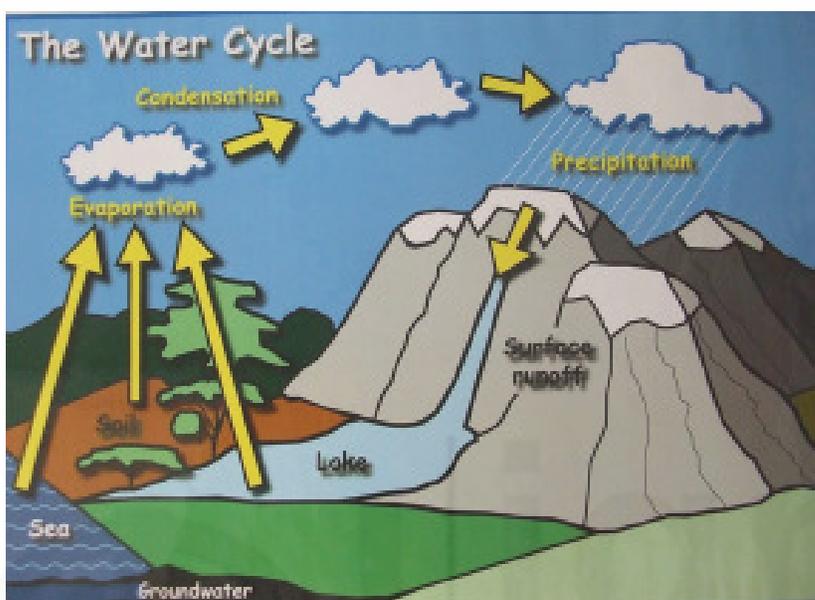


Fig. 16.1: Water cycle

You can see that the whole process in which water evaporates from water bodies into air and falls on the land as rain and later flows back into the sea via rivers is known as the water cycle. Also the water flows carries along with it many nutrients which is used by marine organisms. You can now see that this water cycle is very precious for living being and is continuously regulated by evaporation with the help of solar heat.

### 16.5.2 Nitrogen Cycle

You already know that nitrogen constitutes the maximum amount (78%) of our atmosphere. It is an essential nutrient for all life forms but this atmospheric nitrogen cannot be used directly. Nitrogen is part of proteins, DNA, RNA, vitamins etc. There are usually **two ways** to convert atmospheric nitrogen into nitrates and nitrites so that they can be used to form required molecules.

- By “nitrogen fixing” bacteria (found in roots of legumes like pea, beans, pulses etc.)
- By physical processes (lightning and high temperature convert atm.  $N_2$  to oxides of nitrogen which dissolve in water to form nitric and nitrous acids and fall on ground with rain water).



Plants take the converted nitrogen and form proteins which in turn is eaten by animals. When these animals and plants die, the bacteria convert the compounds of  $N_2$  in their bodies to atm.  $N_2$ . Excess of  $N_2$  in biosphere may result in excess growth of algae in water bodies and cause harm to aquatic life.

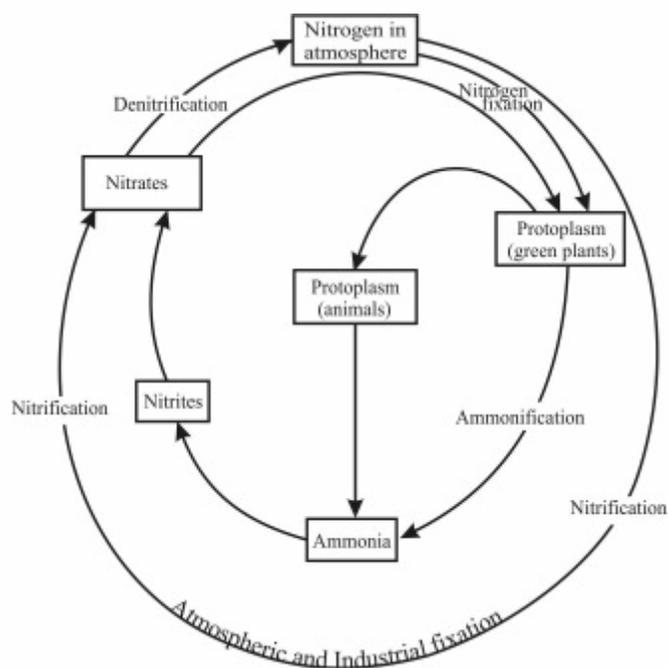


Fig. 16.2: Nitrogen cycle

### 16.5.3 Carbon Cycle

Ask your learners to explore the answers of the following questions:

- Can you think of chemical substances having carbon as one of the components?
- Which form of carbon is used by plants and for what?
- What is the by-product of the above process which is very useful for animals?

After the activity, you can tell them that Carbon occurs in nature as coal, diamond, graphite etc. in free form and as carbon dioxide, carbohydrates, fats etc. in combined form.  $CO_2$ , a residual product of respiration is used by plants for photosynthesis (to prepare carbohydrate). As a result oxygen is given out by plants and this  $O_2$  is essential for our life.  $CO_2$  is also added into the atmosphere by burning of fossil fuels like coal, petroleum products etc. You can use following diagram for further elaboration on carbon:

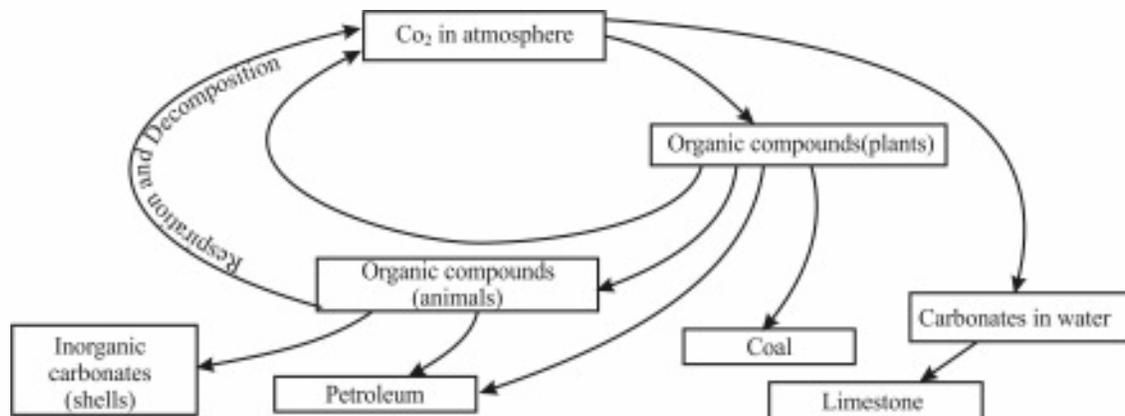


Fig. 16.3: Carbon cycle



## 16.6 NATURAL RESOURCE MANAGEMENT

### Activity 8

Play a quiz round with your learners to show the relationships between various components

present on this earth. For e.g.:

- How do we make furniture?
- Where does the wood come from?
- How do the trees grow?
- How do these trees draw nutrition?
- How do plants use solar energy to prepare food?
- What does a plant need to grow besides soil and solar energy?
- What would happen if there is no water left in our planet?

You will get many interesting responses which will help learners to realize that all the things around us have connection with each other.

This brings us to the fact that since we are dependent on resources obtained from earth we must understand their importance. No natural resource is unlimited; even if it is, it gets polluted so much that it is not suitable for use. Our population is growing day by day and so is the demand of these resources. This leads to a question we must ponder upon as to how we manage these resources so that they can last for the generations to come. Each one has equal right to use them but nobody has the freedom to misuse or exploit them. Two things we must keep in mind are that natural resources must be utilized judiciously and secondly they shouldn't be done in such a manner which may harm our environment. For e.g. mining, etc.

### 16.6.1 Forests

You can start discussion with following activities:

- Ask your learners to make a list of various produces acquired from forests
- Make a list of forest areas they are aware of.
- Do these forests have population living in and around them?

Forests harbor not only different species of plants but also of animals. They may be surprised to know that plants and animals live in complete harmony. Both work equally to replenish each other. Even the families residing in and around forest live in peace. The problem arises when greed of man overpowers. Many industries are based on these like – medicines, fruits, timber, wood, paper, lac, rubber, etc. Human clear the forests for raw materials and do not think of replantation. Certain industries are also dependent on wildlife and for this they are killed ruthlessly. Seeing this various laws and Acts to save these animals have been implemented.

Ask your learners to divide themselves in small groups and discuss the following questions:

- Do they know about any wild life sanctuaries and their role in protecting these animals?
- Do they know about rules to be followed by tourists who visit these places?

You may find few learners, who have visited any wildlife sanctuary, ask him/her to share his/her experiences.

A story was published in the news paper The Hindu on 4<sup>th</sup> January, 2010. Its title was “**Let’s Hug a Tree for Life**”

In a tiny village called Uliana, nestled in the shadow of the Himalayas, lived Meera. She didnt go to school but learnt all her lessons from nature. And her best friends were the trees. She saw each one of them as a different being. “There was Naani tree who was the old gnarled one with the giant curved lap into which meera fitted perfectly. There was Bhaloo tree who was big and black and who, if you rounded a corner without concentrating, could be mistaken for being a grizzly bear. There was chottu tree..”

Life was perfect, till one day she heard her parents speaking of a group of men who were coming from the city to cut down her beloved trees. The situation seemed hopeless as her father said “We little people have no powers to stop them.”

But when the dreaded day arrived, this little girl dared to take action that lead the whole village to save their trees. She clings to her tree and refuses to budge. The rest of the villagers do what she is doing and hug a tree each.

*Source: <http://www.thehindu.com/life-and-style/kids/article75248.ece>*

You can use such real life examples to make your learners aware about such issues. The conservationists have realized themselves and also are also making people aware about the importance of biodiversity. Here it is necessary to cite the example of “Bishnoi Samaj” who plant saplings on the birth of a child in a family. They are completely against cutting of trees. “Save tigers” drive has also helped to increase the number of tigers in our country. So the efforts are on. Forest resources must be used in both environmentally friendly and developmentally sound manner. Development does not mean deteriorating environment but maintaining it to avoid imbalance in nature.

### Activity 9

Share some hints about “Chipko Andolan” with your learners and ask to collect the facts and details of this movement. Learners should be asked to present their views on the whole movement and its importance for Forest Conservation.

### Activities to be undertaken

- 1) Organize a plantation drive with your learners in your nearby area. After discussion about its benefits, enlist the values and skills, which could be inculcated among students through this activity.

### You can ask the learners of your class:

- To celebrate the famous dates like World Environment Day (5<sup>th</sup> June), Ozone Day (16<sup>th</sup> September), International Earth Day (22<sup>nd</sup> April) etc and encourage them for plantation.

- Motivate them to organize discussions based on environmental issues.
- Encourage them to take part in debates, discussion, elocutions on importance of plants.
- Point out the importance of plants in daily life etc.

### 16.6.2 Water

Learners should be asked to reflect on following issues:

- the tragedies ‘farmers’ are facing in many parts of the country
- Why is it so that some areas in our country have good crops and others do not?
- Many a time dead fishes are found in the coastal areas. What is the reason behind this?

Learners may be aware that in our country we have irregular monsoons. To ensure that these may not affect our vegetation, two solutions have been provided. They are:

#### 1) Dams

The stored water always comes handy at the time of crisis. Based on this concept large scale water storage is done in dams. A very good example of this is Indira Gandhi Canal which has brought greenery in Rajasthan where there is always shortage of rainfall. Tehri Dam on river Ganga in Uttarakhand serves similar purpose to people of Tehri Garhwal (Uttarakhand)

#### 2) Water Harvesting

There are two ways by which water can be harvested. They are:-

- i) Rooftop water harvesting– The rainwater falling on roofs of a house is collected in a storage tank through pipes. Another way is to let these pipes take water into a ground pit so that water can seep in to maintain the underground water table.
- ii) Infiltration- All the roads and cemented ground should be leveled in such a manner so that the rainwater can drain into the soil area to maintain underground water level and this process is called infiltration.

Water harvesting has been an old practice in our country. As we already know since people of villages are very close to nature so they respect it. Khadin tanks and nadis in Rajasthan; bandhas in UP and MP; taals in Maharashtra, Baulies in Dekhi and Rajasthan, etc. are some of the old methods of water harvesting.

These processes are necessary as water table needs to be replenished sufficiently. As our population is increasing and so is the use of the natural resources these steps have to be taken. Besides, judicious use of water must be done; be it watering plants, taking bath or washing clothes in machine etc.

### 16.6.3 Coal and Petroleum

Start with following questions with your learners:

- Have you ever heard from your father that the prices of petrol and diesel have been rising drastically?

- Can you reason out why is this happening?

Think of any alternative way to run your vehicle.

You can further deliberate that Coal is the most abundant fossil fuel on earth which is used by us. At least 40% of the world’s electricity comes from coal. Better technology, industrialization, increasing population etc. have increased the demand of coal. When plants and animals die, they get buried in the soil. After many years they form thick layers of carbon rich substance called ‘peat’ is formed. Pressure and temperature then convert it into coal. Fossil fuels like, coal, lignite, petroleum and natural gas are non-renewable natural resources.

Petroleum also occurs deep inside the earth’s crust, as a liquid, and is formed by the bacterial decomposition of marine plant and animal matter and prehistoric forests in the absence of air buried at the bottom of the seas. But you know this process takes thousands of years. So you can understand how difficult it is to replenish this resource. The extensive use of fossil fuel raises serious environmental concerns. The management of such non renewable energy sources involves slightly different perspectives from those resources discussed earlier. We have to manage and try to substitute with alternative resources which are cheap and easily available. Various methods can be used such as:-

- Using vehicles with good mileage
- Using alternative fuels like- CNG, Biogas in place of LPG, Bio-fuel etc.
- Using other sources of energy like – solar energy, wind energy, hydro energy, nuclear energy etc. for generating electricity
- Any alternative resources can also be used by industries too.
- Any choice made must lessen greenhousegases
- Fossil fuel usage must be done judiciously as they emit harmful gases. Therefore commuting in a group is a wiser action than moving around individually in a vehicle.
- We should also use electricity with care. So learn to switch off light, fan, TV, AC etc. when not in use.
- Substitute bulbs and tube lights with LEDs
- Use of solar energy base home appliances should be encouraged.

<b>Activity 10</b>							
You can ask your learner to prepare a comparative chart of fuel prices. Here is one example.							
<b>Year</b>	<b>2000</b>	<b>2002</b>	<b>2004</b>	<b>2006</b>	<b>2008</b>	<b>2010</b>	<b>2012</b>
<b>Rate of Petrol/ liter (in Rs.) Aprox.</b>	28.70	28.92	37.84	44.85	45.62	55.87	73.14
<b>Rate of Diesel/ liter (in Rs.) Aprox.</b>	16.55	18.06	26.28	31.25	32.86	37.75	40.91
You can ask many questions by using such charts like what changes they are observing in the rates of petrol and diesel? Or why the rate of increase is high for petrol than diesel? etc.							

**Some suggested activities:**

You can give them many other activities like:

- Ask them to draw various usages of diesel, petrol and LPG
- Ask them to prepare a comparative chart of consumption of fuels in India
- Ask them to collect information on other fuels like biofuels, biogas, CNG etc. and arrange a discussion on it.

**Check Your Progress**

**Note:** a) Space is given below to write your answer.

b) Compare your answer with the one given at the end of this Unit.

9) What are sanctuaries?

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10) How do we substitute the electricity consuming lights?

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**16.7 LEGAL PERSPECTIVES IN CONSERVATION AND INTERNATIONAL SCENARIO**

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In our country there have been several legislative measures both at state and central government to prevent and control further deterioration of environment. This practice has been even before independence, too. Before independence British govt. enforced various laws like:

The Oriental Gas Company Act, 1857; The North Canal & Drainage Act, 1873; Indian Fisheries Act, 1897; The Explosive Act, 1908; The Poison Act, 1919; The Indian Forest Act, 1927; The Motor Vehicle Act, 1938 and many more.

The real awareness about environmental protection at global level was recognized at the United Nations Conference on the Human Environment held at Stockholm (Sweden) in June, 1972. The main Acts for control of pollution are:

- The River Board Act, 1956
- The Atomic Energy Act, 1962
- The Wildlife (Protection) Act, 1972

- The Water (Prevention and Control of pollution) Act, 1974 and amended in 1988; also renamed as Boards for Prevention & Control of water pollution.

In 1980 “Tiwari Committee” was founded which took many decisions on Environment preservation. A separate environment department was established which was later further divided into two in 1985 – Department of Environment & Department of Forests & Wildlife.

Many other departments and acts were also passed:

- The Forest Conservation Act, 1980
- The Air (Prevention and Control of pollution) Act, 1981 and amended in 1987 to remove the difficulties encountered during its implementation
- **The Environment Protection Act, 1986** was enforced for protection and improvement of environmental matters related to it. According to this law people not abiding by this law can be penalized which can be in the form of imprisonment, fine or both.
- The Motor Vehicles Act, 1988
- The National Environment Tribunal Act, 1992
- The National Environmental Tribunal Act, 1995
- The National Environment Appellate Authority Act, 1997
- Ecology Development Board
- Forest Survey of India
- Indian Institute of Forest Management etc.

*(Source:- Annual Report 2005-06, Department of Forest & Environment, Govt. Of India)*

### Various Amendments in the Constitution

Our constitution underwent various amendments for environmental conservation.

- Constitution of Indian Republic: Article 48(A): “Protection and improvement of environment and safeguarding of forest and wildlife.
- Constitution of Indian Republic: Article 51A (g): It shall be duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures.

Many environments related legal cases have been tackled with the help of above mentioned articles and also Article 21 which ensures that every individual may be saved from any activity which injures his life, health and physique. There are various sections in our constitution which elaborates on the punishments and penalties for acts banned by law and other legal authorities.

### International Scenario

Not only nationally but also internationally the imbalanced environment is being faced. In 1940 thousands of people died of sudden smoke envelope in Los Angeles (America). In 1952, London Episode of SMOG occurred wherein about 5000 people died. We cannot forget the ‘Bhopal Gas Tragedy, in which lakhs of people were affected. All these incidents forced UNO to tackle these problems in unison. On 5<sup>th</sup> -16<sup>th</sup> June, 1972 more than 100 countries took part in the conference held at Stockholm (Sweden). Some of the declarations are-

- Man has started using the environment injudiciously to keep pace with scientific and technological advancement
- To improve and sustain the human environment has become an important topic all over the world.
- Man has tried to use natural resources, brutally. This has led to imbalance in nature, health problems and decrease in non-renewable resources.
- People of developing countries are living below the expected level. Therefore we must give priority to environmental improvement.
- Increasing population has given rise to many problems regarding environmental conservation therefore man must try to improve his environment with social, scientific and industrial growth.
- The time has come when we must bring positive environmental changes at world level.
- Each citizen, community and organizations have to come together and accept the responsibility to work for reaching environmental goals.

**The UN Conference at Rio on “Environment & Development** also known as **“Earth’s Summit”** was held on 3-14 June, 1992. Around 170 countries participated in it. The main concern areas discussed were-

- Decrease in forest areas
- Increasing Greenhouse effect
- Depletion of ozone layer
- Use of new technologies in air conditioners
- Increasing human population
- Decrease in fossil fuel
- Control of pollution
- Bio-diversity etc.

There are different agencies at international level which are working in the field of improving environmental conditions all over the world. Some of them are-

- FAO (Food & Agriculture Organization) – founded in 1945 in order to resolve food related problems in many underdeveloped countries.
- WHO (World Health Organization) – in 1946, which takes responsibility of health related work all over the world. For eg: in our country it has helped in family planning, polio, TB etc.
- IUCN (International Union for Conservation of Natural Resources) – 1948; ensures to prevent misuse of nature and its resources.
- WWF (World Wildlife Fund) – 1961; to preserve wild fauna. You must be aware of “Project Tiger” in our country was funded by WWF.
- Convention on International Trade in Endangered Species of Wild Fauna & Flora, 1972; helps in protecting endangered species.
- UNEP (United Nations Environmental Programme) – 1972; it guides, coordinates and finances various projects on environment and related fields

- IEEP (International Environmental Education Programme) – 1975; undertakes the responsibility of educating and sponsoring seminars and conferences on Environment.
- Earth Scan – founded in 1976 under the guidance of UNEP.

Administration does help the people but despite this we need laws to restrict and punish those who do not abide by the law. The legal help in environment was a necessity so as to give all a better surrounding, control pollution and stop further degradation of nature. United Nations Conference on Environment and Development (the “Earth Summit”, 1992) produced an agreement to protect the world’s biological diversity. The World Wildlife Fund, Green peace and other organizations also have been active in promoting conservation internationally.

**Activity 11**

Organize group discussion of following themes in your class:

- Constitutional Provisions in India for Wildlife Protection
- Various International Annual Environmental Summits and their declaration
- Efforts/measures taken by Indian Government for Environmental Protection in last one decade

**Check Your Progress**

**Note:** a) Space is given below to write your answer.  
 b) Compare your answer with the one given at the end of this Unit.

11) When are the following days celebrated?

- i) World Water Day .....
- ii) World Environment Day .....
- iii) Earth Day .....
- iv) World Ozone day .....

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## 16.8 LET US SUM UP

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After going through the whole content you must be clear that what importance natural resources have in our life. We have to preserve and conserve these resources to survive on this earth. The over exploitation has to be stopped and for the control of this various method have been elaborated. Various bio-geo-chemical cycles happening for ecosystem balance has also been taken up. Besides, legal outlook regarding the penalty for degradation is mentioned and various laws, acts given by constitution have been elucidated.

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## 16.9 UNIT END EXERCISES

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- What do you understand by physical resources?
- Give suggestion how you will make people aware about the negative effects of pollution?

- Describe oxygen cycle? What are the measures we should take to keep the balance of oxygen in atmosphere?
- What do you understand by management of natural resources?
- What is water harvesting?
- What are the various amendments made in constitution regarding environment?

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## 16.10 SUGGESTED READINGS

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- Saxena, A.B. (1986). *Environmental Education*, National Psychological Corporation, Agra.
- Science Textbook for Class VIII, NCERT Publication, N.Delhi.
- Science Textbook for Class IX, NCERT Publication, N.Delhi.
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- Sharma, P.D. (1993). *Environmental Biology and Toxicology*, Rastogi Publication, Meerut.

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## 16.11 ANSWERS TO CHECK YOUR PROGRESS

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- 1) (i) Air (ii) Water
- 2) (i) Heat (ii) water
- 3, 4, 5 and 6. Answer based on your understanding and organize the activities.
- 7) Plants use carbon dioxide with sunlight and chlorophyll to prepare food by the process of photosynthesis.
- 8) This is done by two processes. (i) Nitrogen fixation by bacteria harbored in legume plants and (ii) Physical processes like lightning and heat in atmosphere.
- 9) They are the places where animals are kept in natural environment following strict laws and regulation so that they are not harmed.
- 10) By substituting them with LED or CFL lights.
- 11) (i) 22 March (ii) 5 June (iii) 22 April (iv) 16 September.