

# INCREASING ACCESS TO SECONDARY SCHOOL LEVEL EDUCATION THROUGH THE PRODUCTION OF QUALITY LEARNING MATERIALS

---

## JUNIOR SECONDARY LEVEL

# BIOLOGY

## Module 8: Organisms and the Environment

---

### Partners:

Ministry of Education and Botswana College of Distance and Open Learning (BOCODOL), Botswana  
Ministry of Education, Science and Technology and the Malawi College of Distance Education (MCDE), Malawi  
Ministry of Education, Mozambique  
Ministry of Basic Education, Sport and Culture, and the Namibian College of Open Learning (NAMCOL), Namibia  
Ministry of Education and the Emlalatini Development Centre, Swaziland  
Ministry of Education and Culture and the Institute of Adult Education, Tanzania  
Ministry of Education, Zambia  
Ministry of Education, Sport and Culture, Zimbabwe  
Commonwealth of Learning



COMMONWEALTH *of* LEARNING

## Partners:

Commonwealth of Learning

Ministry of Education and Botswana College of Distance and Open Learning (BOCODOL), Botswana

Ministry of Education, Science and Technology and the Malawi College of Distance Education (MCDE), Malawi

Ministry of Education, Mozambique

Ministry of Basic Education, Sport & Culture, and the Namibian College of Open Learning (NAMCOL), Namibia

Ministry of Education and the Emlalatini Development Centre, Swaziland

Ministry of Education and Culture and the Institute of Adult Education, Tanzania

Ministry of Education, Zambia

Ministry of Education, Sport and Culture, Zimbabwe

Mauritius College of the Air, Mauritius

## COMMONWEALTH *of* LEARNING

Suite 600 - 1285 West Broadway, Vancouver, BC V6H 3X8 CANADA

PH: +1-604-775-8200 | FAX: +1-604-775-8210 | WEB: [www.col.org](http://www.col.org) | E-MAIL: [info@col.org](mailto:info@col.org)

COL is an intergovernmental organisation created by Commonwealth Heads of Government to encourage the development and sharing of open learning and distance education knowledge, resources and technologies.

© Commonwealth of Learning, January 2004

ISBN 1-895369-89-4

These materials have been published jointly by the Commonwealth of Learning and the partner Ministries and institutions.

All rights are reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form, or by any means, electronic or mechanical, including photocopying, revising or otherwise, without the written permission of the Commonwealth of Learning on behalf of the publishers.

The views expressed in this document do not necessarily reflect the opinions or policies of the publishers.

The authors and the Commonwealth of Learning have made all efforts to ensure that clearance has been obtained to include any third-party copyrighted material. Any omissions should be brought to the attention of the Commonwealth of Learning.

## CONTRIBUTORS TO PROJECT - BIOLOGY

### Course Writers

Mrs. S. Tirbhowan

V. Kurrumchand

### Course Reviewer

S. Tirbhowan

### Course Co-ordinator

R. Dhurbarrylall

### Instructional Systems Designer

R. Dhurbarrylall

### Editor

C. Sooben

### Text Entry

Mrs. S. Deenanath

Mrs. P. Hurgobin

Mrs. S. Chengalanee

### Graphic Artist

F. Bredel

### Lay-out and Formatting

Mrs. M. A. Frivole

### Biology student

Miss. N. Narain

### Science Course Materials Management

Mauritius College of the Air

## REVIEW TEAM

Botswana College of Distance and Open Learning

Lawrence Tshipana

Malawi College of Distance Education

Chris F. Layamaman

Namibian College of Open Learning

Joseph Amon

Institute of Adult Education, Tanzania

Andrew Dominick Swai

Emlaladini Development Centre, Swaziland

Simon Sipho Maseko

NDOLA Institute for Skills Training, Zambia

Christopher Chiluband

Ministry of Education, Sport and Culture, Zimbabwe

Luwis Hlombe

## PILOTING TUTORS

Botswana College of Distance and Open Learning

Thandie Keetsaletse

Namibian College of Open Learning

Jona Mushelenga

Sifundzain High School, Swaziland

Saide Richards

Kibasila Secondary School, Tanzania (Ministry of Education)

John Anania

Nilrumah Teacher's College, Zambia

F. Mubanga

NDOLA Institute for Skills Training, Zambia

Christopher Chiluband

Ministry of Education, Sport and Culture, Zimbabwe

Luwis Hlombe



# **JUNIOR SECONDARY LEVEL SCIENCE - BIOLOGY**

## **MODULE 1 – Introduction to Biology and the Classification of Living Things**

Unit 1 The Science of Life

Unit 2 Biological Skills

## **MODULE 2 – The Living Cell**

Unit 1 Cell Structure and Organisation

Unit 2 Levels of Organisation

Unit 3 Compounds of Life

## **MODULE 3 – Energy and Life**

Unit 1 The Need for Energy

Unit 2 Respiration

## **MODULE 4 – Nutrition and Digestion**

Unit 1 Nutrition in Living Organisms

Unit 2 Human Digestive System

## **MODULE 5 – Transport**

Unit 1 Transport in Plants

Unit 2 Transport in Humans

## **MODULE 6 – Support, Movement and Control**

Unit 1 Support and Movement

Unit 2 Hormonal and Nervous Control

Unit 3 Control and Regulation

## **MODULE 7 – Continuity of Life**

Unit 1 Reproduction



## **MODULE 8 – Organisms and the Environment**

Unit 1 Ecological Principles

Unit 2 Population Growth and Regulation

Unit 3 Human Influence on the Environment



# MODULE 8

## ORGANISMS AND THE ENVIRONMENT

### MODULE INTRODUCTION

This Module deals with the relationships of organisms with one another and with the environment. It considers levels of ecological organisations, defines ecological concepts and explains energy flow through ecosystems' recycling of nutrients. It describes population growth and regulation. It also discusses and describes the effects of human activities on the environment and emphasises the importance of conservation.

### MODULE OBJECTIVES

At the end of this Module you should be able to:

- explain ecological terms
  - explain the structure and content of ecosystems
  - describe the carbon, nitrogen and water cycles
  - describe the non-cyclical nature of energy flow
  - explain variation in pollution size and its consequences
  - describe the pattern of population growth
  - explain the consequences of harmful effects of human activities
  - state the need for conservation of natural resources.
-





# UNIT 1

---

## ECOLOGICAL PRINCIPLES

---

### TABLE OF CONTENTS

MODULE INTRODUCTION .....	1
MODULE OBJECTIVES .....	1
INTRODUCTION.....	5
OBJECTIVES.....	5
1.0 ECOLOGY.....	6
1.1 RELATIONSHIPS .....	7
1.1.1 FEEDING RELATIONSHIPS .....	7
1.1.2 THE FOOD CHAIN.....	9
1.1.3 TROPHIC LEVEL .....	10
1.1.4 FOOD WEB .....	11
1.2 THE STRUCTURE OF AN ECOSYSTEM .....	11
1.2.1 CONSUMERS - TYPES.....	13
1.2.2 DECOMPOSERS.....	13
1.3 THE SUN AS THE MAIN SOURCE OF ENERGY .....	15
1.4 ENERGY FLOW IN THE ECOSYSTEM .....	17
1.5 ADVANTAGES OF A SHORT FOOD CHAIN .....	18
1.6 THE HUMAN FOOD PRODUCTION AND FOOD CHAINS.....	19
1.7 NATURAL CYCLES .....	22
1.7.1 THE WATER CYCLE .....	22
1.7.2 THE CARBON CYCLE .....	23
1.7.3 THE NITROGEN CYCLE .....	24
1.8 THE EFFECT OF MAIN COMBUSTION OF ORGANIC FUELS .....	26
1.9 THE CUTTING DOWN OF FORESTS.....	27
POINTS TO REMEMBER.....	30



# UNIT 1

---

## ECOLOGICAL PRINCIPLES

---

### INTRODUCTION

Our environment consists of living and non-living things. The living things depend on their surroundings for their needs and they are affected by the conditions in their environment. Any plant or animal, wherever it lives, is influenced by other plants and animals around it. It is also affected by non-living features like light, temperature, rainfall or a source of energy.

In Ecology we study how living things and non-living things depend on each other. We explore how organisms are adapted to their way of life and explain the effects of human activities on the environment. This Unit will look at these different influences and relationships.

### OBJECTIVES

At the end of this Unit you should be able to:

- define ecological terms
- explain the structure and content of an ecosystem
- state that the sun is the main source of energy input to biological systems
- describe energy losses between trophic levels and the advantages of short food chains
- describe the carbon, nitrogen and water cycles
- explain the effects of combustion of fossil fuels and deforestation.

## 1.0 ECOLOGY

This is the study of the relationships of organisms with one another and with their environment. Some other terms important in the study of ecology are:

### Habitat

It is the natural home of an organism. It is that part of the environment in which the organism lives and reproduces.

A pond, a river, the sea, forests, woods, the soil are all examples of habitats.

### Population

This is a group of like plants or animals which live and reproduce in a particular place.

### Community

A community consists of many populations which live together in a particular place. These organisms usually affect each other. For example, the plants and animals of a pond could be regarded as forming one community. Similarly the organisms living at the top of a mountain form another community.

In a tropical rain forest, squirrels, chimpanzees and tree frogs form a community on the trees. Populations of ants, jaguars, fungi, mosses and gorillas form another community on the forest floor.

### Ecosystem

When different communities interact with one another and their physical environment, they form an ecosystem. This is a self-supporting Unit of the environment. It has a constant source of energy from outside and consists of food producers, food consumers and decomposers.

Deserts, seashores, mountains, rivers, ponds, oceans, grasslands and rainforests are all examples of ecosystems. The earth itself is a huge ecosystem.

## 1.1 RELATIONSHIPS

Within this vast ecosystem there's bound to be numerous relationships. Think of yourself as an example within your environment because you establish relationships with your neighbours. Some relationships are beneficial, while others may not be so. Likewise, every living organism in an ecosystem has some kind of relationship, one of them being a food relationship. Through some more definitions, let's look at some of the feeding relationships.

### 1.1.1 FEEDING RELATIONSHIPS

Every living organism interacts with other organisms by feeding on them, competing with them for food, shelter, water, light, air and minerals or by providing them with food.

#### Producers

Green plants make their own food by the process of photosynthesis. They are called the producers.

#### Consumers

Animals obtain their energy and nutrients by feeding on plants or other animals. Thus they are the consumers.

#### Herbivores

Herbivores are animals that eat plants only.

## Carnivores

Carnivores are flesh eaters and feed on other animals.

## Omnivores

Some animals have a mixed diet of plant and animal food. They are called omnivores.

## Decomposers

Decomposers are organisms like bacteria and fungi that obtain food from dead organisms.

Nearly all energy released on earth is obtained from the sun. The sun is the main source of energy for all forms of life on earth. The energy from the sun is passed along a chain called a food chain.



***Before proceeding further, complete the following activity.***

### ACTIVITY 1

1. *Define the following terms and give an example in each case.*

(a) *Habitat*

.....

.....

.....

.....

(b) *Population*

.....

.....

.....

.....

(c) *Community*

.....

.....

.....

.....

(d) *Ecosystem*

.....

.....

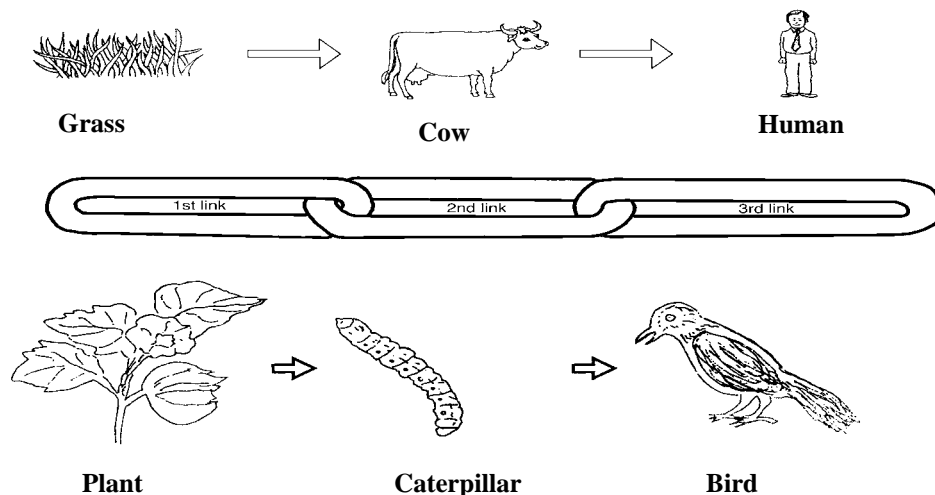
.....

.....

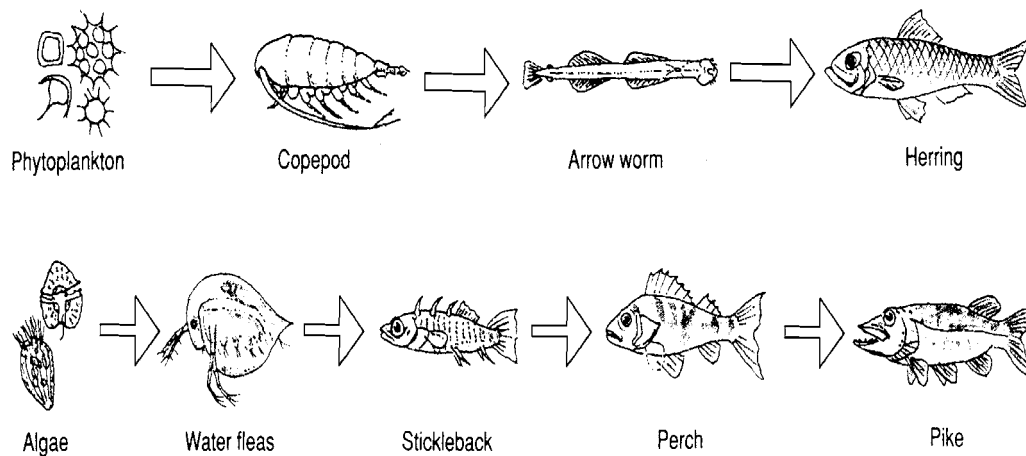
**You will find the answer at the end of the Module.**

### 1.1.2 THE FOOD CHAIN

A food chain shows the transfer of energy and materials from organism to organism along a feeding pathway. Within an ecosystem, one organism eats another and is in turn eaten. Figures 1 and 2 illustrate a food chain on land and in water respectively.



**Fig. 1 Food Chain on Land**



**Fig. 2 Food Chain in Water**

All food chains start with a green plant. Another example is:



The arrow always points away from the source of food. It indicates the direction of energy flow. The green leaves use light to produce their food. The leaves are eaten by caterpillars. These caterpillars are then eaten by birds.

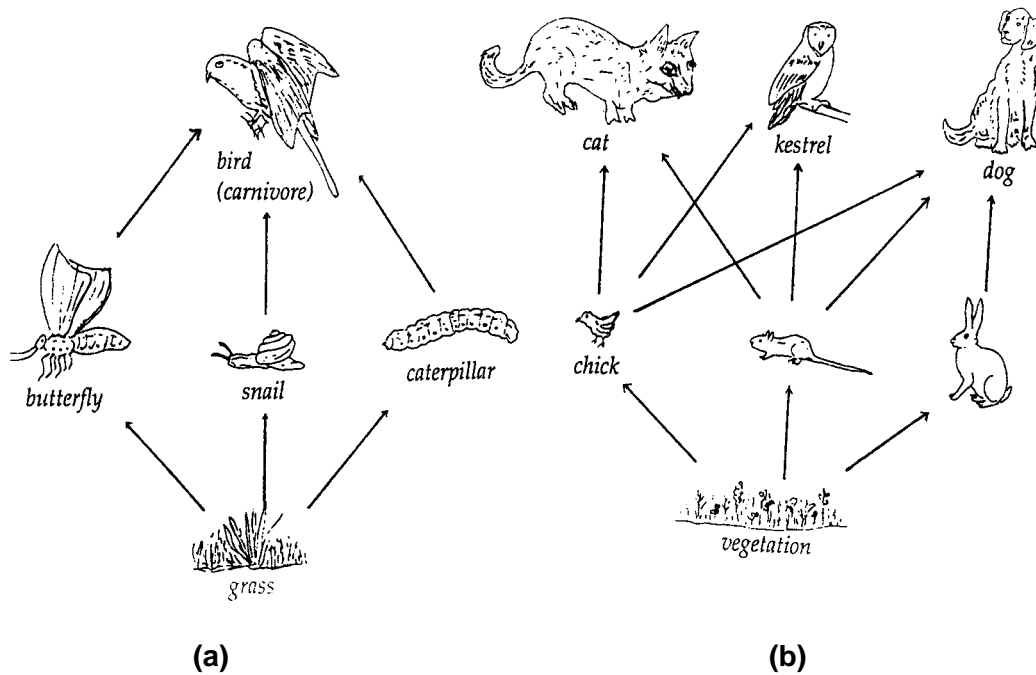
### 1.1.3 TROPHIC LEVEL

Each stage along the food chain is called a trophic or feeding level. In the above example the green leaf is at a first trophic level, the caterpillar is at a second trophic level while the bird is at a third trophic level. The green leaf is thus the producer while the caterpillar is the primary consumer. The bird is the secondary consumer.



### 1.1.4 FOOD WEB

Many animals eat more than one type of food. Likewise, each animal or plant can be eaten by different animals. This results in food chains which are connected to make a food web. Figures 3 (a) and (b) are examples of food webs.

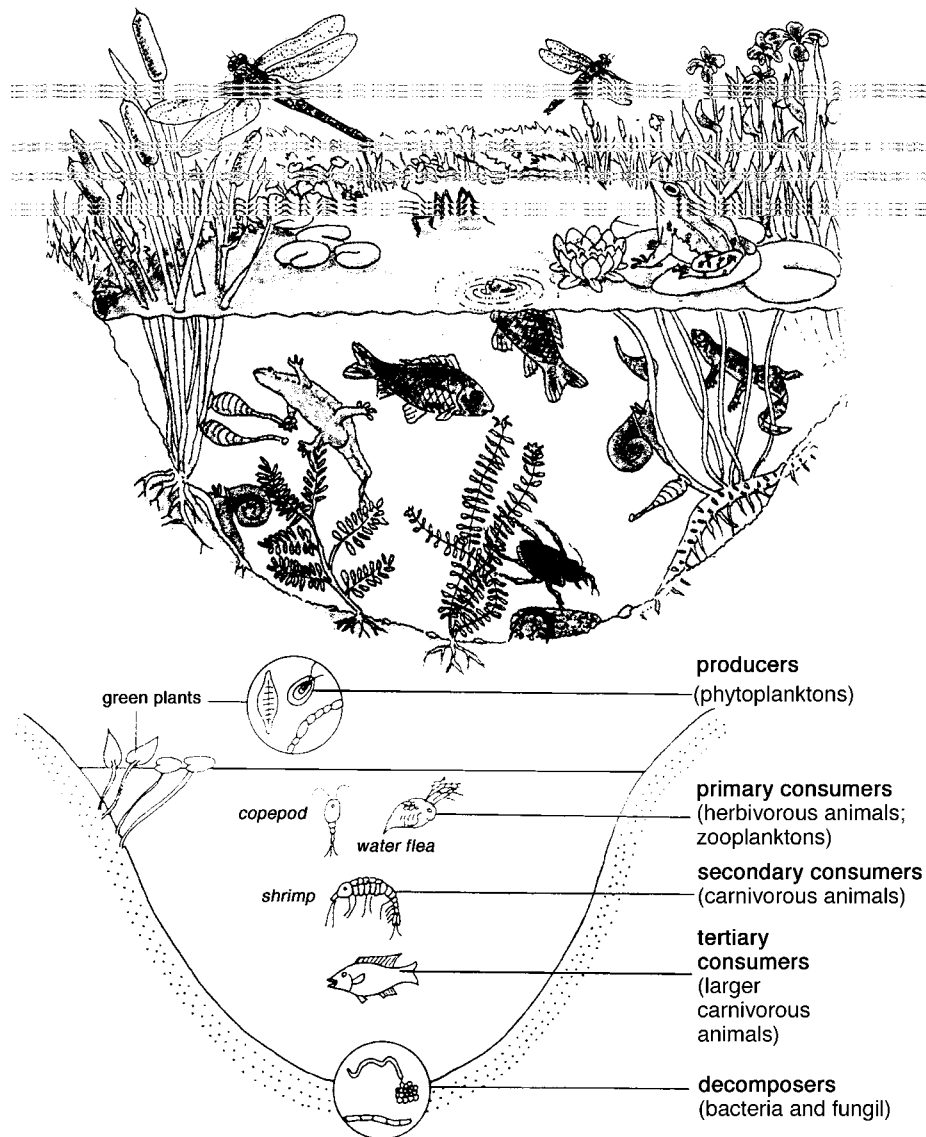


**Fig. 3 Food Webs**

## 1.2 THE STRUCTURE OF AN ECOSYSTEM

Although ecosystems may appear to be very different, their structures are based upon feeding and energy transfer. This has a common pattern. Each ecosystem has a particular set of environmental factors to which the animals and plants adapt for their survival.

Let us consider a fresh-water pond to illustrate the structure of an ecosystem.



**Fig. 4 The structure of a freshwater pond ecosystem**

This ecosystem consists of the following:

- (1) Non-living parts which include water and gases dissolved in that water. These are mostly oxygen and carbon dioxide. There are also inorganic salts like nitrates, chlorides, phosphates and many organic compounds.

- (2) Living organisms which are found at different trophic levels in this ecosystem. They are:
- (i) large green plants like water lilies which grow along the shore or float in the shallow water of the pond.
  - (ii) microscopic floating plants like algae and diatoms which are found near the water surface.

These plants are the producers. They provide food and energy to consumers at different trophic levels. Let's now turn to the types of consumers.

### **1.2.1 CONSUMERS - TYPES**

#### **Primary Consumers**

The primary consumers are animals like pond snails, insect larvae, copepods and water fleas which feed on the producers.

#### **Secondary Consumers**

The secondary consumers are carnivorous animals in the pond. These are shrimps, small fish and water beetles. They feed on the primary consumers.

#### **Tertiary Consumers**

There may also be tertiary consumers like large carnivorous fish which feed on the secondary consumers.

### **1.2.2 DECOMPOSERS**

Another group of organisms found in the pond is the decomposers. These are mostly bacteria and fungi. They break down the waste products and dead bodies of plants and animals, into simpler compounds. These can be re-used by the

green plants to make food. Thus nutrients are used continually in a cyclic form in the pond ecosystem.

 ***Before proceeding further, complete the following activity.***

### ACTIVITY 2

1. (a) *What is a food chain?*

.....  
.....

(b) *Construct a food chain from the following: Hawks, rabbits, grass, snakes*

.....

(c) *What is meant by a food web?*

.....  
.....

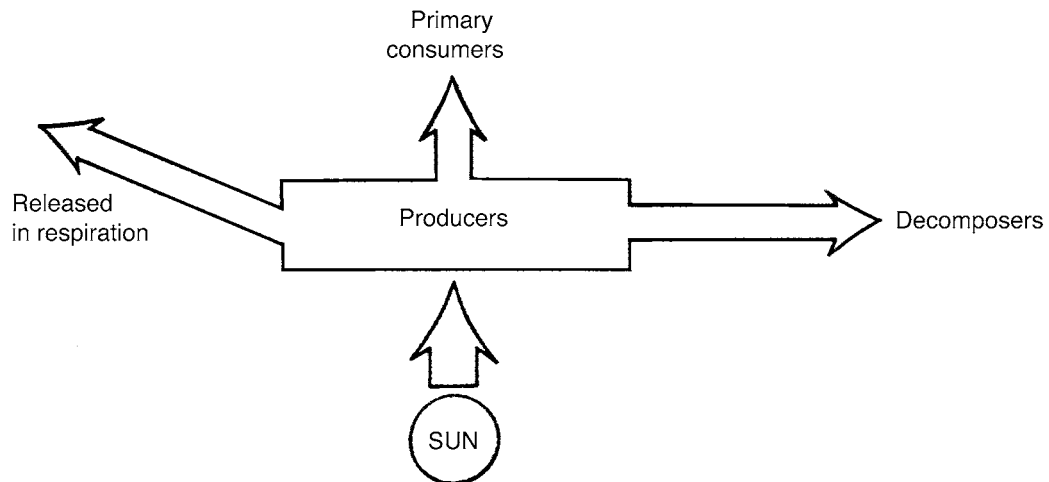
(d) *Give an example of a food web.*

.....  
.....

***You will find the answer at the end of the Module.***

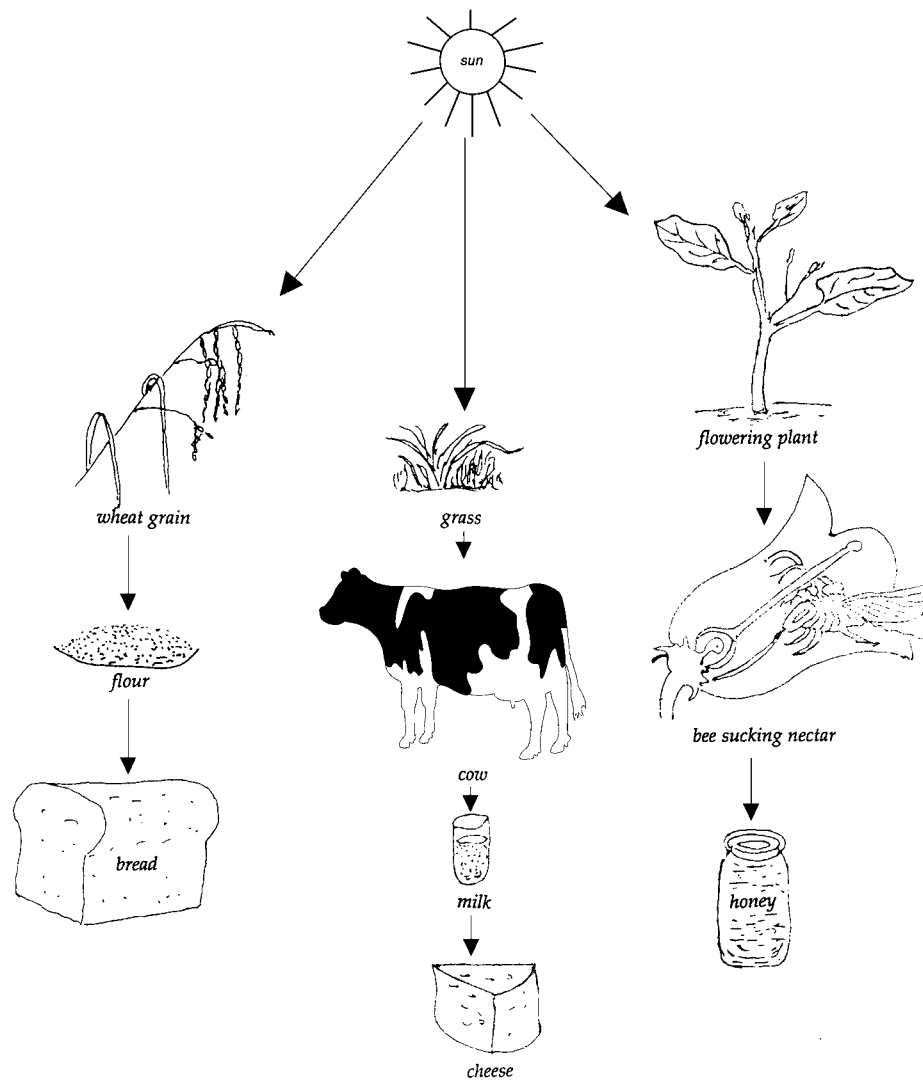
## 1.3 THE SUN AS THE MAIN SOURCE OF ENERGY

Sunlight is the ultimate source of energy used by all living organisms. That is, the energy in all ecosystems has its origin in sunlight. Green plants use energy from the sun to make their own food by photosynthesis. The plant uses some of this energy for its own metabolic activities. The remainder is passed on to primary consumers. This can also be carried to higher trophic levels. Some of the energy is lost as heat to the surrounding. Decomposers obtain energy from this plant when it dies and decays. This is illustrated in Figure 5.



***Fig. 5 Energy flow through a green plant***

Since all animals depend on plants, directly or indirectly for their food, they therefore obtain energy from sunlight. A few examples of our own dependence on photosynthesis can be traced as follows:

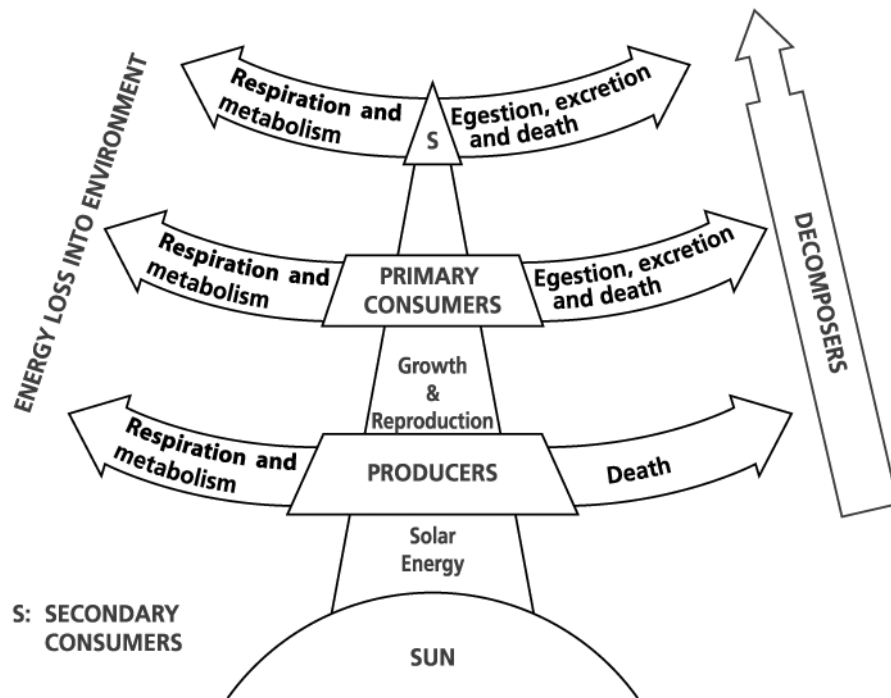


**Fig. 6 Energy flow in food chains**

Even coal and other fossil fuels like petroleum, oil, and natural gas come from tree-like plants which were buried in the earth, millions of years ago. These plants absorbed sunlight for their photosynthesis when they were alive. Nowadays these same fossil fuels are being mined and used as energy sources for various purposes.

## 1.4 ENERGY FLOW IN THE ECOSYSTEM

This is easily illustrated by the Figure below



**Fig. 7 Energy Flow in the Ecosystem**

Green plants convert light energy into chemical energy through the process of photosynthesis. Some of this is stored as organic food in plants, the producers. A good amount of the energy is lost through respiration and other metabolic activities of the plant.

A food chain shows how energy, in the form of food is passed on from one organism to another. When an herbivore feeds on the plant, some of it will be digested and absorbed into the body of the animal. Some of the plant material remains undigested and it passes out as faeces. The food which is absorbed by the herbivore will be converted to heat energy and lost to the surroundings. The remaining will be changed into other forms of energy and used by the herbivore for its metabolic activities and growth. Similarly when this herbivore will be eaten by a carnivore even less energy will be available to the carnivore or the secondary consumer.

We can see that a good amount of energy is lost at every trophic level in a food chain or food web. The amount of energy which reaches the end of a food chain or a food web is only a small fraction of the amount of energy which is absorbed by the green plant (producer) at the beginning. This clearly indicates that the amount of energy along a food chain or food web decreases.

The energy flow in an ecosystem is a one way process. Energy lost to the surroundings cannot be recycled. There is a great loss of energy from the ecosystem as it flows between trophic levels, therefore a continuous supply of energy from the sun is essential to maintain the activities of organisms in an ecosystem.

## **1.5 ADVANTAGES OF A SHORT FOOD CHAIN**

Every plant and animal in a food chain is called a link or trophic level. At every link in a food chain, energy is lost to the surroundings. Usually the number of organisms also decreases along a food chain. This is because the amount of energy transferred decreases along the food chain. Let us consider the following food chain:

Lettuce plant       $\longrightarrow$       caterpillars       $\longrightarrow$       bird



In order to get enough energy a bird has to eat many caterpillars. These in turn must eat many more leaves. Therefore the longer the food chain the smaller the amount of stored energy. This is because energy is lost to the surroundings at every trophic level along the food chain.

When an animal feeds on a plant, it obtains only a small portion of the energy stored in the plant. Much of this energy is used for respiration and maintenance of the plant. Therefore the shorter the food chain, the greater the available food energy.

## **1.6 THE HUMAN FOOD PRODUCTION AND FOOD CHAINS**

Here you will learn about the efficiency of energy transfer from plant products to first order or primary consumers. Consider the following example: A cow is a primary consumer and it feeds on grass which is the producer. More than 60% of the grass eaten by the cow passes out as faeces. About 30% of it is used by the cow's metabolic processes. This means that less than 10% of the grass eaten by the cow is turned into new animal tissue which contributes to the growth of the cow. A carnivore feeding on this cow will thus obtain much less than the 10% which was converted to new animal tissue.

In the same way, the use of plant products to feed animals which provide meat, eggs and dairy products is very wasteful. This is because less than 10% of the plant material is turned into animal products. For example, it is more economical for humans to eat bread made from wheat than to feed the wheat to hens and



 **Before proceeding further, complete the following activity.**

### ACTIVITY 3

1. (a) *At which trophic level are you feeding when you eat*  
*(i) bread, (ii) eggs (iii) an apple (iv) chicken meat*

.....

.....

.....

.....

- (b) *Name the ultimate source of energy for all organisms in a food web.*

.....

.....

.....

.....

- (c) *Why is the flow of energy not cyclic, in an ecosystem?*

.....

.....

.....

.....

- (d) *Which of the following food chains can supply more energy for man:*

(a) Sun → grass → goat →  
man

(b) Sun → rice → man

.....

.....

.....

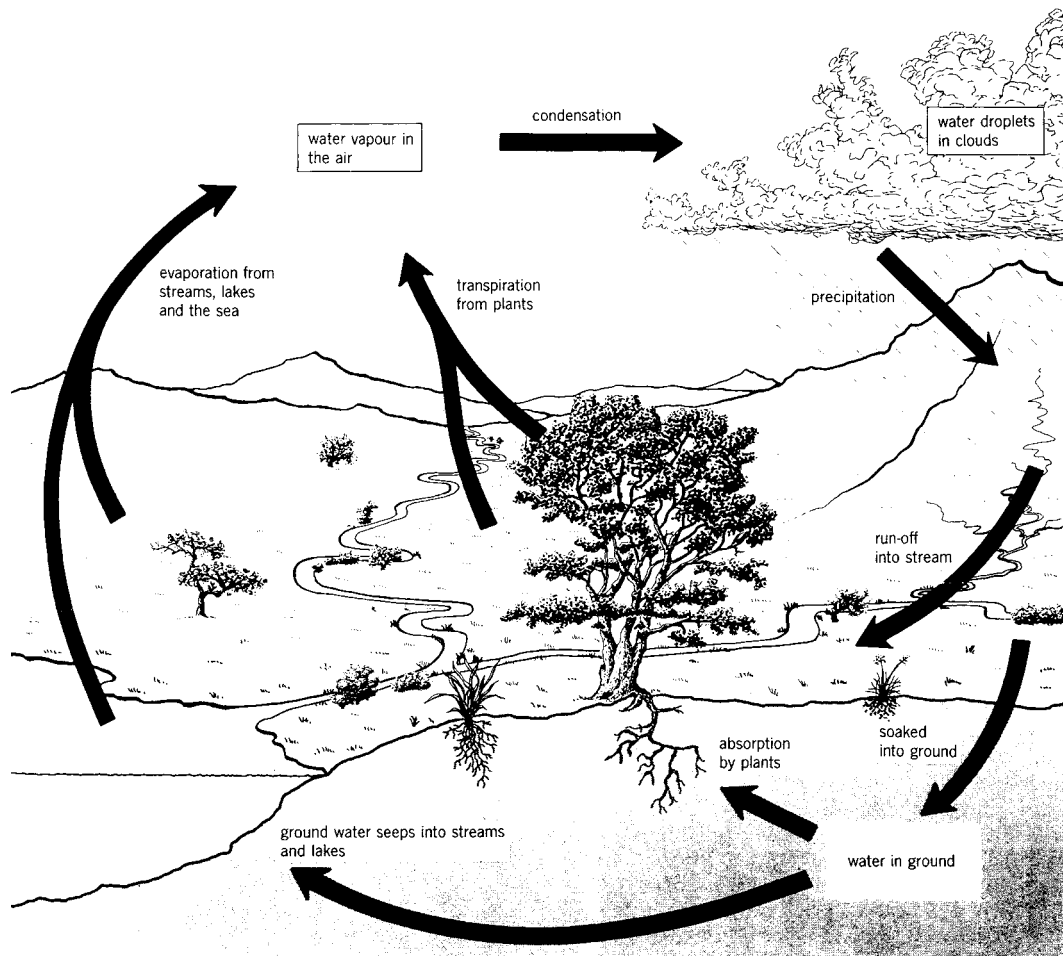
**You will find the answer at the end of the Module.**

## 1.7 NATURAL CYCLES

In all ecosystems, materials are cycled between the environment and the organisms. You will now learn about the water cycle, carbon cycle and nitrogen cycle.

### 1.7.1 THE WATER CYCLE

Where does all the rain come from? Why does the atmosphere never run out of water? The figure below helps you to understand the answer to these questions.

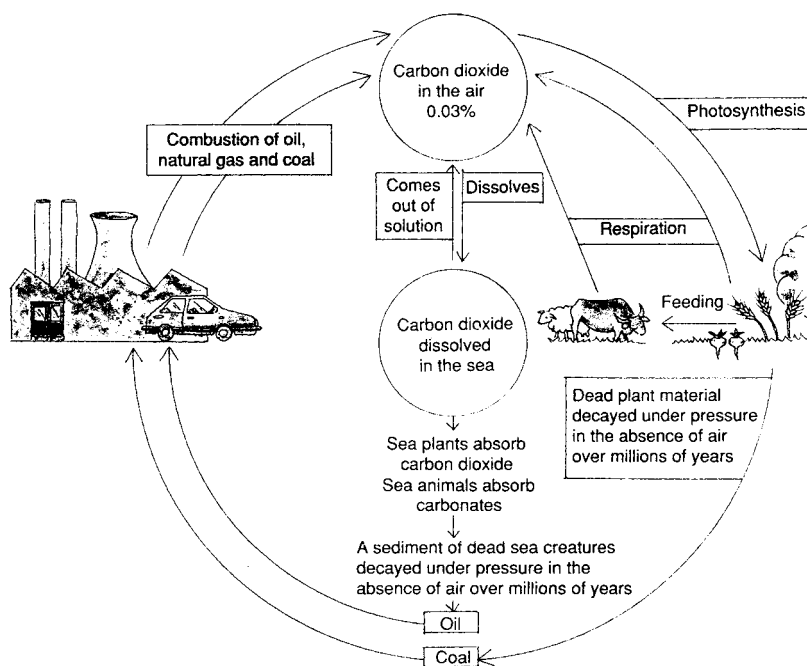


**Fig. 8 The Water Cycle**

The water from lakes, rivers, seas, and oceans evaporates into the atmosphere. Plants also give out water vapour by the process of transpiration. The water vapour rises to the cooler part of the atmosphere. There it condenses to form clouds of tiny droplets. When these clouds rise over high ground, they fall as rain. This rain water collects in ponds, streams, rivers, and lakes. Some of it passes through the soil to form underground water. Some is taken up by roots of plants. The water ultimately reaches the seas and oceans. This chain of events occurs continuously to form the water cycle.

### 1.7.2 THE CARBON CYCLE

All living organisms contain the element carbon. This is found in carbohydrates, fats, proteins which occur in the body of the living organisms. The air around us contains a small amount (0.03%) of carbon dioxide. The carbon, in the form of carbon dioxide circulates from the environment into the bodies of living organisms and then back to the environment. This forms the carbon cycle as shown in Figure 9.



**Fig.9 The Carbon Cycle**

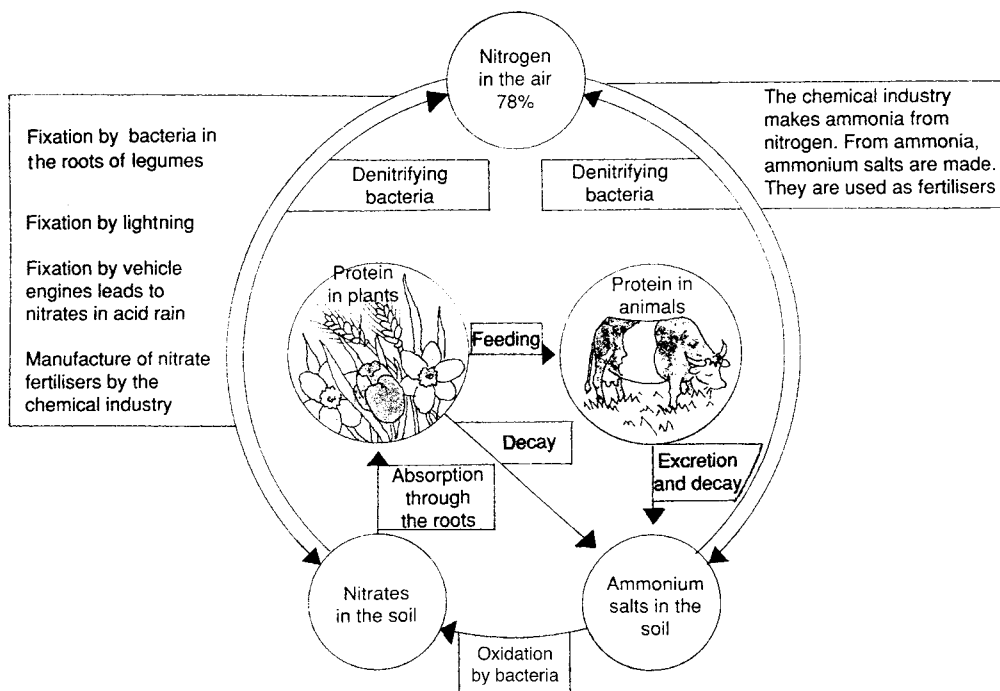
The plants take in carbon dioxide from the air to make their food by photosynthesis. Animals then obtain carbon by eating plants or other animals. However, the amount of carbon dioxide in the air remains more or less constant. This is because it is returned to the atmosphere as fast as it is taken in.

All living organisms release carbon dioxide when they respire. Decomposers like bacteria and fungi give out carbon dioxide when they decompose the bodies of dead plants and animals. When fossil fuels like petrol, natural gas, coal or organic fuels such as wood, alcohol burn, they produce huge amounts of carbon dioxide.

It must be noted that an increasing combustion of organic fuels by humans is disturbing the natural balance of carbon dioxide and oxygen in the atmosphere. This has resulted in the greenhouse effect or global warming.

### **1.7.3 THE NITROGEN CYCLE**

Nitrogen is an essential element in proteins. All living organisms need nitrogen to make proteins. Air consists of about 78% nitrogen gas. But neither plants nor animals can take it in from the air. First, it has to be changed into nitrates. Some processes remove nitrogen from the air while others return it to the atmosphere. The balance of processes which return nitrogen into the air and processes which remove nitrogen from the air are called the nitrogen cycle.



**Fig. 10 The Nitrogen Cycle**

Some plants like clover, peas and beans have root nodules which contain nitrogen-fixing bacteria. Some of those bacteria also live freely in the soil. These bacteria change gaseous nitrogen into nitrogen compounds like nitrates. The nitrates are easily absorbed through the roots and used for making plant proteins.

Animals obtain the proteins they need by eating plants or eating the flesh of other animals which feed on plants. In this way, nitrogen passes along food chains. In the excretory wastes of animals and the decayed products of animals and plants, ammonium salts are present. Nitrifying bacteria in the soil convert these ammonium salts into nitrates. These nitrates are thus absorbed by the roots of plants. Sometimes farmers and gardeners add nitrates and ammonium salts as fertilisers to the soil to make it more fertile.

Nitrogen is also converted into nitrate by lightning. Lightning combines nitrogen and oxygen in the air to form oxides of nitrogen. These oxides dissolve in rain

water which falls to the ground. They then combine with other substances to form nitrates.

Some soil nitrates are changed back into nitrogen gas into the atmosphere by denitrifying. This is brought about by the action of denitrifying bacteria which are mostly found in waterlogged soil where there is low oxygen content.

## 1.8 THE EFFECT OF MAIN COMBUSTION OF ORGANIC FUELS

The burning of organic fuels like coal, oil, natural gas by humans is disturbing the natural balance of carbon dioxide and oxygen in the atmosphere. Besides carbon, coal also contains sulphur. When coal is burned, oxides of sulphur are also released together with carbon dioxide. The coal smoke has many tiny particles with varying amounts of carbon particles and hydrocarbon causing much harm. The sulphur dioxide released by combustion of organic fuels dissolves in the rain water to form acid rain. This

- (1) increases acidity of the soil
- (2) reduces crop yields
- (3) has adverse effects on organisms
- (4) corrodes metal bridges and increases the decay of stone buildings.

Sulphur dioxide also irritates our respiratory system and conjunctiva of the eye.

You must also note that incomplete burning of fuels also produces another poisonous gas called carbon monoxide. This reduces the oxygen-carrying capacity of blood and leads to dizziness and headache.

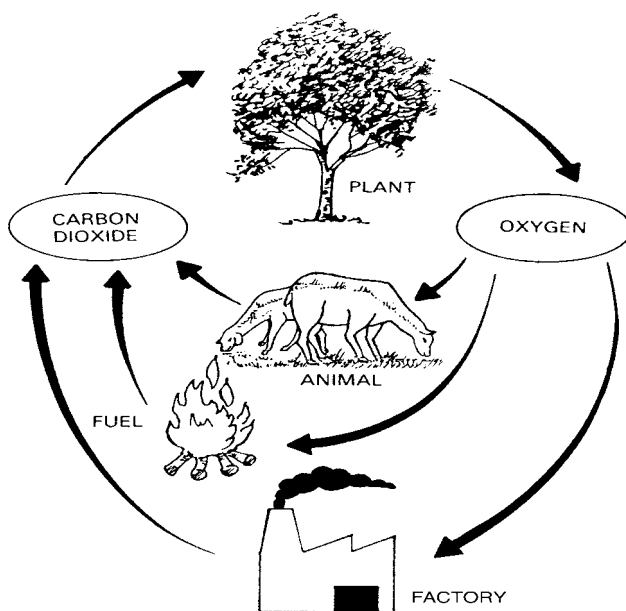
Combustion of these organic fuels has also increased the carbon dioxide concentration in air. This causes the 'greenhouse' effect because the carbon dioxide accumulated in the atmosphere retains heat. This leads to an increase in



average global temperature. Such a change may also affect global weather. This in turn affects the global food production.


## 1.9 THE CUTTING DOWN OF FORESTS

This has been a major cause of global warming. The green plants regulate the concentration of carbon dioxide and oxygen in the atmosphere. This is done by the process of photosynthesis which removes carbon dioxide from the atmosphere and releases oxygen to it.



**Fig. 11 Balance of  $\text{CO}_2/\text{O}_2$**

Recently, deforestation in many parts of the world has reduced the number of trees on planet earth. Thus less carbon dioxide is removed from the atmosphere by photosynthesis. This has promoted the global warming of our planet. The undesirable effects of global warming include sudden climatic changes and a rise in sea levels. Can you think of ways in which this problem can be minimized? Doing something about it is a must for our survival.

 *Before proceeding further, complete the following activity.*

### ACTIVITY 4

1. (a) *Draw a simple diagram to show a:*

(i) *water cycle*

(ii) *Carbon cycle*

(b) (i) *Name two processes which add carbon dioxide to the atmosphere.*

.....  
.....

(ii) Explain what is meant by 'green house effect'?

.....

.....

.....

(iii) Why is the cutting down of forests undesirable?

.....

.....

.....

(c) (i) Why do living things need nitrogen?

.....

.....

.....

(ii) How do plants obtain nitrogen?

.....

.....

.....

(iii) How do animals obtain nitrogen?

.....

.....

.....

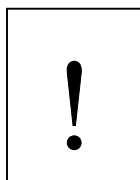
(iv) How are nitrates in the soil changed back into nitrogen gas?

.....

.....

.....

**You will find the answer at the end of the Module.**



## POINTS TO REMEMBER

- Our environment consists of living and non-living things.
- Ecology is the study of organisms and their relations with one another in the environment.
- An ecosystem is a self-supporting Unit of the environment. It consists of producers, consumers and decomposers.
- A food chain shows feeding relationship in an ecosystem.
- Each stage along the food chain is called a trophic or feeding level.
- Food webs are formed when many food chains are interconnected.
- Nutrients are used continuously in a cyclic form in an ecosystem.
- The sun is the ultimate source of energy for all living organisms.
- Plants are called producers because they use the sun's energy to make food for themselves and other organisms.
- Animals are called consumers because they feed on plants.
- Energy is lost at each trophic level along a food chain. The flow of energy in an ecosystem is non-cyclic.
- Shorter food chains supply energy more efficiently.
- Materials are cycled between the organisms and the environment. These are easily shown by the water cycle, carbon cycle, and nitrogen cycle.
- The combustion of organic fuels increases carbon dioxide concentration in the atmosphere, leading to the 'green house' effect.
- Deforestation in many parts of the world has resulted in global warming.

## UNIT 2

---

# POPULATION GROWTH AND REGULATION

---

### TABLE OF CONTENTS

OBJECTIVES.....	33
2.0 POPULATION SIZE .....	34
2.1 CONTROL OF POPULATION SIZE.....	36
2.2 POPULATION GROWTH.....	38
2.3 GROWTH OF YEAST POPULATION .....	39
2.4 HUMAN POPULATION GROWTH.....	41
POINTS TO REMEMBER .....	44



## UNIT 2

---

# POPULATION GROWTH AND REGULATION

---

Any one habitat may have a large number of different organisms living in it. A population is a group of individuals of the same species living in a particular habitat. Here are some examples of populations:

- barnacles on a rocky shore
- bacteria growing on a food medium
- weeds on the surface of a pond
- a shoal of fish in the sea
- all human beings in a given region or country

Populations tend to change in size over a period of time. A number of environmental factors may limit the growth or increase a given population of organisms. In this Unit, we look at how the size of a population is influenced.

## OBJECTIVES

At the end of this Unit you should be able to:

- explain how a population size changes due to death, birth, immigration, emigration
- describe how changes in food supply, predation, diseases and competition affect the population size of organisms.
- identify the three phases of the sigmoid curve of population growth.
- describe the increase in human population and the social implications of current human population growth.

## 2.0 POPULATION SIZE

Most populations stay roughly the same over a period of time. They may go up and down, but the average population stays the same over a number of years. For example, the population of greenfly in your garden might be greater one year than the next. But their number returns to normal again. Over many years, the size of most populations tends to remain at around the same level.

You must note that the size of a population depends on:

Emigration - how many individuals leave a population

Immigration - how many individuals enter a population.

### Emigration


Individuals leave a population when they die or when they migrate (move) to another population. This movement of individuals out of a population is also called emigration.

### Immigration

Individuals enter a population when they are born, or when they migrate into the population from elsewhere. This movement of individuals into a population is known as immigration.

A population increases if new individuals are born faster and the old ones live longer. That is, the birth rate is greater than the death rate. If the birth rate is less than the death rate, then the population will decrease. Can you think what will happen if the birth rate and death rate are equal?



 *Before proceeding further, complete the following activity.*

**ACTIVITY 1**

1. *What is meant by population? Give three examples.*

.....

.....

.....

2. *Name two important factors that determine the size of a population.*

.....

.....

3. *What may cause a population to increase?*

.....

.....

.....

.....

***You will find the answer at the end of the Module.***

## 2.1 CONTROL OF POPULATION SIZE

A number of environmental factors limit the growth of populations. These factors act as natural checks, which prevent the population from growing too large.

Some of these common factors are:

- (1) food supply
- (2) predation
- (3) overgrazing
- (4) diseases and
- (5) competition.

### Food Supply

Individuals in the population compete for food if it is in short supply. In that case some food supply will not survive. However, in most cases the different factors interact to control the population size. For example, a population of rabbits will be affected by the amount of food available and also by the number of foxes around. This is because one fox feeds on many rabbits.

### Predation

Similarly the size of a predator population depends on the numbers of prey. An increase in the number of predators means that more prey will be caught. Thus the number of prey will decrease. The predators' food supply is reduced and this in turn leads to a drop in the number of predators.

### Overgrazing

The eating of plants by herbivorous animals is called grazing. Overgrazing leads to a lack of food in the long run. Thus the herbivores die due to scarcity of food. This decreases their population.

## Diseases

Sometimes populations decrease dramatically in a short space of time. This may occur because the population runs out of food or it has been overcome by disease. Disease can spread very quickly through large populations and affect its members. For example, pests or other diseases easily attack monoculture of arable crops. Thus large areas of crops are easily destroyed. You must have heard about how locusts affect crops.

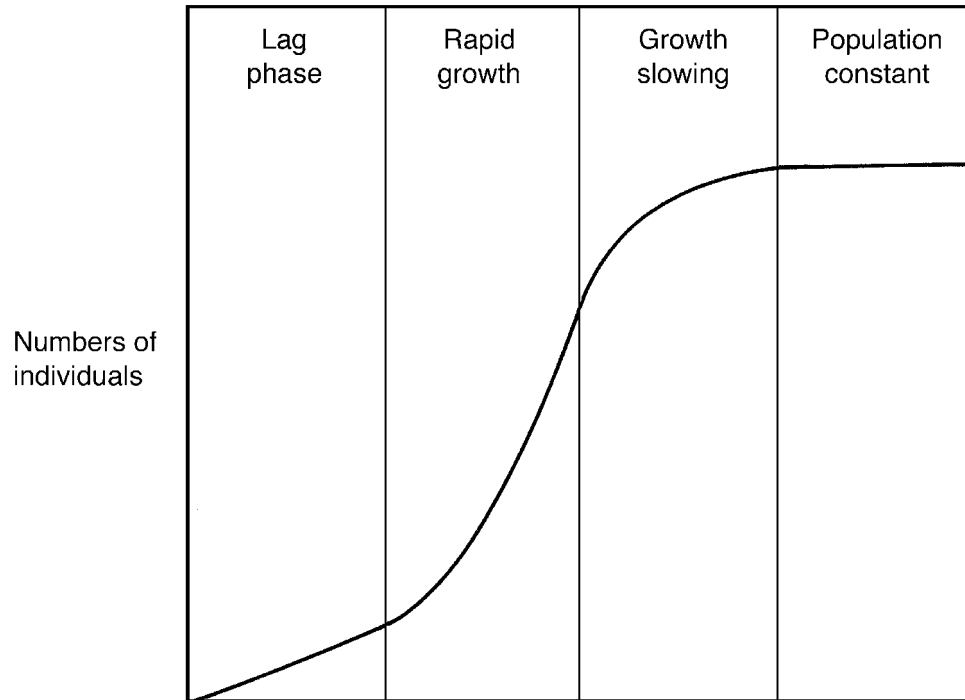
## Competition

Resources like space, light, shelter are commonly in limited supply. The organisms thus compete for such resources and this may limit the size of their population. Competition can occur between individuals of the same species or different species. Plants and animals tend to produce more offspring than the habitat can support. This leads to competition and only those, which are best adapted, will survive.

Similarly weeds compete successfully with crops. They germinate rapidly and grow quickly to establish themselves before the crop matures. They occupy space and tap light, water and minerals from the soil. Thus the crop does not get these resources. Can you think of other similar examples? Find out a few such examples from your own environment and describe them briefly.

## 2.2 POPULATION GROWTH

The population growth of individuals in a species is best shown by the population growth curve. This is illustrated in Figure 12.



***Fig. 12 Population Growth Curve***

### Lag Phase

If the birth rate is greater than the death rate, a population will grow in size. If only a few individuals are present at first, the rate of growth will be very slow. This is called the lag phase.

As the number of individuals increase, more of them reproduce. Then the population grows rapidly if other factors are favourable. However, growth cannot continue indefinitely. This is because there is a limit to the number of individuals that any area or habitat can support. Beyond this limit the population growth slows down as certain factors limit the population size. Such factors may be food supply, water, oxygen, shelter, predation, disease or the collection of toxic wastes. The population may then stabilize at a particular level.

A population growth curve like the one shown in Figure 12 can quite easily be obtained by growing some yeast cells in sugar solution.

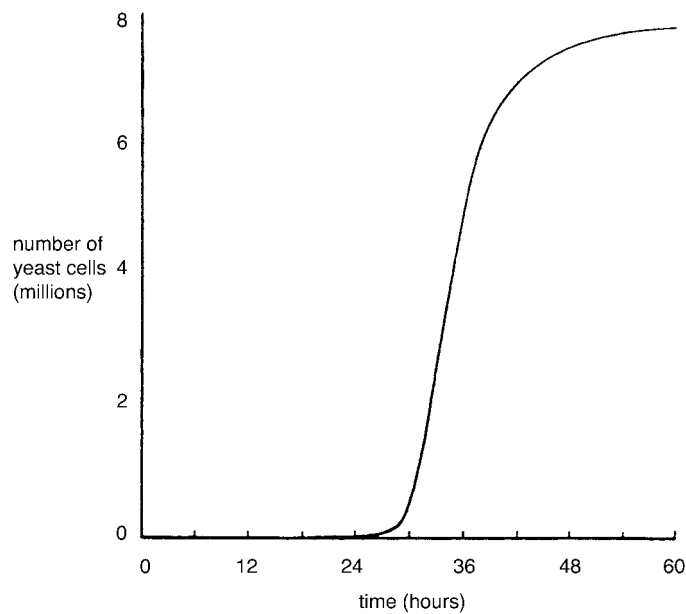
## 2.3 GROWTH OF YEAST POPULATION

You will note that many experiments on population sizes have been done on organisms like bacteria and yeast, because they reproduce quickly and are easy to grow.

A few yeast cells are put into a container of nutrient broth. The cells feed on the broth, grow and reproduce. The number of yeast cells are counted every few hours.

At the beginning of the experiment, the population grows quite slowly. This is because there are only a few cells to reproduce. But once they get going, growth is very rapid. Each cell divides to form 2, then 4, then 8, then 16 and so on.

As the population gets larger, the individual cells can no longer reproduce as fast. They begin to die more rapidly. This may be due to a lack of food or they may have made so much alcohol (as a result of respiration) that they are poisoning themselves. The cells now die as fast as new ones are produced. So the population stops growing and levels off as shown in Figure 13.

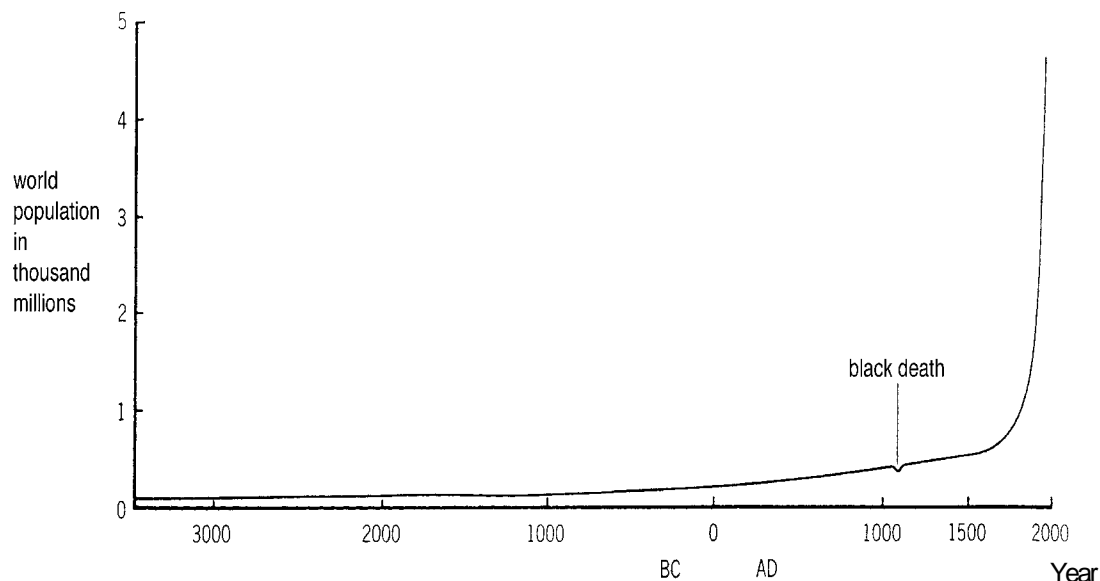


***Fig. 13 Growth of Yeast Population***

## 2.4 HUMAN POPULATION GROWTH

At present the human population is growing very fast, but it has not always been so. For thousands of years, the rate of human population growth was quite slow. The huge increase that we see today has occurred only over the last 300 years. This is mainly due to:

- (i) improved agriculture which has provided greater food production
- (ii) better health facilities, cleaner water supply and improved sanitation
- (iii) vaccination against several diseases and new drugs available to combat many diseases
- (iv) good control over disease-causing organisms
- (v) eradication of diseases which were fatal in the past
- (vi) high level of education



**Fig: 14 World Population Growth**


These have led to lower infant mortality and increased life expectancy of humans in all parts of the world.

You must note that the rate of population growth is influenced by the proportion of young people in the population. However, there are certain population checks like:

- (1) famine
- (2) floods
- (3) war
- (4) earthquakes and
- (5) other natural disasters as well as man-made disasters like terrorists attacks. Together with these we are also facing a major threat in this third millennium with the rapid spread of Acquired Immune Deficiency Syndrome (AIDS). This is more acute in developing countries.

However, the human population is still increasing very rapidly. In developed countries, the population control campaign is quite successful. Thus our objective is to reduce the birth rate. This will involve better education, better family-planning and birth control mechanisms in the under-developed countries so that the population control campaign can be implemented easily.



 ***Before proceeding further, complete the following activity.***

**ACTIVITY 2**

1.     *Make a drawing to show the human population growth in (a) the world,  
(b) your country.*

2.     *The world population is increasing rapidly? Suggest some reasons for  
this.*

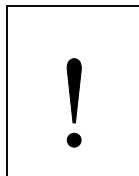
.....  
.....  
.....

3.     *(a) Draw a graph to show the growth of a population of yeast cells.*

*(b) Why does the graph level off towards the end of the growth period?*

.....  
.....  
.....

***You will find the answer at the end of the Module.***



## POINTS TO REMEMBER

- Members of the same species living in a particular habitat form a population.
- Population growth is controlled by environmental factors and depends on birth rate and death rate.
- Population size changes as a result of changes in birth, death and emigration of members within that population.
- Food supply, predation, overgrazing, diseases and competition are mostly responsible to control population size of plants and animals.
- The population growth of individuals in a species is best shown by a population growth curve. This is usually s-shaped.
- Human population growth was quite slow before 19<sup>th</sup> century. It has increased dramatically for the last two hundred years.
- Natural and man-made disasters as well as AIDS are checks to human population growth.
- The success of the population control campaign depends on better education in the under-developed countries.

## UNIT 3

---

# HUMAN INFLUENCE ON THE ENVIRONMENT

---

### TABLE OF CONTENTS

OBJECTIVES.....	47
3.0 POLLUTION.....	48
3.1 POLLUTANTS.....	48
3.2 INTENSIVE AGRICULTURE.....	50
3.3 SOIL EROSION.....	51
3.4 OVER-USE OF PESTICIDES .....	53
3.5 NUCLEAR FALLOUT .....	54
3.6 OVER-USE OF FERTILIZERS.....	55
3.7 WATER POLLUTION BY SEWAGE AND CHEMICAL WASTES .....	56
3.7.1 WATER-BORNE DISEASES .....	57
3.8 ACID RAIN .....	58
3.8.1 PREVENTING ACID RAIN .....	59
3.9 RESOURCES.....	59
3.9.1 CONSERVATION OF OUR RESOURCES.....	61
3.9.2 UTILISATION OF NATURAL RESOURCES .....	61
3.9.3 RECYCLING OF MATERIALS .....	63
3.9.4 CONSERVATION OF NON-RENEWABLE RESOURCES .....	64
3.9.5 IMPORTANCE OF CONSERVATION.....	64
3.9.6 ENERGY .....	64
POINTS TO REMEMBER .....	68
ANSWERS TO ACTIVITIES .....	71



## UNIT 3

---

# HUMAN INFLUENCE ON THE ENVIRONMENT

---

We share the earth with many other living organisms. Each variety of organism has the right to live and contributes to maintain the balance in nature. At present more than 6 billion people are using and often knowingly or unknowingly abusing the Earth's natural resources.

In the past, the world was less populated and people led a simple life. There were more resources for fewer people. As the human population increased, more land had to be used for buildings, roads and agriculture. This has led to cutting down forests, destroying plants and animals, pollution, extracting minerals and energy supplies and soil erosion. You will observe that we as human beings have been utilizing the environment for our own purposes and conveniences. Many things associated with modern life and the increases in population worldwide are mostly responsible for the degradation of our environment. In this Unit, we look at our impact on the environment, the likely consequences and precautions we can take.

## OBJECTIVES

At the end of this Unit you should be able to:

- define pollution
- list some examples and possible sources of pollutants
- discuss the ways in which intensive agriculture may damage the environment
- describe the effects of the over-use of fertilisers

- describe the undesirable effects of water pollution by sewage and chemical wastes
- outline factors which contribute to acid rain, its effects on the environment and measures to control it.
- describe pollution due to pesticides, herbicides and nuclear fall out.
- suggest ways of improving the management of the natural resources in your local environment
- describe the need for recycling materials including water and paper.
- describe the need for conservation of species, their habitats and natural resources.

## 3.0 POLLUTION

This is the harmful effects of human activities on our natural environment. It changes the quality of air, water and land to an extent that our health as well as the life of other organisms are threatened. In other words, pollution is the contamination of the environment. This contamination has been brought about by pollutants.

### 3.1 POLLUTANTS

These are harmful substances or energy in the form of heat or sound that cause pollution. The main pollutants produced by human activities are:

- smoke
- exhaust fumes
- wastes (domestic, agricultural and industrial)
- noise.

These wastes can be divided into two groups:

- (a) Bio-degradable
  - (b) Non-biodegradable
- 
- (a) Bio-degradable pollutants are non-persistent and they are mainly naturally occurring organic substances. They can be decomposed by bacteria into harmless forms. These are wastes from plants and animals. They can be broken down into simpler substances by decomposers.
  - (b) Non-biodegradable pollutants are persistent. These are mainly inorganic substances like metals or artificially produced compounds like plastics that cannot be decomposed.

**We can now proceed with the following investigation.**



### INVESTIGATION 1

**For each investigation you will require the materials indicated.**

*Make a thorough study of your environment and list five different examples of how human beings have used the environment.*

Example 1	
Example 2	
Example 3	
Example 4	
Example 5	

<b>You should record your answers in the space provided.</b>	<p><i>From the above mentioned activity, explain how the utilisation of the environment has</i></p> <p>(i) <i>affected plants and animals, in your area</i></p> <p>(ii) <i>caused different kinds of pollution in your area</i></p>
--	---

## 3.2 INTENSIVE AGRICULTURE

Our increasing human population increases the demand for:

- land
- housing
- farming
- industries and
- recreation.

Thus forests and woodlands are cut down and the soil is ploughed to grow more food. This destroys wildlife habitats and leads to the greenhouse effect (*as explained in Unit One*). Thus mixed populations of trees, shrubs, wild flowers and grasses are replaced by a dense population of only one species such as wheat, maize or beans. This is called monoculture. For a monoculture to be maintained, other plants which compete with this crop plant are killed by chemicals called herbicides.

The crop plants are also protected against fungal diseases by other chemicals called fungicides. To destroy insects which eat and damage the plants, the crops



are sprayed with insecticides. In addition to these, large amounts of artificial fertilizers are also used. This is because the land is soon depleted of some minerals as the same crop is grown on that land year after year.

### 3.3 SOIL EROSION

Bad agricultural practices lead to soil erosion. That is, the soil can be blown away by the wind or washed away by rain water, when it is exposed. This may occur due to:

- (1) deforestation - The layer of soil on steep slopes is usually thin but can support the growth of trees. If these trees are cut down, the soil is no longer protected. Consequently this soil is easily washed away by rain water to reach streams and rivers.

You should note that plants protect the soil in the following ways:

- (a) their leaves prevent rain from hitting the soil directly,
- (b) their roots hold the soil particles together.

The forest forms a stable ecosystem. It is the natural habitat of many species of organisms. Deforestation destroys these natural habitats. Thus, many wild plants and animals die due to a lack of natural environmental conditions. This drives many species to extinction and others may be in danger of extinction.

- (2) Poor farming methods - If the land is ploughed year after year and treated only with chemical fertilisers, the soil structure is destroyed. Such a soil easily becomes dry and sandy. In strong winds this soil is easily blown away as dust.
- (3) Over-grazing - If too many animals are kept on a pasture, they eat the grass down almost to the roots. Their hooves trample the surface soil

into a hard layer. Thus rain water does not penetrate such a soil. The water runs off the surface and carries away the soil with it.

Soil erosion, whether by water or wind, is greatest when there are no plants to protect the soil.



*Before proceeding further, complete the following activity.*

### **ACTIVITY 1**

1. *What has happened to our natural resources as human population has increased during the past 200 years?*

.....  
.....

2. *Name a human activity that causes the destruction of natural habitats.*

.....

3. (a) *What is meant by pollution?*

.....  
.....

- (b) *Name three pollutants.*

.....  
.....

4. *Differentiate between a bio-degradable and non-biodegradable pollutant.*

.....

.....

.....

.....

5. *What are the harmful effects of deforestation?*

.....

.....

6. *How can fertilizers kill aquatic life?*

.....

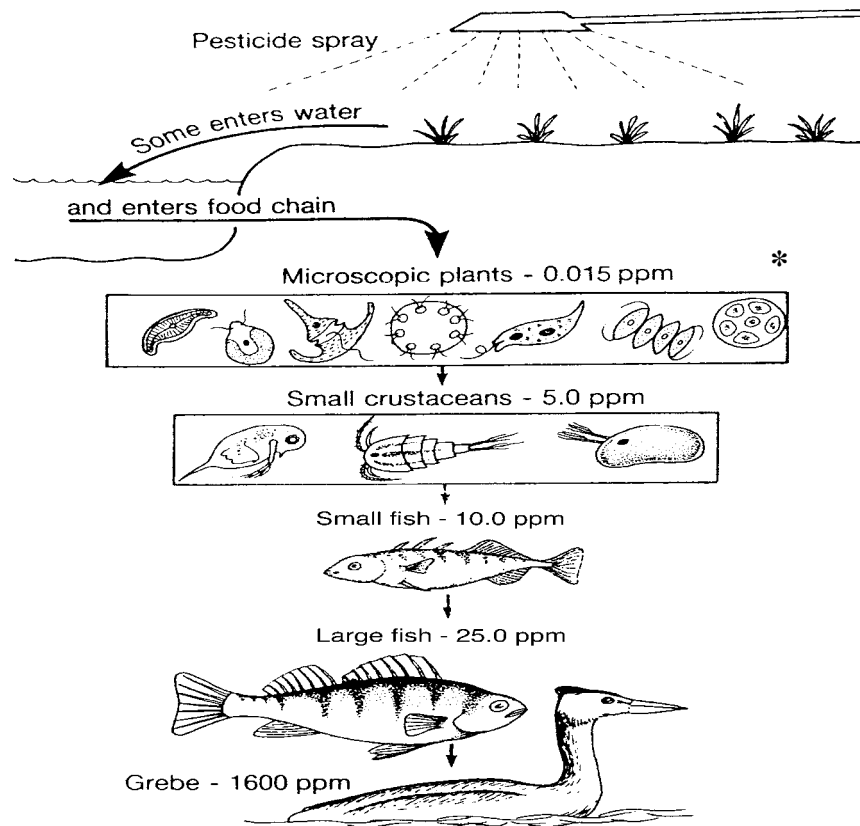
.....

.....

***You will find the answer at the end of the Module.***

## **3.4 OVER-USE OF PESTICIDES**

Nearly all pesticides kill the harmless or beneficial organisms as well as the harmful ones. The concentration of insecticides often increases as it passes along a food chain. For example, the concentration of an insecticide reaching water in a lake may be very low. The microscopic plants and animals which feed in this lake water build up higher concentrations of the chemicals in their bodies. This increases in the bodies of the small fish which feed on the microscopic plants and animals. The small fish are eaten by larger fish which in turn may be eaten by birds or other consumers. These top consumers may accumulate high concentrations of the chemicals. This can even lead to their death.



\*ppm – parts per million

Fig. 15

### 3.5 NUCLEAR FALLOUT

There are two main forms of radiation:

- electromagnetic waves and
- sub-atomic particles.

These can easily harm living organisms and they are lethal in the long run. Two major sources of man-made radiation are:

- (a) radioactive fall out, from the testing of nuclear weapons and
- (b) the wastes from a nuclear power industry.

Like pesticides these radioactive materials may also contaminate the long food chains. For example, the waste product of nuclear weapons and nuclear reactors may be absorbed into grass from the air. The cattle eating the grass then pass it into their milk which may be consumed by humans. This in turn affects the bone tissue of humans and it may lead to cancer.

## 3.6 OVER-USE OF FERTILIZERS

Fertilisers are chemical substances which improve crop growth by giving plants the nutrients they need. These are mostly nitrates and phosphates. Some of these chemicals are not taken up by crops. Thus they are washed out of the soil by rain and reach the streams and rivers. Here they allow the overgrowth of microscopic algae. They also support the growth of bacteria. This makes the water murky and poor in oxygen content. Thus other aquatic animals like shrimps and fish die due to suffocation (lack of oxygen).

Sometimes chickens, calves, pigs and other farm animals are reared in large sheds. Their urine and faeces are washed out of the sheds with water. You can already imagine what's likely to happen if this mixture reaches streams and rivers. It supplies an excess of nitrates and phosphates for the microscopic algae.

These algae are at the bottom of a food chain. They use the nitrates and phosphates and multiply so rapidly that the microscopic animals which feed on them, cannot control their growth. So they die and fall to the bottom of the river or lake. Here, their bodies are broken down by bacteria. These use up the dissolved oxygen from water. Such water becomes deoxygenated and can no longer support animal life. Fish and other organisms suffocate and die.

## 3.7 WATER POLLUTION BY SEWAGE AND CHEMICAL WASTES

Water pollution is due to the discharge of untreated domestic, agricultural and industrial wastes into streams, rivers or seas. The domestic sewage, manures of chicken and pigs from farms and wastes from factories like tanneries, dairies, paper mills are common examples of organic pollutants.

The release of organic wastes or pollutants into streams and rivers provides abundant food for rapid growth of bacteria and fungi. These use up the dissolved oxygen and release toxic wastes into the water. The lack of oxygen and the toxins in the water kill other aquatic animals like the fish and shrimps.

The decay of the dead bodies of these aquatic animals, in the absence of oxygen, produces foul-smelling gases like methane, ammonia and hydrogen sulphide. Again these gases are poisonous to other living organisms.

Detergents come mainly from domestic wastes. Some detergents contain a lot of phosphate. Detergents form a foamy layer on the water surface. This reduces the penetration of light and the dissolution of oxygen in the water. Thus many aquatic organisms suffocate and die.

Furthermore the high phosphate content of detergents supports algal overgrowth. Again this depletes the water of its oxygen and leads to the death of aquatic life.

**Note:** You should also refer to **Chemistry Module 2 Unit, 2 - 2.4.1**.

It is also the right time now to address some diseases which we can suffer from and associated directly or indirectly with water.

### 3.7.1 WATER-BORNE DISEASES

These are diseases directly associated with water.

➤ **Cholera**

Cholera a severe diarrheal disease is transmitted to us via water. You may lose gallons of fluids containing valuable electrolytes, bicarbonates and ions leading to dehydration and shock.

➤ **Bilharzia**

Bilharzia is common in the tropics where ponds, streams and irrigation canals may have bilharzia - transmitting snails. Washing, swimming in these water bodies expose you to infection which manifests itself by blood in urine or faeces. This is accompanied by anaemia and fatigue.

➤ **Typhoid**

Typhoid is due to drinking polluted water and eating food contaminated by the typhoid bacteria. Normally you have fever, severe headache, nausea and loss of appetite.

Having looked at water-borne diseases, we shall now focus on two more where water has a role, but slightly differently.

➤ **Malaria**

Malaria is transmitted by female Anopheles mosquitoes. Stagnant water in lakes, ponds, ditches, puddles etc are breeding ground for the larvae and pupae of the mosquito. When bitten by the adult mosquito, we may become infected and develop fever. The brain can also be affected.

➤ **Dysentery**

This is due to a bacterial infection resulting in diarrhoea, fever, vomiting, abdominal pain as a result of poor hygiene.

It is advisable to wash hands properly **before** handling food, eating, cooking, handling babies etc.

Do so as well after using the toilet, changing babies etc.

**Medical attention** should be sought for the above conditions.

## 3.8 ACID RAIN

Many factories and all motor vehicles release poisonous substances and polluting gases into the air. Factories produce:

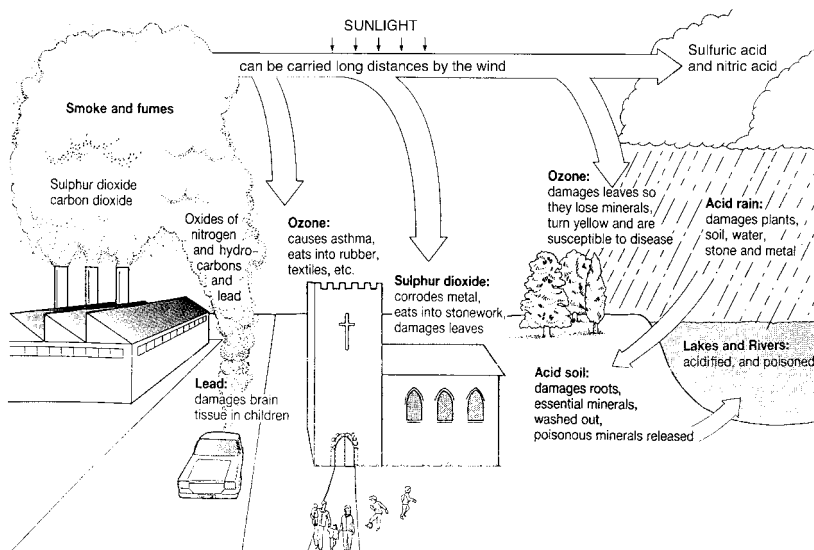
- smoke and
- sulphur dioxide.

Motor vehicles produce:

- lead compounds
- carbon monoxide and
- oxides of nitrogen which lead to smog.

Fossil fuels like coal and oil contain sulphur. When these are burnt, they release sulphur dioxide into the air. Oxides of nitrogen from power stations, factories and vehicle exhausts also contribute to air pollution. These gases are soluble and they dissolve in rain water as it falls. This forms acid rain.

This acid rain corrodes metal railings, metal bridges and eats away stonework on buildings. It causes essential minerals in the soil to be washed away by rain. It may also cause the release of poisonous chemicals like aluminium and mercury. It damages trees and crops. The leaves turn yellow and fall off. The roots are also damaged so that they cannot absorb minerals. The soil turns acidic. Water in lakes and streams become acidic and this harms all forms of aquatic life.





### 3.8.1 PREVENTING ACID RAIN

We can reduce acid rain by burning less coal, oil and gas. Furthermore the coal and oil can be treated to remove some of their sulphur, before they are burnt.

The chimneys of factories can be filled with smoke-cleaning equipment.

Similarly the vehicle exhausts can be fitted with devices to minimise pollutants.

## 3.9 RESOURCES

The Earth is our natural habitat. It will remain so till the human race exists. If we use this habitat wisely, we shall ensure our own survival. By doing so we shall also help other organisms to survive. Already many animals and plants have become extinct and others are threatened to disappear soon. Therefore we must live in harmony with nature and make rational use of the resources available.

You should understand that a resource can be a living or non-living thing which is useful to humans. Resources are either natural or man-made. Water, animals, plants, soil, forests are examples of natural resources while buildings, roads, vehicles, bridges, computers are man-made resources.

There are two types of natural resources, renewable and non-renewable resources. Renewable resources are those which, when removed or utilized, are replaced by nature. For example, fish in a lake or trees in a forest.

Non-renewable resources are those which when removed or utilized are not replaced.

For example, coal in a mine, sand in a sand quarry.

Soil lost during soil erosion may take hundreds of years to be replaced by nature. Therefore soil is classified as a non-renewable resource.

 *Before proceeding further, complete the following activity.*

**ACTIVITY 2**

1. *Explain briefly why the over-use of pesticides is dangerous?*

.....

.....

2. *State two ways in which water is polluted in towns and cities.*

.....

.....

3. *How are detergents harmful to aquatic life?*

.....

.....

4. (a) *Why is radiation dangerous?*

.....

.....

(b) *Where could harmful radiation come from?*

.....

5. (a) *Explain how acid rain is produced?*

.....

.....

(b) *State the main effects of acid rain.*

.....

.....

6. (a) What is a resource?

.....  
.....

(b) Give three examples of  
(i) renewable resources

.....  
.....  
.....

(ii) non-renewable resources

.....  
.....  
.....

***You will find the answer at the end of the Module.***

### **3.9.1 CONSERVATION OF OUR RESOURCES**

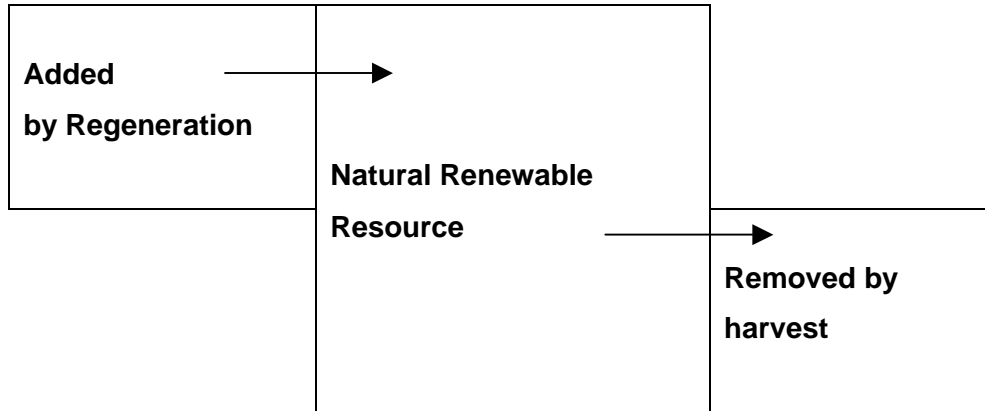
This is the careful management of our environment. It involves the proper use of the resources and the control of pollution. Conservation includes the preservation of habitats and the protection of plants and animals from harm or over exploitation. It provides good quality of life for us to live.

### **3.9.2 UTILISATION OF NATURAL RESOURCES**

We must always use the natural resources intelligently and rationally. Any disturbance of the balance in nature may destroy the whole system in nature.

Renewable natural resources should be utilised in such a way that there is a proper balance between harvest and renewal of these resources. This will ensure a continuous yield of these resources.

The principle of rational utilization of a living renewable resource can be represented as follows:



For example, consider a lake which can support a maximum of 20,000 adult fish. Assume an annual increase of 2000 young ones by reproduction. There are three possible options for utilizing this resource.

**Option A** - By catching only 1,000 fish yearly, the fish population in the lake will lead to increase.

**This is a waste of resource.**

**Option B** - By catching 2,000 fish yearly, the resource is preserved. Here the catch is equal to the natural increase. Fish will be obtained continuously for this lake.

**This is a rational utilization of the resource.**

**Option C** - By catching 5000 fish yearly, the resource is over-exploited.

**This will soon lead to its extinction.**

Therefore over-fishing in lakes, rivers or the sea should be prevented. Similarly after trees are removed for timber or paper, the cleared area should be reafforested. This ensures future supply and also prevents soil erosion. The proper application of fertilizers and crop rotation in agriculture maintains soil fertility and prevents soil erosion.

Farmers can help save wildlife by using pesticides only when it is really necessary. They can leave wild habitats untouched, and introduce wild species of plants in places where farming is difficult.

### **3.9.3 RECYCLING OF MATERIALS**

Recycling means turning materials from used things into new goods. Recycling is one of the methods for conserving resources. Every day a large amount of rubbish is dumped as waste. Much of the materials discarded as rubbish are valuable materials which could be recycled and used.

For example, newspapers, paper bags, cardboard boxes and other paper products, if thrown away, represent a loss of materials. More trees would have to be cut to make the paper. Yet the paper can be easily recycled and used again.

Another important resource is water. Water is scarce in many parts of the world. Sewage, if untreated, represents a loss of water. Furthermore untreated sewage may also pollute streams, rivers and lakes. This makes such water unfit for human consumption. Therefore water that has been used for any industrial purpose or from sewage can be recycled and re-used for irrigation purposes.

Recycling is important because:

- (i) less land is used for throwing wastes. It reduces land pollution
- (ii) it slows down the depletion of natural resources like minerals and trees.
- (iii) it helps to save energy. Less energy is needed to recycle the material than to produce it.

### 3.9.4 CONSERVATION OF NON-RENEWABLE RESOURCES

Metals and fossil fuels like coal, petroleum, oil, and natural gas are non-renewable natural resources. They cannot be replaced after use. Their supply is limited. They will be exhausted in future.

Therefore metals from cans, discarded vehicles and other resources are processed and re-used.

Fossil fuels should be burnt completely to assure their maximum use. This is done by developing more efficient engines or processes.

### 3.9.5 IMPORTANCE OF CONSERVATION

It is very important to conserve natural resources present in our environment for the following reasons:

- (1) to prevent plant and animal species becoming extinct.
- (2) to preserve the balance of nature.
- (3) to avoid the depletion of certain resources.
- (4) to maintain the diversity of species.
- (5) to preserve the beauty of the environment.

For conservation to be successful it should gain support from each one of us.

### 3.9.6 ENERGY

Energy is such an important resource in our life that we'll spend a few minutes on it before winding up this Module and the Biology section.

We have mentioned Energy in Chemistry and Physics too, in different contexts on several occasions but for now we'll categorise it as:

Renewable energy

and

Non-renewable energy

### **Renewable energy sources**

- Solar energy
- Wind energy
- Wave energy

These sources can be tapped without depleting the reserves.

### **Non-renewable energy sources**

On the other hand the sources of non-renewable energy when tapped can run out. In fact it is said that at the rate we're using them, it won't be long before we run out.

- Coal
- Petroleum
- Gas
- Nuclear energy

Research so far has proved that the non-renewable sources are harmful to our environment and ourselves e.g. they contribute to the greenhouse effect.

On the other hand, renewable sources are said to be cleaner and safer. This is all we wish to say about energy here.

We can now proceed with the following investigation.



## INVESTIGATION 2

**For each investigation you will require the materials indicated.**

**You should record your answers in the space provided.**

1. *Decide on five things that you can do to help conservation.*

2. *Identify plants and animals that are becoming rare in your country. Stick pictures or write them in your notebook and write one or two sentences by the side of the picture, relating to that particular organism.*



 *Before proceeding further, complete the following activity.*

### **ACTIVITY 3**

1. (a) *What is conservation?*

.....

.....

(b) *State the importance of conservation.*

.....

.....

2. (a) *What is meant by over-exploitation of a resource?*

.....

.....

(b) *Give three examples of over-exploitation of resources by man.*

.....

.....

.....

3. (a) *Why is recycling of resources important?*

.....

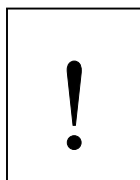
.....

(b) *Name two resources which are recycled.*

.....

.....

***You will find the answer at the end of the Module.***



## POINTS TO REMEMBER

- Human population has increased rapidly in the last two hundred years. This has led to the degradation of our environment.
- Pollution is the harmful effects of humans on the environment. These harmful substances are also called pollutants.
- The pollutants may be bio-degradable or non-biodegradable.
- Soil erosion may occur due to deforestation, poor farming methods and over-grazing by animals.
- Deforestation destroys natural habitats and wild life.
- Pesticides increase in concentration as they pass along a food chain.
- Radiations come from nuclear weapons and nuclear power industries. They are lethal and cause cancer.
- Over-use of fertilisers may cause overgrowth of algae in water bodies. It depletes water of oxygen and kills aquatic life.
- Water is commonly polluted by discharge of untreated domestic, agricultural and industrial wastes into water bodies.
- Release of detergents and organic wastes into water bodies supports algal growth. This causes death of aquatic life due to depletion of oxygen from the water.
- Smoke from factories and exhausts from vehicles contain oxides of sulphur and nitrogen. These dissolve in rain water to produce acid rain.
- Acid rain is harmful to all living organisms and it also corrodes metal structures and stoneworks.
- A resource is a living or non-living thing which is useful to humans. It may be natural or man-made.

- Some resources are renewable and others are non-renewable. They must be utilized with care and rationally.
- Conservation is the proper management of resources and the control of pollution.
- Over-utilisation or over-exploitation of a resource leads to its extinction or exhaustion.
- Recycling is turning of used materials into new goods. It reduces pollution, slows down depletion of natural resources and helps to save energy.
- It is important to conserve natural resources to prevent the extinction of species, maintain the balance of nature and preserve the beauty of the environment.



# ANSWERS TO ACTIVITIES

## UNIT ONE

### ACTIVITY 1

1.
  - (a) It is the natural home of an organism. It is that part of the environment in which the organism lives and reproduces.
  - (b) It is a group of plant or animals of the same kind which live in a given habitat or place.
  - (c) This consists of many populations which live together in a particular place.
  - (d) When different communities interact with one another and their physical environment, they form an ecosystem. This is a self-supporting Unit of the environment which consists of producers, consumers, decomposers which interact with the physical environment.

### Activity 2

1.
  - (a) It is the transfer of energy and materials from one organism to another along a feeding pathway.
  - (b) Grass → Rabbits → Snakes → Hawks
  - (c) This consists of several food chains which are interconnected.
  - (d) Refer to drawing in Figure 3.

### **Activity 3**

1.
  - (a)
    - (i) Second trophic level.
    - (ii) Third trophic level.
    - (iii) First trophic level.
    - (iv) Third trophic level.
  - (b) The sun.
  - (c) Energy in the form of heat is lost at each trophic level along a food chain. This energy is not available to be recycled.
  - (d) Food chain (b). This is because there are fewer trophic levels.

### **Activity 4**

1.
  - (i) Refer to Figure 8.
  - (ii) Refer to Figure 9.
- (b)
  - (i) Respiration; Combustion.
  - (ii) This is caused by an accumulation of carbon dioxide in the atmosphere which leads to global warming.
  - (iii) This reduces the number of plants. Therefore there is an increase in carbon dioxide concentration in the atmosphere which leads to the greenhouse effect. It also causes soil erosion.
- (c)
  - (i) Nitrogen is essential for making proteins.

- (ii) Plants obtain nitrogen in the form of nitrates and ammonium ions from the soil.
- (iii) Animals obtain nitrogen from the proteins in their food.
- (iv) Nitrates in the soil are changed to nitrogen gas by the process of denitrification. This is brought about by denitrifying bacteria present in the soil.

## UNIT TWO

### **Activity 1**

1. It is a group of plant or animals of the same kind which live in a given habitat or place. For example,
  - barnacles on a rocky shore;
  - a shoal of fish in the sea;
  - all human beings in a given region or country.
2. How many individuals leave a population; how many individuals enter a population.
3. When birth rate is greater than death rate.

### **Activity 2**

1. Refer to Figure 14.
2. Improved agriculture providing greater food production;  
Better health facilities;  
Vaccination against several diseases;  
Good control over disease-causing organisms;  
Poor population control in certain underdeveloped countries.

3. (a) Refer to Figure 13.
- (b) The graph levels off towards the end of the growth period because the population has increased and the cells are now dying as fast as new ones are being produced.

## UNIT THREE

### Activity 1

1. Our natural resources have been decreasing as human population has increased during the past 200 years.
2. Building of roads.
3. (a) It is the harmful effect of human activities on the natural environment which contaminates it.  
(b) Exhaust fumes from vehicles; noise; industrial wastes.
4. A biodegradable pollutant is one which is non-persistent. It can be decomposed by bacteria into harmless forms with time. Whereas a non- biodegradable pollutant is one which is persistent and remains undecomposed forever.
5. Increase in carbon dioxide concentration in atmosphere leading to global warming; soil erosion; destruction of natural habitats for many organisms.
6. When fertilizers reach water bodies they cause overgrowth of microscopic algae. These also support the growth of bacteria. This makes the water murky and poor in oxygen content. Thus other forms of aquatic life are killed.



## **Activity 2**

1. Overuse of pesticides leads to destruction of ecosystems. The concentration of the pesticides increases as it passes along food chains. Thus organisms found at higher trophic levels are killed.
2. In towns and cities water is mainly polluted by the discharge of untreated domestic, agricultural as well as industrial wastes. The water may also be polluted by a release of detergents.
3. Detergents form a foamy layer on the water surface. This reduces the penetration of light and the dissolution of oxygen in the water. Thus many aquatic organisms suffocate and die.
4. (a) Radiation is dangerous because it can cause cancer in the living organism.  
(b) Nuclear reactors; nuclear weapons.
5. (a) Oxides of nitrogen as well as sulphur dioxide from industries and vehicles exhausts are released into the atmosphere. These gases dissolve in rain water and falls as acid rain.  
(b) It corrodes metal railings, metal bridges and eats away stone works on buildings. It also damages trees and crops.
6. (a) A resource is a living or non-living thing which is useful to us.  
(b) (i) Fish in a lake; trees in a forest; animals on a farm.  
(ii) Coal in a mine; sand in sand quarry; metal ores in the earth crust.

### **Activity 3**

1.     (a)     It is the careful management of our environment. It involves the proper use of resources and the control of pollution.  
  
         (b)     It prevents extinction of plants and animals;  
                  It keeps the balance of nature;  
                  It helps to maintain the diversity of species and the beauty of the environment;  
                  It avoids the depletion of our resources.
2.     (a)     Overexploitation of resources involves using the resources faster than they can be replaced by nature.  
  
         (b)     Overfishing; deforestation; mining of fossil fuels.
3.     (a)     It reduces land pollution and slows down the depletion of natural resources. It also helps to save energy.  
  
         (b)     Water; paper.