

Biosphere

15

15.1 Organizational levels and interactions of biosphere

15.1.1 Environmental equilibrium/Ecological balance

The physical and the biological components in which interactions take place for the existence of organisms is environment. Soil, water and air come under the physical component and all the organisms that is plants, animals and micro organisms are included in the biological component or the biotic component. Other than that temperature, rainfall, humidity and sunlight come under environmental conditions.

The organisms and the physical environment have a balanced relationship. This favourable relationship is referred to as the **environmental equilibrium**. Even a small change in the environment can affect its existence. Then it has an ability to restore its conditions. But today this equilibrium is affected due to complicated human activities.

15.1.2 Organizational levels in the biosphere

Biosphere is organized from the simplest level to complex level. This organization can be shown in the following flow chart.

Individual → Population → Community → Ecosystem → Biosphere

Observe the organizational levels of the biosphere in the diagram given below.

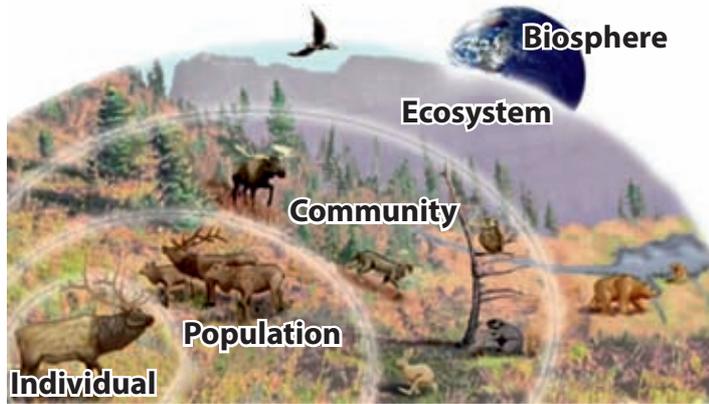


Figure 15.1 - Organizational levels in biosphere

- **Individual**

A single organism belongs to a particular species and lives in the environment is referred to as an individual.

E.g. - Coconut plant, Elephant

A species is a group of similar organisms who can interbreed naturally to produce fertile offsprings.

Assignment 15.1

Name different species found in a particular location of your home garden or school premises.

- **Population**

A group of organisms belong to the same species in a particular geographical location during a specific time period is called a population.

E.g. - The number of elephants lived in Yala national park in year 2011 is 5,879
Human population in Sri Lanka in year 2014 is 21,899,445

- **Community**

A group of different populations, interact with each other in a particular area is referred to as community

E.g. - Animal community in Yala national park
Mangrove plant community in Negombo lagoon area

- **Ecosystem**

All the communities and the non living component with which they interact in a particular area is called an ecosystem.

E.g. - A pond, A decaying log, A forest
A beach with rocks and cliffs

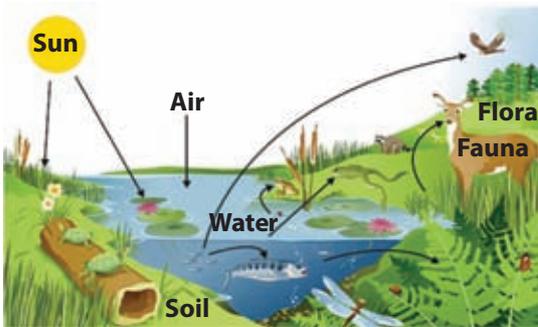


Figure 15.2 - Interactions in a pond ecosystem

Figure 15.2 shows the interactions of the living organisms with the non living component in a pond ecosystem.

• Biosphere

The part of the earth and its atmosphere that is inhabited by living things is called biosphere. The biosphere is composed of three components.

- Lithosphere - The crust and the upper mantle of the earth.
- Hydrosphere - The region that includes all the oceans and fresh water bodies. 70% of the earth surface is covered with water.
- Atmosphere - The region that contains air around the earth.

15.1.3 Growth of population and growth curves

The number of organisms of a species, living in a unit area of a selected habitat is called the population density.

E.g. - Human population density of Sri Lanka in year 2014 is 329.12 km^{-2}

The size of a natural population varies with time. There are four factors that affect the population density.

- Births (Number of new born organisms added to the population)
- Deaths (Number of organisms die in the population)
- Immigration (Number of organisms add to the population from outside)
- Emigration (Number of organisms leave the population)

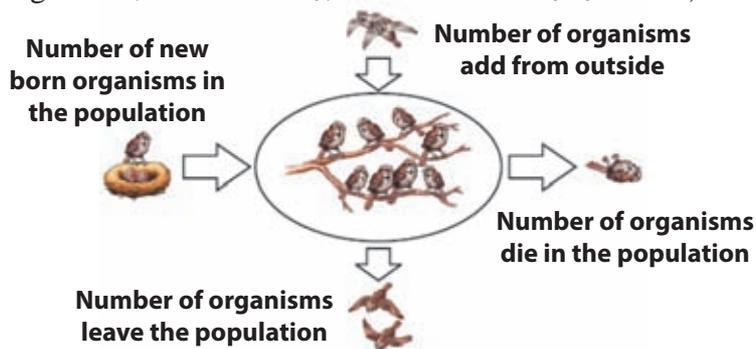


Figure 15.3 - Factors affecting population density in biosphere

Typical growth curve of population

The number of organisms in a natural population changes with time according to a particular pattern. When this pattern is expressed in a graph it will be a sigmoid shaped growth curve. There are four main phases in it.

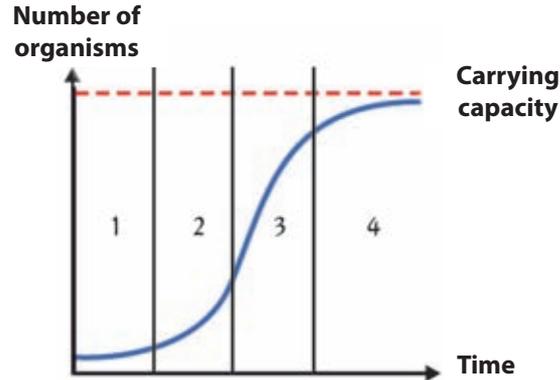


Figure 15.4 - Typical population growth curve

Phase 1 - Slow growth phase (Lag phase)

During this phase population growth increases as reproduction gets underway. Often starts slowly because initially there is a shortage of reproducing individuals which may widely dispersed.

Phase 2 - High growth phase (Exponential phase/ Log phase)

This phase represents the maximum growth rate as organisms are well adapted to the environment and the number of organisms that reproduce is high. Presence of favourable environmental conditions and abundance of food increases the growth rate of organisms rapidly. Birth rate exceeds death rate.

Phase 3 - Deceleration phase

Due to the competition for resources, food shortage, spreading of diseases, predation and parasitism, the growth rate of population decreases.

Phase 4 - Stationary phase/ Stabilizing phase

The number of organisms in a population increases till it has a population adapted to environmental conditions which the environment can bear. Once it reaches its carrying capacity the population achieves the dynamic equilibrium. During dynamic equilibrium birth and death rates balance. Hence the growth of the population is considered as zero. When it comes to this balanced situation the number of organisms in the population is called as the carrying capacity.

- **Growth curve of human population**

Although the growth curve of a natural population is S shaped, it takes J shape for human population. That means the human population is still in exponential phase.

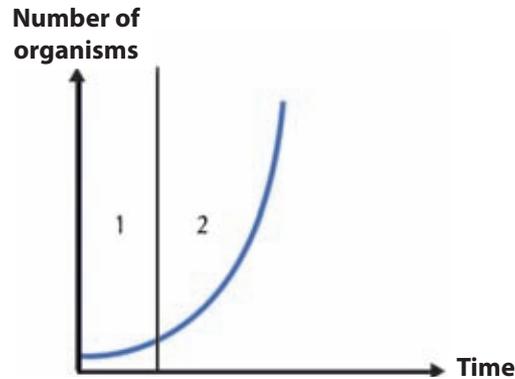


Figure 15.5 - Growth curve of human population

It has taken 300,000 years for the human population to become, one billion. But it has taken only 130 years for it to become two billions and 15 years for it to become four billions. There are two reasons for this rapid growth.

- Increase of birth rate
- Decrease of death rate

The development of technology, progress in medical field and high rate of food production are some of the reasons for high population growth.

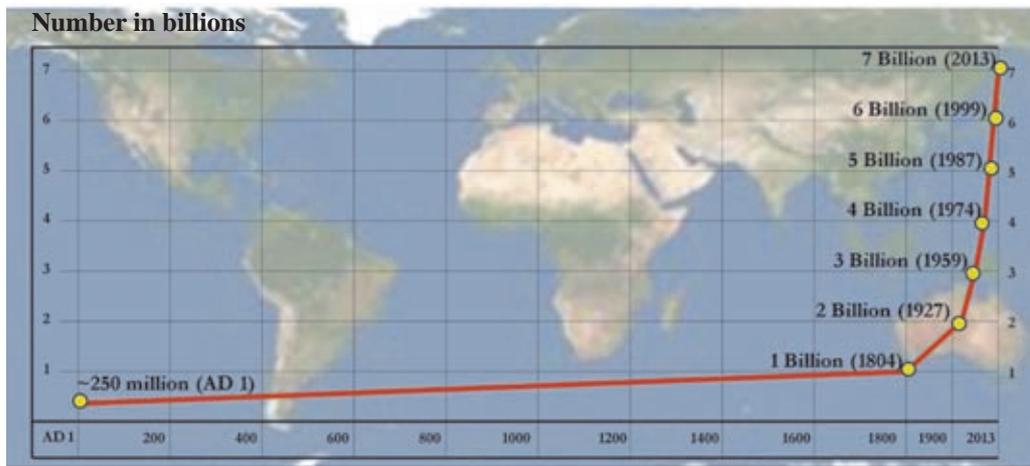


Figure 15.6 - Growth curve of human population from 1 AD to year 2013

Assignment 15.2

According to the graph, predict the time that would take for the world human population to become twice as it was in 2013.

15.2 Mechanisms involve in maintaining the equilibrium of ecosystems

15.2.1 Flow of energy and nutrients

The energy source of all ecosystems in the biosphere is the sun. Flow of energy and nutrients among ecosystems is essential for the existence of the biosphere.

• Food web

The mutual relationships for food among organisms is referred to as food webs. Different trophic levels of many food chains are inter-connected in a web like structure in the biosphere. Due to this relationship an organism is free to depend on different types of food. This helps to avoid bioaccumulation of organisms. An example for a food web is given in figure 15.7

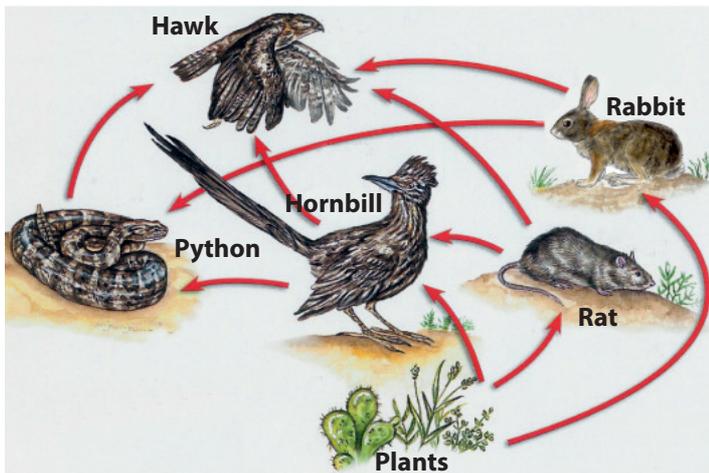


Figure 15.7 - An example for a food web

Assignment 15.3

Build up a food web in a pond ecosystem.

• Food chains

The sequence of energy and materials flow from producer to consumers such as primary consumer and then to the secondary consumer is referred to as a food chain. This can be shown in a linear diagram as follows.

E.g. :-

Grass → Grass hopper → Toad → Cobra → Hawk

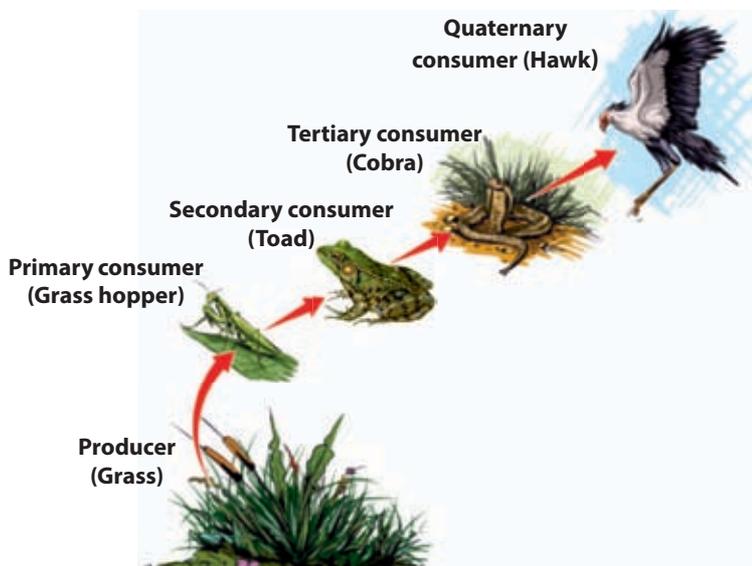


Figure 15.8 - An example for a food chain

Assignment 15.4

Observe different modes of nutrition consumed by different organisms in the environment. Write down their relationships for food.

Trophic level

Every organism belongs to a certain trophic level according to their mode of nutrition. The links of a food chain are known as trophic levels. The number of trophic levels of a food chain cannot be exactly predicted. Most often it is less than five links. Somehow the organisms belong to last trophic level would be carnivorous predators.

All organisms can be divided into three groups on the basis of their mode of nutrition.

- Autotrophs
- Heterotrophs
- Decomposers

Autotrophs

Organisms such as green plants, algae and some bacteria which can transform simple inorganic compounds into organic compounds to fulfill their nutrition requirement are called autotrophs.

According to the energy source used to produce their food, autotrophs can be divided into two groups, as photo-autotrophs and chemo-autotrophs. Green plants are photo-autotrophs and some bacteria are chemo-autotrophs.

Heterotrophs

The animals that cannot produce their own food are known as heterotrophs. They depend on food produced by other organisms. Therefore they are known as consumers. The consumers are further divided as follows,

1. Primary consumers : They are herbivores. Feed on producers.
2. Secondary consumers : They are carnivores. They can be omnivores too. Feed on primary consumers.
3. Tertiary consumers : They are carnivores.

Decomposers

Organisms feed on bodies of dead organisms and organic waste products by converting complex organic compounds into simple compounds are known as decomposers. Saphrophytes like bacteria and fungi belong to this group. This process is called decomposition.



Figure 15.9 - Stages of decomposition process of a dead body

● Ecological pyramids

Ecological pyramids can be built up using number of organisms, biomass and energy relationships in different trophic levels of an ecosystem.

The base of the pyramid represents, producers, and the rest of the rows represent consumers in different trophic levels respectively.

There are three types of Ecological pyramids.

- Number pyramid
- Biomass pyramid
- Energy pyramid

Number pyramid

The graphical representation of number of organisms in different trophic levels is called the number pyramid. It is expressed as the number of organisms per square meter (1 m^2).

The number of organisms in a particular trophic level can be greater or lesser than the number of organisms in the upper trophic level. Therefore upright and inverted number pyramids can be seen.

An upright number pyramid is shown in Figure 15.10.

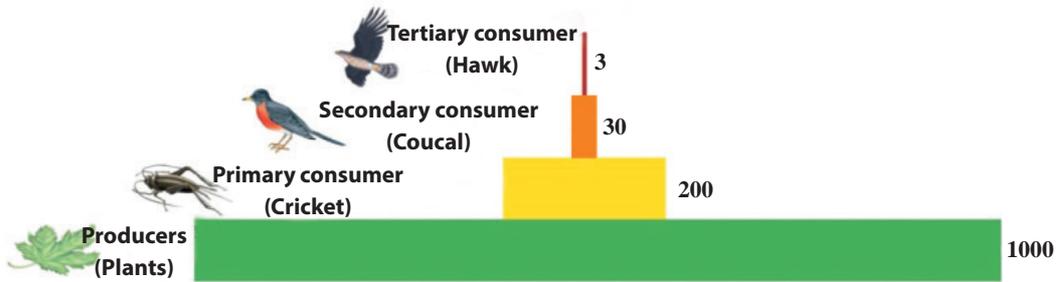


Figure 15.10 - Upright number pyramid

An inverted number pyramid is shown in figure 15.11.

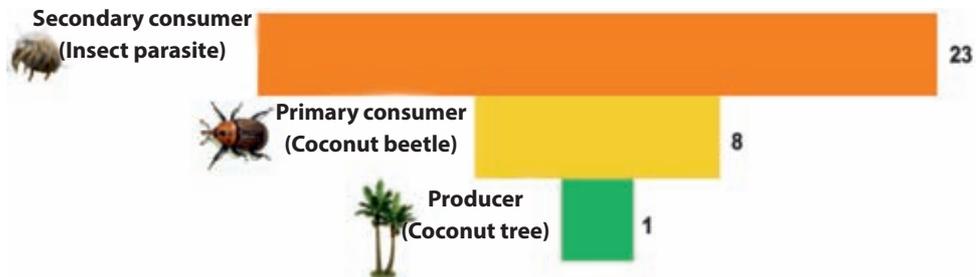


Figure 15.11 - Inverted number pyramid

Biomass pyramid

The graphical representation that shows the total amount of organic matter present in different trophic levels is called biomass pyramid. By considering the dry mass of organisms it is expressed as grammes per square meter per year ($\text{g m}^{-2} \text{yr}^{-1}$)

Mostly the biomass of consumers is less than the producers. Therefore most of the time the biomass pyramids are upright. But rarely, the biomass of consumers in aquatic environment is greater than that of producers. Then the biomass pyramid is an inverted one.

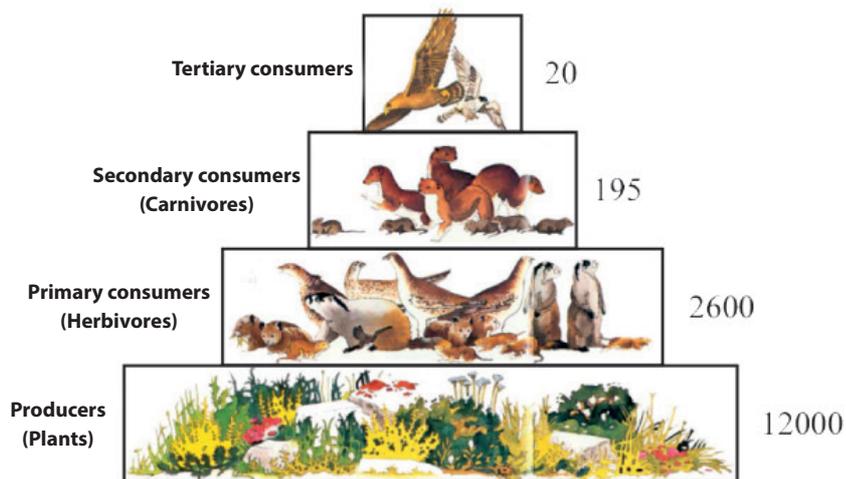


Figure 15.12 - A biomass pyramid

Energy pyramid

The graphical representation that shows the amount of energy, flows through different trophic levels is called the energy pyramid. It is expressed as kilo joules per square meters per year ($\text{kJ m}^{-2} \text{yr}^{-1}$).

Only 10% of energy in a trophic level passes to the upper trophic level. 90% of the energy is dissipated to the environment. Therefore the energy in the upper trophic levels is less than the lower trophic levels. So the energy pyramids are always upright. The number of links in a food chain is less than five levels due to this loss of energy.

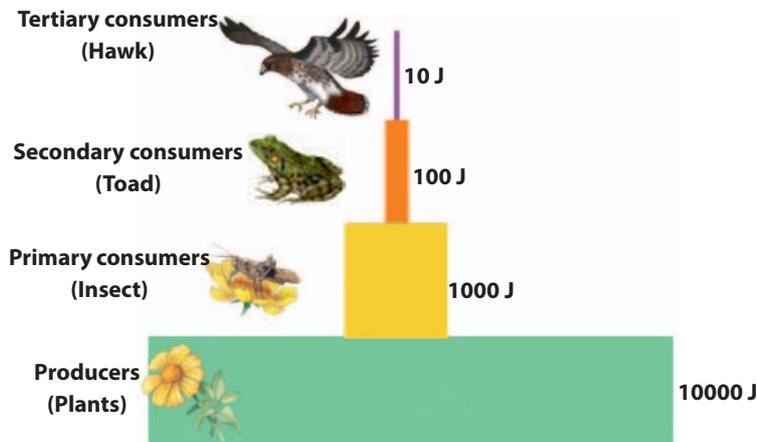


Figure 15.13 - An energy pyramid

- **Flow of energy through ecosystem**

The main energy source of the biosphere is the sun. Green plants absorb sunlight, and use CO_2 and water as raw materials to produce glucose. This process of fixing energy of sunlight is called photosynthesis.

The energy fixed by producers passes from organism to organism along trophic levels. Only 10% of the energy of lower trophic levels passes to the upper trophic levels. 90% of energy is lost in each trophic level as heat.

Energy dissipation

The loss of energy during transferring energy from one trophic level to the next, is called energy dissipation.

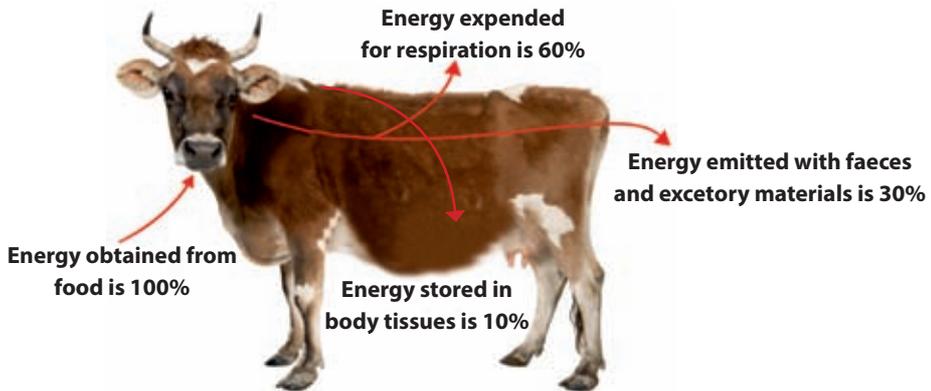


Figure 15.14 - Energy dissipation of a cattle

As a considerable amount of energy is lost during the flow of energy from one trophic level to the next, the shorter food chains are efficient than longer food chains.



Figure 15.15 - A long food chain



Figure 15.16 - A short food chain

15.2.2 Biogeochemical cycle

The process of cyclic circulation of essential chemical components through atmosphere, hydrosphere and lithosphere of biosphere is called Biogeochemical cycle.

Cyclic circulation of water, carbon, nitrogen, oxygen and phosphorous takes place in the biosphere. The natural environmental balance is maintained by these Biogeochemical cycles.

A few such Biogeochemical cycles are given below.

- Carbon Cycle
- Nitrogen Cycle
- Phosphorous Cycle

Among the above Biogeochemical cycles carbon and nitrogen cycles are discussed in details.

• Carbon cycle

The main method of fixing carbon in an ecosystem is photosynthesis. Animals depend on green plants and they receive carbon through those food. Decomposers obtain carbon by digesting dead organisms. All organisms release carbon as CO_2 during respiration. When decomposers are absent, carbon in dead plants and animals convert in to fossil fuels. This process needs millions of years to be completed. During combustion of fossil fuels carbon releases. Micro organisms play a major role in carbon cycle. They release carbon in dead matter rapidly to the atmosphere. Carbon cycle is represented in the diagram 15.17.

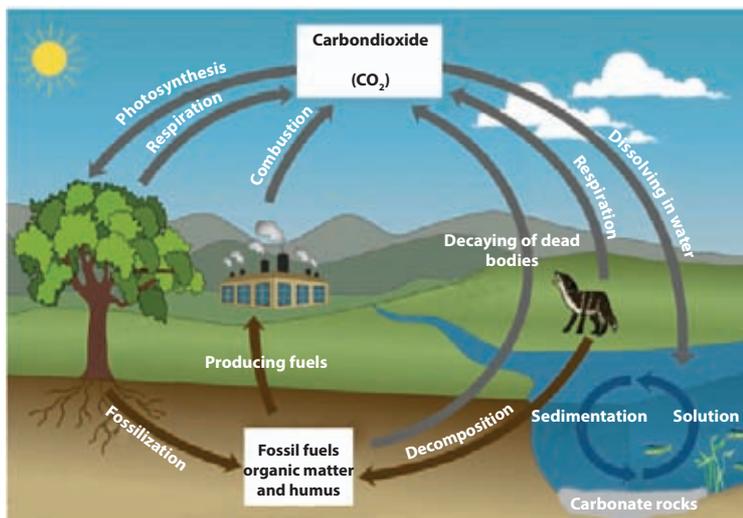


Figure 15.17 - Carbon cycle

• Nitrogen cycle

The main source of nitrogen of earth is the atmosphere.

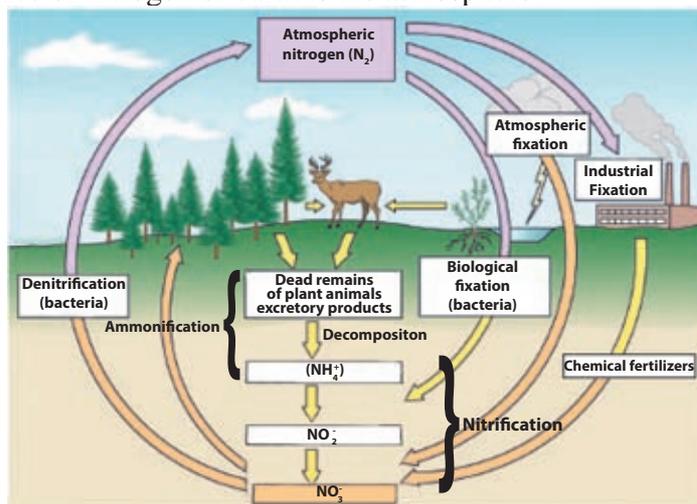


Figure 15.18 - Nitrogen cycle

The fixation of atmospheric nitrogen takes place in three main methods.

□ Biological fixation

Free living bacteria in soil (*Azotobacter*) and symbiotic bacteria like *Rhizobium* live inside root nodules of leguminous plants that can convert atmospheric nitrogen into NH_4^+ .

□ Atmospheric fixation

During lightning atmospheric nitrogen is converted to nitric oxide and nitrogen dioxide.

□ Industrial fixation

Atmospheric nitrogen converts to nitrate during industrial production of chemical fertilizers.

Nitrifying bacteria like *Nitrosomonas* first convert Ammonium compounds into nitrites and then *Nitrobacter* bacteria convert nitrite to nitrates. These nitrates are absorbed by plants and used to synthesise proteins. These plant proteins pass into animals through food chains.

Due to microbial activity on dead bodies of organisms, the nitrogenous compounds convert to ammonium compounds known as ammonification and collect into soil. The denitrifying bacteria like *Pseudomonas* and *Thiobacillus* convert nitrates back to atmospheric nitrogen.

Assignment 15.5

Prepare a creative exhibit board to display the nitrogen or carbon cycle.

15.3 Different environmental pollutants and their effects

Disposal of different effluents by the rapid growing population, affects the environmental balance. Let us discuss about the effects of these waste materials.

15.3.1 Environmental pollution

Discharge of pollutants, which cause deleterious effects on natural environment is called environmental pollution.

Environmental pollution are of three types.

- Soil pollution
- Water pollution
- Air pollution

15.3.2 Factors affecting environmental pollution

There are many factors which cause pollution. Let's do the activity 15.1 to identify those pollutants.

Activity 15.1

Materials required :- Different waste materials found in environment

Method :-

- Make a list of pollutants found in the school premises after a field trip.
- Classify them according to the methods given below.

Method I



Method II



- If you are asked to place different waste disposal bins in your school premises decide what type of bins to be placed mostly after analyzing the amount of different waste materials.

There are different types of waste materials involved in environmental pollution. We have to be aware of them to reduce their usage.

These different types of wastes are,

- Agro chemical waste
- Industrial waste
- Greenhouse gases
- Heavy metals
- Particulate matter
- Domestic waste
- Electronic waste
- Nuclear waste

- **Excessive usage of agro chemicals**

The artificially synthesised chemicals for agricultural practices are called agro chemicals. Mainly agrochemicals include chemical fertilizers, weedicides, insecticides, and fungicides. They are used to get short term benefits, but they cause many ill effects on the environment and hazardous to health.

Weedicides, insecticides and fungicides are commonly known as pesticides. The dose of a pesticide required to kill 50% of a population of a particular pest species is defined as lethal dose (LD_{50}).

Assignment 15.6

List out the agro chemicals that are used for a specific crop from its planting to harvesting. Avoid touching those agro chemicals.

The gazette announcement issued on 23rd of December 2014 by the government has banned selling and usage of chemicals such as Glyphosate, Propanil, Carbaryl, Chloropyrifos and Carbofuran.



Figure 15.19 - Different types of chemical substances sold at market

• Discharge of industrial effluents to the environment

The waste materials that discharge after the production process which cannot be used again are called industrial wastes. The discharge of these industrial wastes to the environment causes harmful impacts on the environment. Industrial waste are as follows.

Hydrocarbons

The compounds formed by combination of carbon and hydrogen only in different ratio are called hydrocarbons.

Methods of releasing hydrocarbons to the environment

- Release of CH_4 (methane the simplest hydrocarbon) due to bacterial activity on garbage and dead plant and animal matter in marshy lands.
- During usage of liquid petroleum (LP gas), petrol, diesel, kerosene as fuel that are obtained by fractional distillation of crude oil.
- During usage of lubrication oil and greese which are products of fractional distillation of crude oil.

Emission of greenhouse gases

The temperature of the earth is fixed by a steady state balance between the energy received from the sun and the energy radiated back by the earth. Carbondioxide, water vapour, methane, ozone and CFC absorb radiation given out from the earth and some of it re-radiates back to the earth's surface. This re-radiation helps to warm the earth and maintains a climate that will support life. This is called greenhouse effect and these gases are called greenhouse gases.

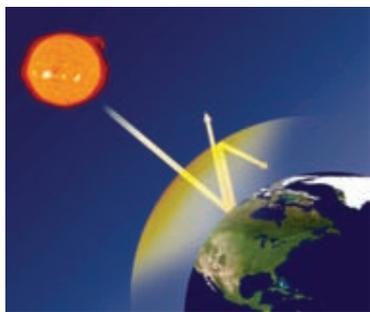


Figure 15.20 - Greenhouse effect

Types of greenhouse gases

Carbondioxide	(CO_2)
Sulphurdioxide	(SO_2)
Oxides of Nitrogen	(NO_x)
Methane	(CH_4)
Chloro Fluoro Carbon	(CFC)
Water vapour	(H_2O)

Due to emission of greenhouse gases enormously, global warming increases.

Ways by which greenhouse gases released to the environment

- Release of CO_2 due to excessive combustion of fossil fuels.
- Sulphur dioxide is released instead of CO_2 due to combustion of fossil fuels and eruption of volcanos.
- Release of CH_4 due to anaerobic decomposition of dead plant and animal matter in marshy lands and garbage.
- CFC is released when using refrigerators and air conditioned appliances.

Accumulation of heavy metals in the environment

The metals with high density and higher relative molecular mass are called heavy metals. Discarded metal items, instruments and parts of vehicles that contain heavy metals accumulate in the environment. Some heavy metals are naturally present in the soil of some areas.



Figure 15.21 - Soil containing heavy metals

Types of heavy metals

Mercury	(Hg)
Arsenic	(As)
Chromium	(Cr)
Cadmium	(Cd)
Lead	(Pb)
Copper	(Cu)
Manganese	(Mn)
Zinc	(Zn)

Methods by which the heavy metals released into the environment

- Release of industrial wastes, wastes of zinc mines, electro plating and cadmium (Cd) released during production of orange coloured pigments.
- Due to excessive usage of agro chemicals, arsenic (As) is released to the environment.
- Release of lead (Pb) from lead mixed petrol.
- Due to excessive usage of coal, discard of damaged thermometers, barometers, CFL bulbs, the paints used to apply on ships and industrial wastes release mercury (Hg).
- Chromium (Cr) is released by paints, cement, paper and rubber. Chromium is used as a pigment to colour them.

Assignment 15.7

- List out the materials and appliances that is utilized at home. Discuss the ill effects caused by different types of heavy metals in them.

Particulate matter

There are two types of particulate matter accumulated in air. They are solid particulate matter and liquid particulate matter.

Solid particles	Liquid particles
<ul style="list-style-type: none"> • Carbon particles • Heavy metal particles • Ash • Dust • Asbestos 	<ul style="list-style-type: none"> • Water droplets • Liquid organic particles • Mercury droplets



Figure 15.22 - Particulate matter of asbestos

Sulphurdioxide

A colourless gas with a pungent smell. When it releases to the environment it causes a big impact on the atmosphere.

Methods of releasing SO₂ to the environment

- When using coal as a fuel
- During combustion of petroleum
- During combustion of vulcanized rubber products
- During bacterial activity on organic matter
- During eruption of volcanoes

Oxides of nitrogen (NO_x)

Oxides of nitrogen (NO, NO₂) cause a big impact on the environment once they are released to the atmosphere.

Methods of releasing oxides of nitrogen to the environment

- During lightning, the reaction between N₂ and O₂ form oxides of nitrogen.
- During combustion inside the engines of vehicle N₂ and O₂ react together to form oxides of nitrogen.

Acid rain

Naturally rain is little bit acidic due to dissolution of carbondioxide and nitrogendioxide (NO₂). The pH is about 5.6 of natural rain water. Sometimes this pH decreases, that is acidity of rain increases. The reason for the increase of acidity in rain is due to increase of sulphurdioxide, sulphurtrioxide and nitrogendioxide in the atmosphere.

Sulphurdioxide is water soluble and then it makes sulphurous acid (H₂SO₃) with water. This sulphurous acid further oxidizes to make sulphuric acid (H₂SO₄). Sulphuric acid is formed due to dissolution of sulphurtrioxide too. Nitrogendioxide helps in increasing acidic nature of rain. It forms nitric acid with water. Water mixing with above acids to form rain is known as acid rain.

Adverse effects of acid rain



Figure 15.23 - Acid rain

- Destruction of forests and crops.
- Destruction of aquatic organisms due to increase of acidity in water.
- Affect the absorption of minerals by plants.
- Dissolving of limestones and other rocks.
- Destruction of metallic buildings, statues, and other ruins.
- Some poisonous heavy metals dissolve in water and the concentration increases in reservoirs.

Activity 15.2

- Detect the acidity of normal rain and the rain after drought period using indicators.

Domestic waste



Figure 15.24 - Domestic-waste

Food scraps, spoiled food, plastic and polythene wastes, discarded clothes, glass and porcelain items, garden wastes and human excretory matter belong to domestic wastes. These are added to the environment continuously.

Electronic waste



Figure 15.25 - Electronic waste

The electrical and electronic accessories which are stopped permanently from reselling, and selling are called e-waste.

Electronic wastes due to the modern technology are added to the environment at a higher rate.

The materials released as e- waste

- Lead - Battery, circuit boards, cathode ray tubes of computers and televisions
- Mercury - Thermometers, florescent lamps
- Cadmium - Battery, cellular phones
- Berilium - Computers, telephone, automatic electronic apparatus
- Arsenic - Light emitting diodes (LED)
- Polyvinylchloride (PVC) - Computer casings, wires, etc.

Nuclear-waste

The radio active and high toxic materials discarded by nuclear preparation centres and nuclear weapons are known as nuclear wastes. Uranium and plutonium are the main elements used as nuclear fuels. The radioactivity of them can exist for a longer period of time. Therefore, they are deposited in deep sea or ground after covering by thick concrete or metal casing.

• Domestic chemical-waste



Figure 15.26 - Domestic chemical - waste

With the industrial development, the usage of chemicals for domestic purposes instead of natural materials has become popular. In present days there are many such chemicals that are used for domestic purposes. Food additives, cleaning agents, medicine, paints and cosmetics are the main chemicals that come under domestic chemical waste.

Food additives

The substances that are added to food to enhance the taste, odour, appearance, nutrition and shelf - life are called food additives.

E-number

E-number is a code given by European union to indicate that the food additive is experimentally proven to assure that it is safe for human consumption. Though it is given by an E- number, reliability of some additives is not 100% assured.

Activity 15.3

Identify E-numbers of food items that is brought home. What are the substances denoted by those numbers? What is the purpose of adding such things? What are the adverse effects of them.

Activity 15.4

- Do an investigation about the substances such as colourings and flavours which are used for the fast foods. Fill the table using those information

Food type	Ingredients	Defects

Extra knowledge

Materials added and the objective	Substances contained	Adverse effects
Pigments (Attractive colour)	FDSC Blue No 1, FDSC Red No - 40 Beta carotene	Allergies, Deformities in children
Sweeteners (Enhance sweetness)	Sucrose, Glucose, Fructose	Obesity, Diabetes, Belly protrude outwards
Taste Enhancer (Enhance the taste of food)	Monosodium Glutamate (MSG)	Headache, Chest pain, Weakening of taste buds, Heart attack
Preservatives (Preserve food without spoilage)	Ascorbic acid, BHA, BHT, EDTA, Sodium Benzoate, Calcium Propanoate, Sodium Nitrate (NaNO ₃)	Allergies, Vomitting, Nausea, Stomachache, Infertility, Cancers, Mutations, Disorders in liver and kidney
Stabilizers (Enhance the texture)	Gelatine, Pectin	Diarrhoea
Leavening agent (Make porous)	Sodium bicarbonate (Baking soda) Calcium carbonate Monocalcium phosphate	Stomachache, Cancers
Bleaching agents	Sulphurdioxide SO ₂	Breathing difficulties
Nutrients (Addition of nutrients that are destroyed during production)	Thyamine hydrochloride Riboflavin Folic acid Ascorbic acid	Nausea, Vomitting

Diseases caused by food additives

- Wheezing
- Kidney disorders
- Diabetes
- Cardiac diseases
- Cancers (Digestive tract, Lungs, Liver, Thyroid gland)
- Allergies (Skin diseases)
- Disorders associated with nutrition
- Diseases of nervous system
- Hyperactivity of children
- Mental disorders
- Diseases associated with digestive tract.

Cleaning agents

Soap or different types of shampoo are used to cleanse skin and hair. Soap or detergents are used to wash clothes and different types of cleaning agents are used to clean floors and walls. Cleaning agents are important to do the cleaning activities which cannot be done with water, better. The basic raw materials of soap are plant oil or animal fat and a strong base like sodium hydroxide or potassium hydroxide. Coconut oil and other plant oils are often used for this purpose.



Figure 15.27 - Detergent swans

Soap bubbles are formed less in dense water. Artificial detergents are used as a solution to this. These are produced with a mixture of artificially synthesized chemicals. When both these types are added to water, it is harmful to the aquatic organisms. Furthermore, there is a threat of coral reefs being destroyed in the marine areas near hotels and it also affects to reduce the bio diversity of fresh water sources.

The harmful effects of the excessive use of artificial detergents are detergent swans which can be seen on the surface of water systems.

Medicines

In the past, man had a sound knowledge of popular indigenous medicines and they used natural medicines. At present there are different kinds of medicines at home that are used without prescription to ease simple ailments. Examples are using anodynes for fever, using different creams for pains and itching and using antacids for gastro acidity. Moreover, when there are cuts and bruises, antiseptics like spirit is used. Antiseptics is a chemical which is applied on living tissues which destroy microorganisms or prevent their growth. When they are used, the correct dosage should be taken on the correct time. It is very dangerous to use medicine without the advice of the doctors for a long period of time. In the past, margosa, turmeric liquid and salt water were used as disinfectants and at present artificial disinfectants are used to clean the floor, kitchen, toilets and bathrooms. Disinfectants destroy microorganisms and it is not safe for them to come into contact with living tissues. Many side effects can be resulted due to their excessive use and they should be used moderately. By using disinfectants often and excessively in the toilet, the microorganisms that decompose faeces are destroyed.

The following grid contains examples for medicines, disinfectants and antiseptics that are used in homes.

Medicines	Disinfectants	Antiseptics
Magnesium carbonate	Phenol	Iodine
Aluminum hydroxide gel	Chlorine	Surgical spirit
Aqueous magnesium hydroxide (milk of magnesia)	Alcohol	Boric acid

Cosmetics

For cleanliness, beauty, health and pleasantness, people have used natural plant extracts like sandalwood, turmeric and types of clay as cosmetics for thousands of years in the history.

At present, perfumes, bleaching creams, talc, hair colourants and bleaches, deodorants and lipsticks are used as cosmetics. There are naturally or artificially synthesized oils, colourings, fragrant substances, distilled substances and preservatives contained in them. Most of them are complex carbonic substances. In perfumes and deodorants, there are alcohol, esters and distilled substances. When these are used excessively, some diseases are caused in some people. Sometimes, headaches, vomiting and breathing difficulties can occur. In most of the lipsticks, there is led and the excessive usage can cause dryness and cracks on lips.

Mercury is present in some cream. In some other creams, carbon compound that controls the formation of melanin colourant is present. This will destroy the natural protection that protects the skin from ultraviolet rays and poses the risk of skin cancer. It gets into the skin and harms the connective tissues. The use of cream for a long period of time can cause defects in skin. Sometimes, this can harm the brain, liver and kidneys. Some hair colourings and compounds with bleaches cause allergies in some people. This causes itching in the scalp, skin rashes, swelling, cancers and even death.

Paints

A material that is applied on surfaces to protect the surface having a desired colour are called paints. Paints contain three components.

- Pigment - They are produced mainly by metal oxides or metal salts. Bronze, gold, zinc and aluminium metals are prepared into a fine powder and used as pigments.
- Binder or non volatile substance
- Vehicle or solvent - Volatile hydrocarbonic substance such as turpentine is used as vehicle. water is used as the vehicle for water soluble binders.

• Combustion of fossil fuel and waste matter

Combustion of fossil fuel enormously in factories, automobiles, petroleum power stations results in emitting a large amount of carbonmonoxide (CO), carbondioxide (CO₂) and sulphurdioxide (SO₂). Burning of plastics and polythene too emits dioxin and other gases.

• Persistent Organic Pollutants - POPs

Some toxic, hazardous organic substances have been identified as persistent organic pollutants. They are released to the environment from different sources. These pollutants have certain specific features as follows.

- Persist in the environment for a long of time period
- Accumulate in the body of organisms along food chains
- Widely dispersed in the environment
- Highly toxic

Twelve organic pollutants have been identified as dirty dozen which can pose effective threat to the earth.

Extra knowledge
Dirty dozen

Chemicals associated with factories	Industrial and cumbustive byproducts	Pesticide
<ul style="list-style-type: none"> □ Hexacholoro benzene □ Polychlorinated biphenyls / PCBs 	<ul style="list-style-type: none"> □ Dioxin □ Furan 	<ul style="list-style-type: none"> □ Aldrin □ Chlordane □ DDT □ Deildrin □ Endrin □ Heptachlor □ Mirex □ Toxaphene

Other than those, some other compounds belong to persistent organic pollutants. These POPs cause certain adverse effects as follows,

- Inborn defects
- Cancers
- Mental defects
- Weakness of the immunity and function of reproductive system.

15.3.3. Adverse effects of environmental pollution

● Direct effects of environmental pollution

Acid rain

It is mentioned in page 184 about acid rain. Acid rain has been described as a harmful condition caused by the industrial wastes such as oxides of nitrogen and sulphur.

Global warming

Greenhouse effect occurs in the atmosphere with the high concentration of the polyatomic molecules of greenhouse gases such as carbondioxide, methane, CFC etc. High amount of energy received from sun is refracted away from the earth when the greenhouse gases exceed their permissible level. Hence, the temperature of the atmosphere increases. This is called global warming. Changes that occur due to global warming are shown in Figure 15.28

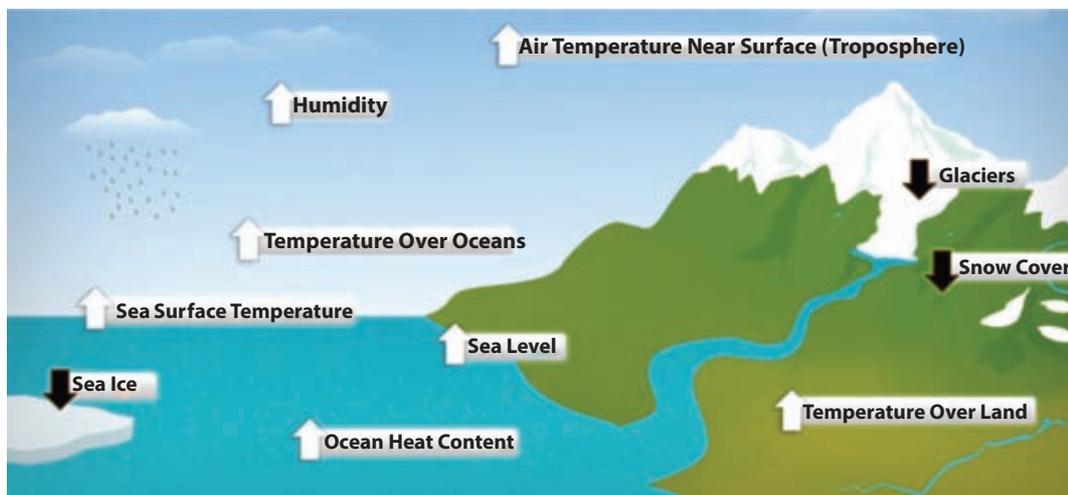


Figure 15.28 - Changes that occur due to global warming

III effects of greenhouse effect

- Melting of polar Glaciers due to global warming
- Rising of sea level and small islands will be submerged
- Change of global climatic patterns

Depletion of ozane layer

Ozone is a trimetric molecule of oxygen. This is a thin layer found at 25 km away from the earth surface. At higher atmosphere oxygen absorbs Ultra Violet radiation and forms atomic oxygen. This atomic oxygen is highly reactive. They react with O_2 to form O_3 . This O_3 is converted back to O_2 and natural equilibrium is maintained. This ozone layer acts as a protective shield to prevent the entry of harmful UV radiation to the earth surface. But gases like CFC and nitric oxide (NO) destroy ozone layer by detaching O_2 . CFC at higher atmosphere obtain solar radiation and is converted to atomic chlorine. This atomic chlorin reacts with O_3 and breakdown ozone molecules. Similarly nitric oxide also reacts with ozone to destroy them.

Due to the depletion of ozone layer, holes appear in it. As a result, radiation with high energy reaches the earth surface.

III effects of ozone layer depletion

- Cause cataracts
- Cause mutations
- Reduce body immunity
- Affect photosynthesis and reduce crop yield

Photo chemical smog

It is a yellow coloured mist that is formed due to reaction, resulted between sunlight and the chemicals in vehicle emission, which causes eye irritation and vision impairment.

Extra knowledge

The oxides of nitrogen released due to combustion of fossil fuel and unburnt hydrocarbons transforms into ozone aldehyde, Peroxy Acetyl Nitrate (PAN), Peroxy Benzyl Nitrate (PBN) at 15°C in the presence of sunlight. Due to these secondary pollutants, photochemical smog is formed.



Figure 15.29 - Photochemical SMOG

Adverse effects of photochemical SMOG

- Cause respiratory tract disorders like cough, wheezing etc.
- Toxic to plants. So plant growth and food production is affected.
- Vision is affected due to turbidity.
- The quality of rubber and clothes reduces due to bleaching.

Biomagnification

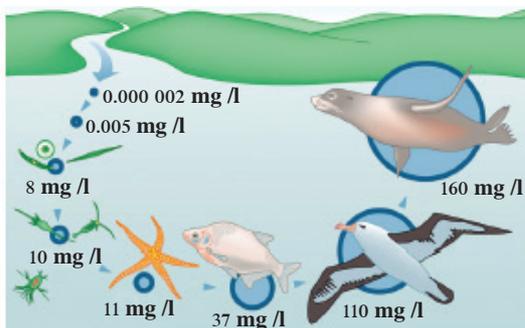


Figure 15.30 - Biomagnification

Collection of toxic chemical pollutants along with food chains from one trophic level to the other is called biomagnification.

● Extra knowledge ●

Dichloro Diphenyl Trichloro Ethane (DDT), Poly Chlorinated Biphenyl (PCB), Mercury, Copper (heavy metals) accumulate in the body of organisms.

Features of bioaccumulated substances

- These substances do not degrade easily and retain for a longer period of time
- Can pass from one organism to the other
- Soluble in lipids
- Become active as biochemicals

These substances enter into lower trophic levels in micro amounts. But they get concentrated along higher trophic levels.

Eutrophication



Figure 15.31 - Eutrophicated reservoir

Phosphate and nitrate concentration in reservoirs increases due to waste materials from industries, agrochemicals, faecal matter and detergents. As a result algae grow excessively and form a green coloured foamy layer. This incident is known as eutrofication. The over populated algae die due to competition and anaerobic bacteria act on these dead matter and emit gases such as hydrogen sulphide (H_2S) ammonia (NH_3), methane

(CH_4) which result an unpleasant odour.

Ill effects of eutrofication

- Loss of transparency of water
- Unable to utilize water
- Reduction of bio diversity due to death of aquatic plants and animals
- Loss of beauty of reservoirs

Increase of radiation level

Exposure to radiation increases day by day. These radiations are released by natural sources and due to human activities. Especially destruction of ozone layer and accidents in nuclear power stations are the reasons for this situation.

E.g. :- Fukushima power station in Japan, Churnobill power station in Russia



Figure 15.32 - Accidents in nuclear power stations

- **Indirect effects of environmental pollution**

- Loss of habitats of organisms**

- The natural environment where a plant or an animal lives is known as a habitat. These habitats are lost due to environmental pollution. Wild elephants tempt to destroy villages and agricultural lands due to the loss of their habitat. That is a result of environmental pollution.

- Desertification**

- The change of the ground condition making unsuitable for the plant growth is called desertification. Deforestation, greenhouse effect, salination and natural causes such as weather changes are the reasons for desertification. Irregular monsoon rains causing droughts is a result of this.

- Reduction of crop yield**

- When the conditions required for photosynthesis are not present in optimum levels the productivity of plants is affected. Therefore, the yield is reduced. Lands become infertile due to their constant use for agriculture. The productivity of plants decreases through water, land and air pollution.

- Constructions and degradation of natural environment**

- Metal statues, buildings, ruins and marble buildings are eroded by acid rains. Natural limestones also degrade due to acid rains. As temperature of the environment increases wall plasters and paintings of Taj Mahal is at a risk of deterioration.

Health issues

As environment is polluted, the infectious (contagious) and non - infectious (non-contagious) diseases spread rapidly in the environment. Due to improper disposal of garbage, diseases like Dengue spread.

Reduction of biodiversity

Reduction of number of species in a unit area of biosphere is known as reduction of biodiversity. When pruning some plants used in landscaping some parts are removed. When ornamental fish like catfish grow in size they are released to the natural water bodies. These organisms become a threat to other organisms in the natural environment and affect the biodiversity.

Introduction of invasive species

Invasive species are results of the changes in the environment. These species can tolerate the conditions and therefore invade the habitats of native species.

E.g. - Giant Mimosa, Trout, Andara, Lantana

Assignment 15.8

Prepare a report about invasive plants and animal species of Sri Lanka.

Economical losses

An extra amount of financial input and effort is needed to revise the environment and maintain it.

15.4 The factors that affect the life style of human and the problems created

15.4.1 Factors that affects the life style of human

Several factors on earth affect the life style of human. Industrialization, urbanization, commercial agriculture and irrigation systems are some of them.

- **Industrialization**

The process by which a country transforms primarily from an agricultural society to a society that produces goods and services is called industrialization. The industrialization initiated from Western Europe in AD 1800 with the technological development and insufficiency of small scale production.

- **Urbanization**

Aggregation of people in areas with abundant resources with the growth of human population is called urbanization. People migrate to cities in search for employments and comfortable life style. As a result, urbanization takes place.



Figure 15.33 - View of an urban area

- **Commercial agriculture**

Large scale agriculture which exceeds the subsistence food production and commercial intentions are called as commercial agriculture. Here, use of modified varieties to obtain productive harvest, agrochemicals and machinery are taken into consideration.

- **Irrigation systems**

Instead of depending on direct rain water, man constructed tanks, ponds, reservoirs, canals, dams and tunnels to obtain water for agricultural purposes. They are considered as irrigation systems.

- **Utilizing materials and energy abundantly and differently**

Due to technological development and complex needs of life, materials harmful to environment in a great extent are being used while minimum labour is spent whereas machinery is used consuming energy.

15.4.2 Problems that arise due to changes in life style

- **Growth of non contagious diseases and disabilities**

Diseases which are not spread from one person to the other are called as non contagious diseases. According to data of World Health Organization (WHO) annually 38 million people die due to these type of diseases. Most common contagious diseases are cancers, pulmonary diseases and diabetes. Excessive consumption of tobacco and liquor, wrong food habits and lack of physical exercises are the causes for these diseases. Non contagious diseases have

become a major problem in Sri Lanka today. Out of the deaths occurred due to diseases, 60% had occurred due to non contagious diseases. Out of them several diseases are given below.

Chronic Kidney Disease /CKD

Chronic Kidney Disease or renal failure is spreading gradually in agricultural areas in Sri Lanka. Gradual loss of kidney functions including the urine production is known as renal failure. There are two main forms of renal failure as follows,

1. Acute renal failure

Loss of kidney function temporarily for a few hours or days is a feature of acute renal failure. It is often reversible with immediate treatment.

2. Chronic renal failure

Chronic renal disease causes gradual loss of kidney function which is not reversible.

Other causes for renal failure are,

- Diabetes
- High blood pressure
- Constant urine infections
- Calculi in bladder
- Urinary tract Infections
- Intoxication (snake, wasp, hornet venom, agrochemicals)
- Allergies

Symptoms of renal failure

- Urinary urgency may occur frequently at night
- Little or no urine output
- Pain in the back
- Swelling of feet and ankle
- Weakness, pale skin
- Urine contain protein
- Rashes on palm and soles



Figure 15.34 - Patches due to clinical kidney disease

Speciality of the kidney disease

- Though acute renal failure occurs due to uncontrolled diabetes or high blood pressure people might have chronic kidney disease without any prior disease.
- Most of the people who have the disease are engaged in agriculture. Tendency of people who spray the agrochemicals having the disease is high.
- The first patient was reported from Padaviya Govi Janapadaya in 1994. Though at the beginning farmers of 50-60 years of age were seen to have the disease, later people of 25-30 years of age have got the disease at present.
- Delayed symptoms keep the patient ignorant about this disease. Sometimes when the patient realizes, he is affected by the disease and 40-60% of the kidney has lost its function.
- Most of the people affected are identified to be drinking hard water

Factors that have been identified to be contributing to CKD

- Toxic elements emitted by blue green algae.
- Absorption of agrochemical into body.
- Absolutely heavy metals such as Cd, Pb, As
- Drinking water with fluoride
- Dehydration
- Using drugs without any control
- Consumption of liquor

Measures that can be taken to avoid CKD

- Refraining from using agrochemicals, and food for which agrochemicals are used
- Maintaining a wholesome life style to control and prevent diabetes and high blood pressure
- Minimizing the frequent urine infections during childhood or which adults are affected from
- An adult drinking 3.5-4.5 litres or 5-6 bottles of clean water a day
- Receiving medical treatment for skin allergies immediately
- Refrain from improper use of pain killers
- Refrain from liquor consumption and smoking

Diabetes

Increase of blood glucose level above the normal level is known as diabetes. Normally, insulin converts the excess glucose in the blood into glycogen and allows it to store in the liver. Failing of the secretion of insulin due to dysfunction or inborn absence of beta cells in the Islets of Langerhans which is located in the

pancreas, secretion of insulin fail. When diabetes is not controlled kidney weakens and gradual blindness occurs. Due to busy life style, consumption of food items made of wheat flour and polished rice which are digested instantly, abstaining from exercising and mental stress are some of the causes of diabetes.

Cancer

Cancer is a disease caused by an uncontrolled division of abnormal cells in a part of the body. With the industrialization, harmful radiation, chemical and heavy metals are abundant in the environment. Frequent exposure to radiation and intake of heavy metals to the body, increase the possibility of a cancer.

Heart diseases

Narrowed or blocked blood vessels, heart muscles, valves or rythem not functioning properly lead to heart diseases. Chest pain, heart attack, strokes, thrombosis are some forms of heart diseases. The main cause of heart diseases is the changes in the human life style. With the industrialization, activities of human have become more convenienced, lack of physical exercises, rest and mental stress cause these diseases.

Pulmonary diseases

An unhealthy condition which affects the organs or tissues which involves in the respiration such as trachea, bronchi, bronchioles, alveoli and other nerves and muscles may cause pulmonary diseases. Harmful gases emitted from vehicles and factories also contribute to this.

Wheezing

The air ways are obstructed by the mucus produced due to allergies in trachea, bronchi, bronchioles and alveoli of the respiratory system. Harmful gases and dust particles (Air pollutants and irritants) remain as causes.

Gastritis

Inflammation and swelling in the lining of the stomach due to increasing acidity is the main symptom of this disease. Not taking meals on time because of busy life style, frequent consumption of food containing excessive oil and acids, mental stress caused because of living under a competitive condition are the causes of this disease.

Cataracts

Due to the change in the nature of proteins in the lens of the eye, the transparency of the lens ceases. It is known as the cataract. Here, light does not enter the eye and the eye sight is weakened. Due to the emission of harmful gases from factories, the ozone layer becomes depleted. Thus, ultraviolet rays fall on earth. The exposure to these rays is a cause for this disease.

15.5 Sustainable development and environmental management

Sustainable development is the smart use of the natural resources by safeguarding the balance of the environment in such a manner that the future generations can use them in the future.

Environmental management is the maintenance of natural resources by using them in an environmental friendly manner to fulfill the needs of man.

15.5.1 Sustainable agricultural uses

A sustainable development could be expected by reforestation, use of traditional knowledge and technology, carbon foot print, minimizing food miles, waste management and energy management.

- **Multiple cropping**

Cultivation of different crops in one land area instead of mono cropping in large scale is called multiple cropping. Multiple cropping avoids the risk of destroying the cultivation with a disease and also reduce pests with high resistance.



Figure 15.35 - Mono cropping



Figure 15.36 - Multiple cropping

- **Biological pest control**

The biological pest control is the use of another plant, animal or a microorganism which do not harm the cultivation in order to destroy pests. Coconut caterpillar *Promecotheca cumingii* was a major coconut pest which was successfully controlled, using a larval parasitoid *Dimokia javanica*.

- **Use of organic fertilizer**

It is environmental friendly to use substances made by transforming complex organic compounds found in animals and plant parts to simple compounds as fertilizers. Organic fertilizers are the decomposed plant and animal matter which help to improve, soil structure and porosity to enhance the activity of soil organisms.

Assignment 15.9

Engage in a discussion about the advantages caused to the environment by using the above mentioned agricultural uses.

- **Reforestation for environmental balance**

Environmental management is the maintenance of natural resources by using them in an environmental friendly manner to fulfill the needs of man.

As a result of changing the environment by man according to his necessity, the forest cover gradually decreased. Specially, paddy cultivation, vegetable cultivation, tea cultivation, rubber cultivation and large scale development projects were the reasons for this situation.

At present, we experience the harmful effects of the decrease of the natural forest cover. Therefore, in order to reestablish the environmental balance, it is necessary to do reforestation in suitable areas.



Figure 15.37 - Reforestation

15.5.2 Traditional knowledge and use of technology

- **Agriculture**

It is mentioned that during the rule of King Parakramabahu the Great, our country was self sufficient with rice and rice had even been exported. But, at present, we are unable to achieve such heights although machines and agricultural chemicals are excessively used. Therefore, instead of seeds and agricultural chemicals purchased from multinational companies, it is the high time to use traditional agricultural methods such as local seeds and cultivation methods.

Extra knowledge ●

Some important information of traditional varieties of paddy

Type of paddy	Function
'Kuruluthuda'	<ul style="list-style-type: none"> ● Induce spermatogenesis ● Make body strength ● Reduce joint pain ● Increase immunity ● Act on excretory system readily
'Kahawanu'	<ul style="list-style-type: none"> ● Facilitate digestion of food ● Facilitate absorption of sugar ● Prevent carcinogenic properties
'Rathhal'	<ul style="list-style-type: none"> ● Activate excretory system ● Make the body comfortable ● Cure lung diseases and fever ● Heal abdominal disorders ● Clean urine and bile
'Madathawalu'	<ul style="list-style-type: none"> ● Removal of toxic metals from body ● Prevent diabetes ● Avoid gene mutations ● Enhance immunity ● Growth and repair of tissues ● Cooling of body
'Suwadal'	<ul style="list-style-type: none"> ● Control eye diseases ● Induce nerve activities and control diseases ● Aids in spermatogenesis ● Reduce oedema ● Anti-diabetic properties
'Mavee'	<ul style="list-style-type: none"> ● Anti-diabetic properties ● Reduce burning sensation, Thridosha and prevent constipation ● Improve skin condition
'Kaluheenati'	<ul style="list-style-type: none"> ● Prevent constipation ● Anti cancerous properties or carcinogenic properties ● Body warming ● Aids in spermatogenesis

● **The technology of irrigation**

Sri Lankan irrigation system is one of the unique water management systems in the world. Historical large tank can be identified as a great technical attempt with a very complex scientific knowledge.



Figure 15.38 - An ancient tank bund

The reservoir constructed across a river, canal or a branch of it with the aim of collecting sufficient water for agricultural activities is known as a tank.

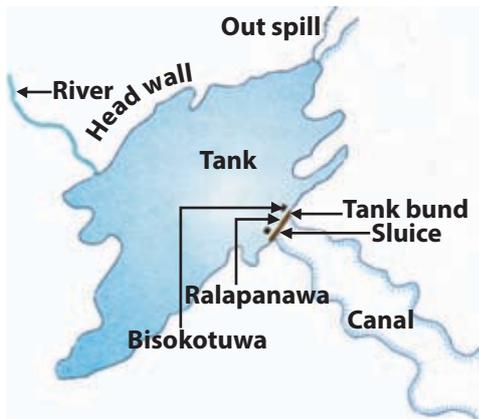


Figure 15.39 - Major parts of a tank

The large tanks distributed in the dry zone of Sri Lanka hold a huge water capacity. Major factor that should be paid attention to constructing such large scale tanks is, keeping the collected water for a long time. Also by controlling the pressure caused by its colossal capacity of collected water and controlling the power caused by its extremely destructive pressure when the water is taken out for use.

There are several functions done by tank bund, sluice, Bisokotuwa (Sluice gate), Ralapanawa and canal, which are considered as the major parts of a tank. The tank bund was built with soil connecting the hills from either side.

The robustness is essential if the stability of the tank bund and needs to be protected. To maintain this situation a systematic methodology has been applied. Tank bund had been constructed of several soil layers. It had been made of several thoroughly beaten layers such as, a layer of clay, soil, gravel and clay (Kirimeti) layer, kept one on one.

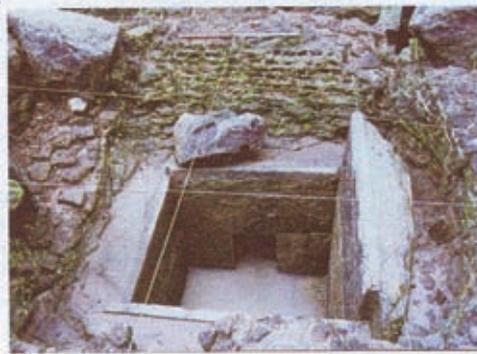


Figure 15.40 - A sluice gate

When water in large tanks is taken out a huge pressure is exerted and the magnitude of pressure increases with the height of water column. The sluice was built at a specific level on the tank bund using huge pieces of stones in a way that it began from the area where water is filled in the tank bund and going under the tank bund or piercing it. A slab of stone, connected to the sluice vertically was used to release water. There are more than one sluice made in tanks with a high bund.

Bisokotuwa is also a part of the sluice. It means that the rectangular space made of stones, from which water flows out from the tank. Its purpose is to take water out with less pressure level after releasing water at different pressure levels. The mud sluice is at the bottom level of a tank bund. This mud sluice was used to remove alluvial collected after a rainy season.

When a tank is filled with water, waves occur on its surface, and the waves can erode the bund. The Ralapanawa is made by keeping stones on the interior slope of the tank bund. A brink (**Isweti**) is built to avoid collecting water with eroded mud, sand and gravel, to the tank water.

The small sized water tanks built in the upper part of tank collect water first and next the large tank.

The upper part of tank that is Head wall (**Wew Ismaththa**) is the water catchment area. Clearing forest, cultivation and building of houses is strictly prohibited in this area.

The surrounding area parallel to the water level is known as **wew thawulla** and this is rich with natural habitats of flora and fauna.

Accordingly, tank is a marvellous human creation that is compatible with nature.

Assignment 15.10

Make a scientific investigation about the technology of irrigation system of Sri Lanka, and prepare a report.

• Conventional food patterns

Food comprises of a collection of nutrition, healthiness, culture, tradition, environment, creation, folk tales, literature, technology, etc. The traditional food patterns improved the quality of life of our people. But consumption of oily, starchy

food, flavourings and bad food habits cause number of issues in public health. This condition has influenced the tendency of non-contagious diseases like high blood pressure and diabetes.

Important facts about natural flavourings

- The most reactive parts of a food
- Improve the colour, taste, odour and appetite of food.
- Contain bactericidal properties
- Minimize, harmful effects caused by food
- Has unique taste and quality, which cannot be obtained by artificial flavourings.

E.g. :- Cinnamon - Control the blood glucose level.
Reduce diseases caused by phlegm
Has anticancer properties

Clove - Give pleasant odour to mouth
Relieve pain
Destroy microorganism (Detergent property)

Pepper - Stimulate digestion of food
Relieve abdominal disorders

● Indegenous medical science

This field consists of Aurveda, **Siddha**, **Unani** and native medicinal fields, which has history of thousands of years. Ayurveda is one of the important medical fields, descended from India. It is a perfect science with two traditions.

1. Clinical medicine (Kayachikithsa)
2. Surgical science

According to Ayurveda there are three types of reaction that take place in human body. Those three factors are known as **Va, Pith and Kapha**.

'Va' - Air
'Pith' - Bile
'Kapha' - Phlegm

Imbalance of these three factors cause diseases according to Ayurveda. Ayurveda field of medicine, use plants, or parts of plants to treat patients.

Treatments are given in three ways

1. Medicine
2. Food
3. Exercises

In Ayurvedic medicine, treatments are done to the cause or root to the disease. Body activity is not controlled artificially by giving medicine (drugs) externally. Therefore side effects are not resulted.

Food is also a significant factor to cure diseases. It should be consumed to balance Va, Pith and kapha the three factors.

Its main target is not only curing diseases, but also maintaining physically and mentally fit healthy life.

15.5.3 Carbon footprint and minimization of food mile

- **Carbon footprint**

The amount of carbondioxide released into the atmosphere as a result of the activities of a particular individual, organization or community is a carbon footprint. Total carbonfoot print cannot be calculated as CO₂ is naturally produced whereas it needs more data.

- **Water footprint**

The amount of fresh water utilized in the production or supply of the goods and services used by a particular person or group.

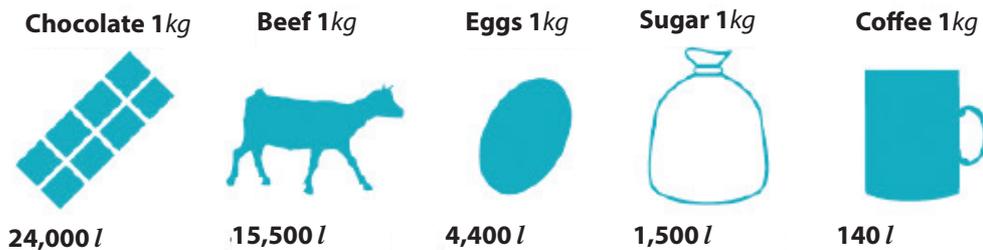


Figure 15.41 - Water footprints of several foods

- **Food mile**

The distance over which a food item is transported during the journey from producer to consumer, is known as food mile.

The food mile changes according to the quantity of food and the place it is produced.

E.g. - Food mile of some of the foods that you take for your breakfast can be calculated as follows. Suppose you are in kurunegala.

(1)

Rice	1 mile	(Taken from your paddy)
Potato curry	100 miles	(Taken from Welimada area)
Coconut	0 mile	(Taken from your coconut trees)
Eggs	10 miles	(Taken from a poultry farm of your area)
Summation	<u>111 miles</u>	

(2)

String hoppers made up of rice floor	85 miles	(Rice taken from Polonnaruwa)
Dhal curry	925 miles	(Taken from Misur area of India)
Coconuts	0 mile	(Taken from your home garden)
Coconut sambol	185 miles	(Taken from Jaffna)
Summation	<u>1195 miles</u>	

(3)

Bread		(Wheat flour taken from America)
Fish curry	9340 miles	(Taken from Negombo)
Coconuts	44 miles	(Taken from your home garden)
Coconut sambol	0 mile	(Taken from Chennai, India)
	<u>800 miles</u>	
Summation	<u>10184 miles</u>	

As long as the food mile is short, sustainability and environmental friendliness is high. Therefore we should take actions to shorten the magnitude of food mile.

15.5.4 Waste management

Consumption of substances becomes greater with the increase of human population. Eventhough natural waste materials deteriorate gradually, they get collected to the environment rapidly. Odour of such waste spreads in urban areas, rather than in villages. Non deteriorative materials such as polythene, plastic, electrical cells, electronic waste, electric bulbs and, printed coloured newspapers get collected in the environment continuously. When burning these waste materials gases such as dioxine emits. When these waste materials are burried, soil gets polluted and heavy metals get collected into soil. Public is unaware of the danger of them. It is very important to be knowledgeable that gradual disposal of the tiny piece of plastic, battery of a mobile phone CFL bulb be catostrophic. It is our responsibility to collect waste matter separately and forward it to the process of recycling.

The waste handling technique named 4R is practised in waste management

Reuse - Use as many items as possible again and again.

E.g. Polythene

Reduce - Unnecessary items should be avoided or minimized.

E.g. - Avoid taking antibiotics and vitamins unnecessarily

Replace - Use of eco friendly substances instead of incompatible materials with nature.

E.g. - Use of organic fertilizer instead of chemical fertilizer.

Recycle - Process to convert different raw materials, animal dung and dead bodies into new products to prevent waste of potentially useful materials.

E.g. - Production of bio gas using animal excretory matter, dung and dead matter.

Recycling polythene and plastic in order to produce fuel.

15.5.5 Energy management

Consumer is provided with an opportunity to utilize energy with the aim of conservation of energy and minimization of cost. Planning and monitoring of energy production and consumption is required for sustainable utilization and then fulfil the needs of the consumer. This process is referred to as energy management.

- **Energy crisis and technological issues**

Drastic increase of price of economically important energy resources due to their constricted supply is referred to as energy crisis. Fuel oil crisis, electricity crisis and dearth of energy resources also indicate this problem. Energy crisis occurs as a result of the great demand for the supply of limited natural energy resources.

Reasons for energy crisis

- Drastic growth of human population
- Increase of the number of industries
- Over consumption of energy
- Wasting energy
- Non investigation of renewable energy resources
- War activities
- Political problems

Technical problems arise during the management of available energy. Technology for extraction of energy resources, methodology of purifying energy resources are some of them.

Assignment 15.11

List out the steps you follow to utilize energy with minimum wastage.

- **Monitoring of daily energy consumption**

It is necessary to be aware and compare the energy consumption by measuring it daily. Then wastage can be minimized.

- **Energy auditing**

The purpose of monitoring is to visit different institutions, and make recommendations and advise based on the results of the respective energy audits and make the authorities aware related to energy consumption.

In this context making the public enthusiastic on reduction of energy consumption and improving energy efficiency are ensured.

- **Energy efficiency**

Energy efficiency is defined as utilization of minimum quantity of energy for a particular service through effective management of energy consumption.

It is possible to improve energy management and control through energy efficiency. It also enables to provide an enhanced service by utilizing minimum energy. However this does not mean that the service is withheld or controlled.

Assignment 15.12

Investigate the electrical appliances at your home and record their wattage (power). Hence compare their level of energy consumption.

- **Sustainable energy use**

In sustainable use maintenance of a certain aspect at a desired status/level is expected. Due to technical reasons, utilization of most renewable energy resources still remains at a lower level.

E.g. Solar energy, Wind energy, Biomass

Importance of utilizing natural energy in architecture

In constructing a house some steps need to be taken in order to maintain good indoor air circulation. When natural sunlight incidents upon the surfaces the temperature of indoor environment increases. Hence it is not desirable to place fenestrations (windows) on East and West walls of the house. Especially since heat transfer from the western side is high, it is not done. By placing windows on North and South directions good air circulation and natural cooling can be maintained within the house. Electrical energy consumption for air conditioning can be minimized to a great extent by means of natural ventilation. Day light harvesting can be utilized for reducing electrical energy consumption due to artificial lighting. This enables a substantial reduction of operational cost of a building. Using thick curtains can also lead to reduction of heat transfer in air conditioned spaces. This considerably reduces energy consumption for air conditioning. Rain water harvesting can be applied as an energy conservation measure. In boiler systems exhaust gases discharged through the chimney stack contain high temperature waste heat which can be extracted to heat boiler feed water and as an air pre-heater. With the utilization

of eco-friendly natural energy sources it is possible to minimize the adverse effects on the environment.

Different Conventions, Legislations and Acts are in function at international and national level for the management and sustainable use of the environment.

Several examples for international conventions are given below.

- Montreal protocol to control the gases which harm the ozone layer
- Kyoto protocol to minimize the emission of greenhouse gases

State institutions under the Ministry of Environment, Central Environment Authority, Marine Environment Protection Authority, Geological Survey and Mines Bureau, State Timber Corporation, National Gem and Jewellery Authority implement law, rules and regulations related to environmental management.

Assignment 15.13

Prepare a booklet on renewable energy sources.

Summary

- There is a natural balance among living organisms, physical component and the environmental conditions in the biosphere. This balanced relationship is known as the environmental equilibrium.
- The increasing human population and their activities cause the breakdown of the ecological balance.
- The simple organizational level that is individual, organize to form population, community, ecosystem and finally forms the biosphere.
- The flow of energy and natural minerals among organisms is essential to maintain the ecological balance.
- The flow of energy and nutrient among organisms occur through food chains, food webs and bio geo-chemical cycles.
- Environmental pollution is the breakdown of ecological balance due to the waste materials released to the environment by man.
- Agro chemicals, industrialized waste, greenhouse gases, heavy metals, particulate matter, food additives, cleaning agents medicine, detergents and perfumes are the main causative agents of environmental pollution.
- Man is experiencing direct and indirect effects of environmental pollution at present.
- Usage of indogenous knowledge and technology, indogenous medicines waste management and energy management are some of the effective ways for sustainable development.

(3)

1. Name two applications in sustainable agriculture.

2. State two fields where indigeneous knowledge and technology can be applied.

3. What is known as **food mile** ?

4. Name two ways to shorten the food mile.

Technical terms

Biosphere	- சேவலோலய	- உயிர்க்கோளம்
Bio geo - chemical cycles	- சேவல ஐ ரசாயனிக வக	- உயிர்ப்புவி இரசாயனச் சக்கரம்
Industrialization	- கார்கீகரணய	- கைத்தொழில் மயமாக்கம்
Urbanization	- நாலீகரணய	- நகரமயமாக்கம்
Non - contagious diseases	- லே நோவன ரோக	- தொற்றாத நோய்கள்
Food chain	- ஂநார டாலய	- உணவுச் சங்கிலி
Food web	- ஂநார டாலய	- உணவு வலை
Energy pyramid	- ஂகீகீ பீரமீடய	- சக்திக் கூம்பகம்
Number pyramid	- ஂ஁லா பீரமீடய	- ஂண்ணிக்கைக் கூம்பகம்
Biomass	- சேவல பீகனீ஁	- உயிர்த்திணிவு
Sustainable development	- கீரசார ஂவர்ப்பனய	- தொடர்ச்சியான அபிவிருத்தி
Environmental management	- பரீசர கலமநாகரணய	- சூழலில் முகாமைத்துவம்
Energy management	- ஂகீகீ கலமநாகரணய	- சக்தி முகாமைத்துவம்
Waste management	- ஂபடலா கலமநாகரணய	- கழிவு முகாமைத்துவம்
Carbon food print	- கா஁னீ பீசஂவன	- காபன் அடிச்சுவடு
Food mile	- ஂநார ஂகழிவு	- உணவின் மைல் பெறுமானம்

Introduction

This textbook was compiled by the Educational Publications Department in accordance with the syllabus prepared by the National Institute of Education for the use of Grade 11 students in the Sri Lankan school system with effect from 2016. An effort has made here to arrange the subject content to suit the national educational goals, common national competencies, the objectives of teaching science and the content of the syllabus.

The subject of science directs the student towards a more active learning process in a manner as to develop knowledge, skills and attitudes needed for a developmental scientific thought.

Each chapter is compiled based on the three main subject areas that comprise the Science subject; Biology, Chemistry and Physics. Pictures, charts, graphs, activities and assignments are included to enable the easy understanding of the related concepts of the subject.

At the end of each chapter, a summary was included and it provides the opportunity to identify the basic concepts of each chapter and to revise the subject matter. Furthermore, there is a series of exercises at the end of each chapter. It will contribute to measure the expected learning outcomes through a self evaluation.

Activities, self evaluative questions, solved examples, assignments and exercises are planned in a manner as to develop the higher order skills such as it enables the students to develop knowledge as well as the higher order skills such as comprehension, application, analysis, synthesis and evaluation.

For the purpose of directing the student to study further about the subject matter, more information is included in the “For extra knowledge”. It is given only to broaden the subject area of the child and certainly not to ask questions at term tests. Some of the activities mentioned in the textbook could be performed at home and some of them should be performed in the science laboratory of the school. Activity based learning helps to create a liking towards learning science in the students and it will easily establish the concepts.

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