UNIT-1 What is Environment?

Learning Outcomes

By the end of this unit the learner will be able to:

- ✓ Define what an environment is
- ✓ Identify the components of an eco-system
- ✓ Describe the terms 'sustainability' and 'sustainable development'.

Unit 1

What is Environment?

Introduction

Humans live in all sorts of places, including forests, deserts, cities, farms, and more. All of these places make up our physical environment. Earth's physical environment supports many kinds of life forms – everything from jellyfish, to giraffes, to mankind. All of these living creatures make up the biological environment.

The physical and biological environments work together like partners to create a stable, self-sustainable system known as **the natural environment**, which supports them both. In prehistoric times, humans worked within this system as part of the biological environment. However, as humans evolved, they created a new type of environment known as the **man-made environment**.

People are social by nature. We live in groups and interact within a system of rules and expectations known as our society, creating and maintaining different ways of life we call cultures. These interactions make up our **social environment**.

In this unit, you will study these three main types of environments – the natural, the man-made, and the social. These environments are constantly changing, which affects life on earth. Some of these effects can be lasting, even permanent, and they are not always positive. As just one of the many species of life on Earth, it is our responsibility to help keep these environments healthy and balanced.

Explanation

The term "natural environment" evokes images of landscapes which contain basic elements such as soil, water, plants and animals. In fact, all of these things put together make up an organism's natural environment – a specific place which it has adapted over time to live in and interact with. The parts of the natural environment that are made up of living creatures – the plants and animals – are the **biotic components**. The non-living parts – such as the soil and the water – are the **abiotic components**.

Nothing on Earth can live completely alone. Interaction with other living organisms is necessary for survival. For instance, we know that most organisms depend, either directly or indirectly, on green plants. However, plants also depend on animals for things such as the pollination of flowers and the spreading of seeds.

Here are a few examples to help illustrate the concept of a natural environment. Figure 1.1 shows a pond. What are the components of this particular environment?

The abiotic factors of the pond's environment include light, temperature, altitude, and the water in which natural gases and organic matter are dissolved. These factors determine what sort of life can survive here, and changes in these factors can drastically affect the health of any organisms living here.

The biotic components are made up of microscopic organisms as well as larger plants and animals. Plant life here includes phytoplankton and the plants growing in and around the pond. Animal life in the pond's environment includes zooplankton, bacteria, insects, worms, molluscs, tadpoles, frogs, ducks and several kinds of fish.

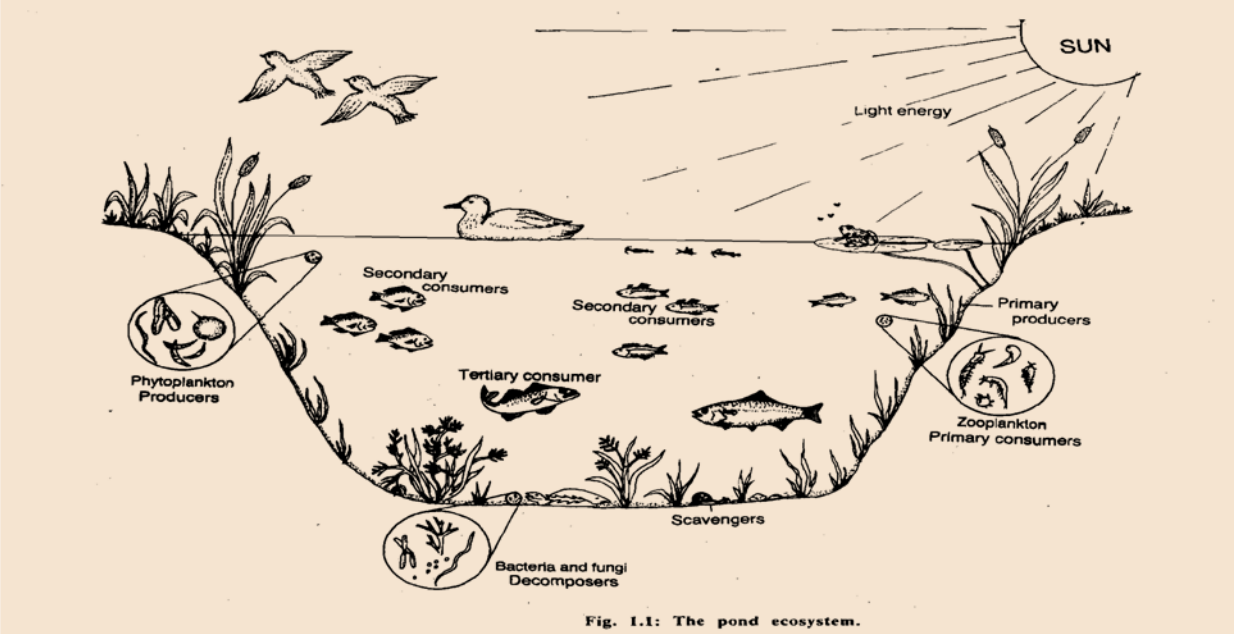

Fig. 1.1: life in a pond

Let's take a closer look at one of the fish in this pond. As we've said, the biotic and abiotic factors of this scene make up the natural environment of this fish, also known as its **external environment**. There is another environment here as well, contained inside the body of the fish: its **internal environment**. The surface of the fish's body acts as a barrier separating the two environments.

An organism's internal environment is usually more stable than its external environment. However, the internal environment can also change. Illness, injury or environmental stress can upset its balance. Generally, when the factor causing the upset is removed, the internal environment will regain its natural balance.

Natural Environment and its Components

An environment includes many different components. Below, we have divided them into two categories: abiotic and biotic.

Environmental Factors

Abiotic	**Biotic**
Energy	Microbes
Radiation	Plants
Temperature and heat flow	Animals (including humans)
Water	
Atmospheric gases and wind	
Fire	
Gravity	
Topography	
Geological substratum	
Soil	

Most living beings cannot exist more than a few kilometres below or above the surface of the Earth. This incredibly thin "skin" around the surface in which life can survive is known as the **biosphere**. The biosphere includes four major categories, or habitats: marine, estuarine, fresh water and terrestrial.

Each habitat also contains subcategories, each of which has a specific set of physical and biological features which set them apart from one another. These subtypes are known as **ecosystems**. Because they are part of the biospheres which make up the natural environment, ecosystems also contain abiotic and biotic components which interact with one another in order to create a stable, self-sustainable system.

The Ecosystem

What is an Ecosystem?

As we said earlier, it is impossible for an organism to live alone. Living things constantly interact with their external environments and with one another. Most tend to create communities, which often stay together for generations. These systems of interaction between organisms and their environment make up the ecosystem. The word "ecosystem" was coined by Arthur Tansley in 1935. The prefix "eco" means environment.

In any ecosystem, there is continuous interaction between the biotic and abiotic components. This interaction involves the input, transfer, storage, and output of energy and materials. Organisms are constantly consuming organic materials and then storing and converting these materials back into other organic matter. Much of this matter is then released back into the environment. Each step of this process requires energy. To cope with the effects of these interactions, the ecosystem is constantly adjusting in order to maintain its natural balance, or equilibrium. In other words, an ecosystem uses feedback from its living and non-living components in order to self-regulate.

Before we explain how these components function in an ecosystem, let's talk about a larger unit of the natural landscape – the biosphere.

Biosphere

A biosphere is a unit of earth and air which contains multiple smaller units, or ecosystems. The three main parts of a biosphere are the **lithosphere** (solids), the **hydrosphere** (liquids), and the **atmosphere**, the layer of gases lying on top of the earth's surface. The atmosphere extends up to a height of 22.5 kilometres.

Figure 1.2 shows a simple diagram illustrating the three main parts of the biosphere and where they come into contact. These points of interaction are important for life in the biosphere because these are the places where the basic processes of life, such as photosynthesis and respiration, occur.

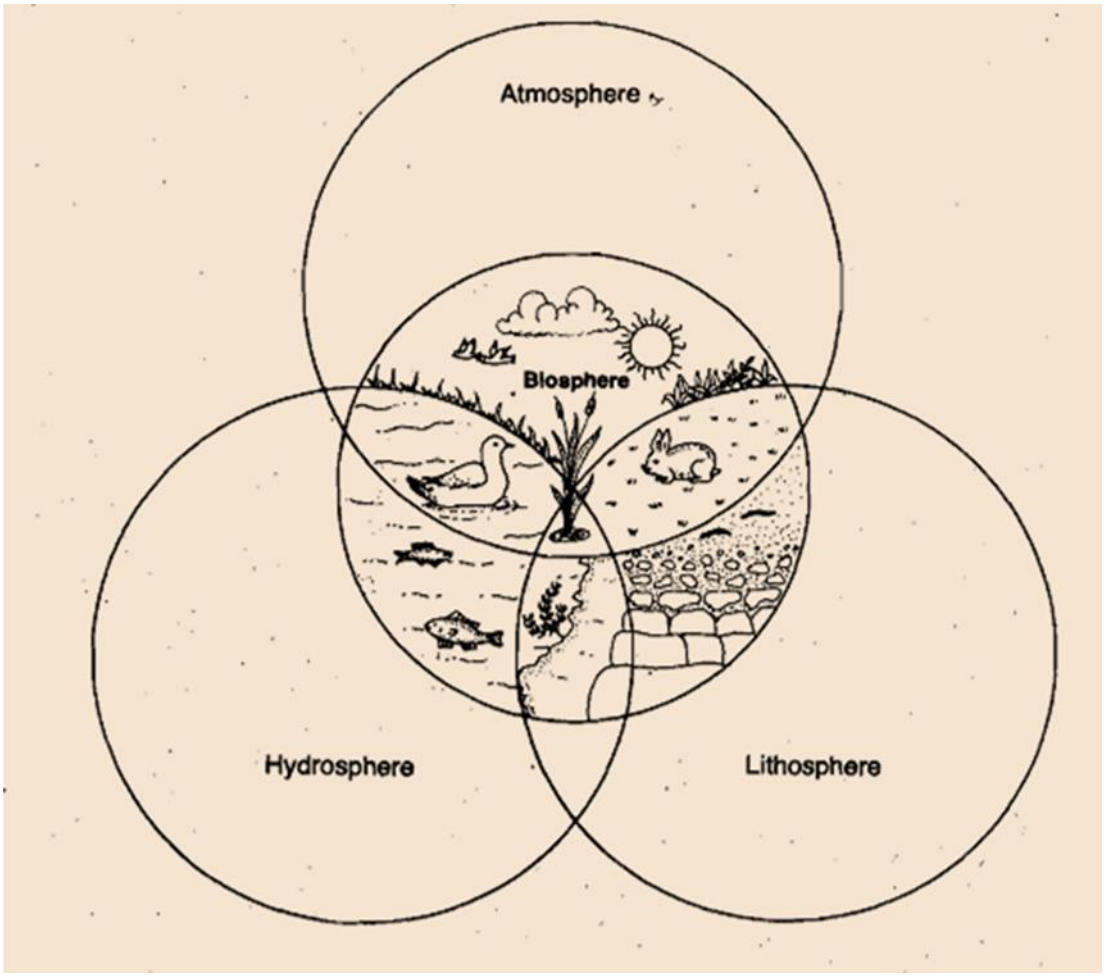

Fig: 1.2: a simplified scheme of the biosphere

Life is mainly found where there is solar radiation, or sunlight. As stated above, this includes the atmosphere, the surface, and a few meters of the upper layers of soil and water on the surface.

Atmosphere

The air in Earth's atmosphere is essential for life. Many of the elements it contains move through a cycle that creates a constant supply of metabolites. It is during this process that the importance of the relationship between the biosphere and the atmosphere starts to become clear.

Green plants combine a variety of inorganic elements and compounds. For example, when solar energy is converted into chemical energy, carbon dioxide in the atmosphere enters the biosphere and becomes a basic part of all organic compounds. Along with water, carbon dioxide is used by all plants during the process of photosynthesis to produce organic substances such as glucose and oxygen.

Hydrosphere

You already know that water is important because all living organisms need water to survive. In metabolism, it is the only source of hydrogen and also a possible source of oxygen. Earth is sometimes called "the Watery Planet" because it is the only planet in our solar system with an abundant supply of water. In fact, there's more water than land – oceans form 71% of the planet's surface.

Solar energy interacts with water, causing it to evaporate and move into the atmosphere as water vapour. As the water vapour rises to higher altitudes, it cools down and condenses, forming clouds. The clouds then precipitate as rain or snow and return to the place where it all began: the hydrosphere.

Water is a raw material used for various metabolic processes. Living organisms mainly take it from the hydrosphere. During the process of metabolism, part of the water consumed by organisms is excreted back into the environment. The water which the organism does not excrete returns to the environment only after the organism dies and decays.

Lithosphere

The other subdivision of the biosphere is the lithosphere, which impacts the metabolic process in two ways. One, it is the only place that contains most of the minerals which both terrestrial and aquatic organisms need to survive. Two, it forms the soil which terrestrial plants need in order to take root and grow.

Components of Ecosystem

The biological, or biotic, components of an ecosystem include:

i) Organisms – mainly green plants, certain bacteria, and algae – that can create their own food using sunlight. These are the **autotrophs**, or **producers**.
ii) All other organisms that do not make their own food, but instead survive by consuming other organisms. These are the **heterotrophs**, or **consumers**.

Consumers such as goats, cows, deer, rabbits and insects, all of which eat plants, are called **primary consumers**. Organisms that feed on the herbivores – for example, frogs that eat grasshoppers – are called **secondary consumers**. The organisms that eat the secondary consumers – such as hawks, which

eat frogs – are called **tertiary consumers**. While the primary consumers are herbivores, the secondary and tertiary consumers are carnivores. Animals such as lions and vultures are top carnivores because they are not hunted by other animals.

The producers can also be divided into subcategories. Green plants and special types of bacteria which can use solar energy to produce food are called **primary producers**. The heterotrophs which become food for other animals are **secondary producers**.

An ecosystem is therefore a basic unit of the natural environment which is home to a complex natural community. This community obtains its food from plants through one, two, three or four steps, which are known as the first, second, third and fourth trophic levels, or food levels. These levels are:

- Trophic Level I: green plants (producers)
- Trophic Level II: herbivores (primary consumers)
- Trophic Level III: carnivores (secondary consumers)
- Trophic Level IV: top carnivores (tertiary consumers)

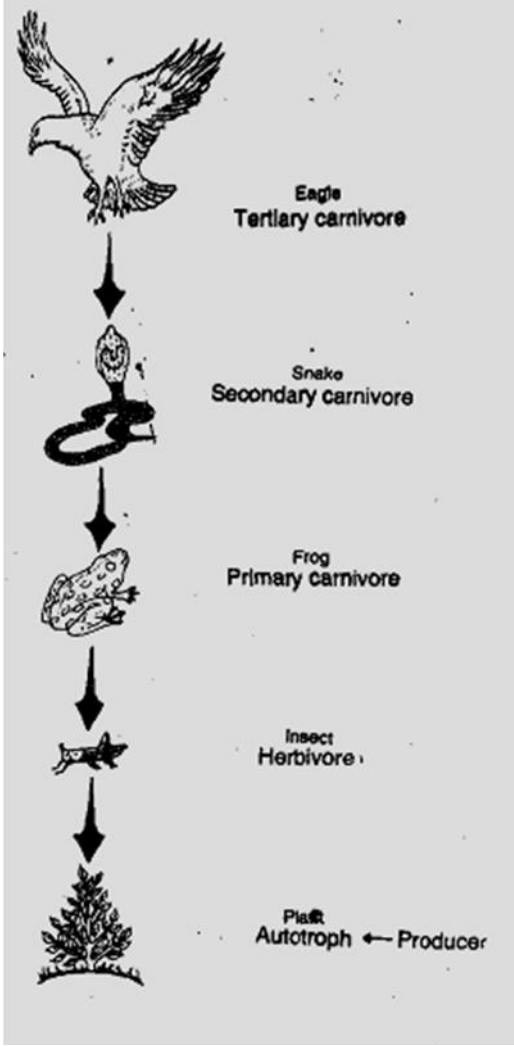

Fig: 1.3: trophic levels in an ecosystem

As the consumers and producers complete their life cycles, new generations are born while the older ones die out. But what happens to the dead?

Decomposition, the gradual breakdown of organic matter, plays an on-going role in every ecosystem. It is a means by which the ecosystem recycles old materials to generate new, fresh matter. The fungi and bacteria which are responsible for the process of decomposition are called decomposers, or reducers. Certain decomposers are what we call scavengers. The role played by decomposers in an ecosystem is very special and important to the survival of its population.

Abiotic components also play a major role in the survival of an ecosystem. These include inorganic elements and compounds, such as carbon dioxide, water and nitrogen, and the organic compounds created by an organism's daily activities or death. Other important abiotic components of the ecosystem are physical factors such as temperature, moisture and solar radiation. It is in this abiotic landscape that the biotic organisms interact.

Functional Components of an Ecosystem

We can think about the functional components of an ecosystem in terms of the following:

- energy flow,
- food chain,
- diversity pattern in time and space,
- nutrient or biogeochemical cycles,
- development and evolution, and
- control or cybernetics.

The following flow chart illustrates how the various components of an ecosystem function and interact, including how energy flows and how materials are cycled.

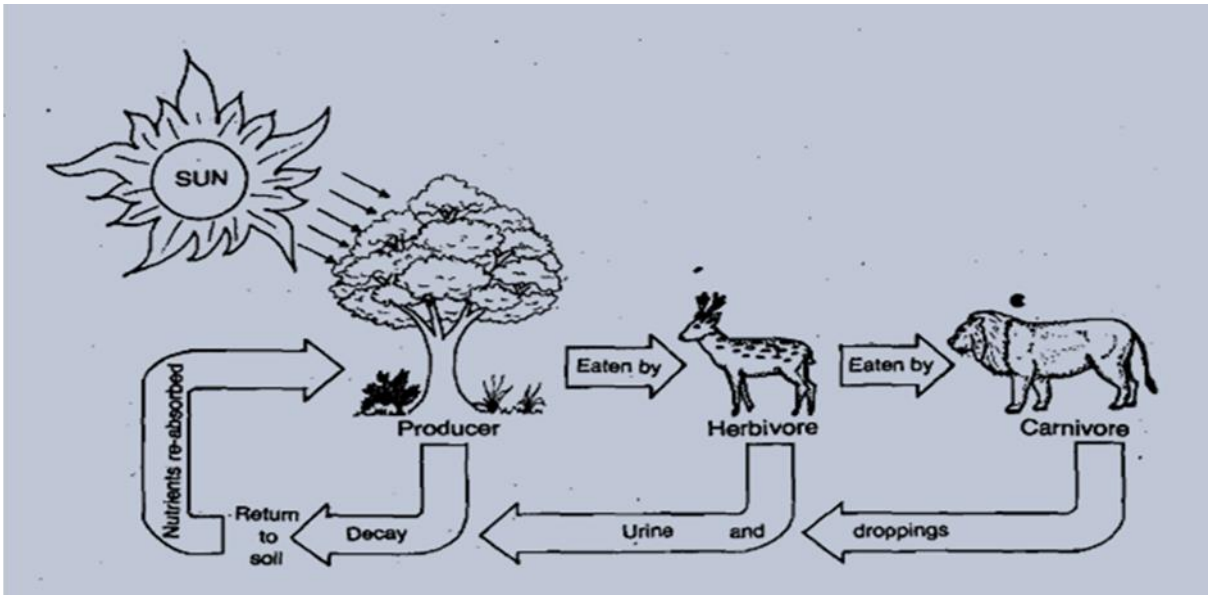

Fig: 1.4: a balanced, natural ecosystem

Incoming solar energy → autotrophs produce → herbivores consume → carnivores consume → producers and consumers die and decay → decayed matter is absorbed by autotrophs

As you can see, the process begins when plants convert solar energy into chemical energy through photosynthesis. At the same time, the plants also absorb various inorganic elements and compounds from the land or water in which they grow. These plants are then eaten by grazing heterotrophs. This means that the heterotrophs aren't just consuming chemical energy in the form of the carbohydrates, fats and proteins found in the plants themselves. They are also consuming some of the other nutrients which were absorbed by the plant before it was eaten. In this manner, a portion of energy and nutrients is passed all the way up through multiple levels of consumers until it finally reaches the decomposers.

However, while some energy is passed along, other energy is lost during transitions from one trophic level to the next. Figure 1.5 shows how energy is transferred and lost as it moves along through the trophic levels of an ecosystem.

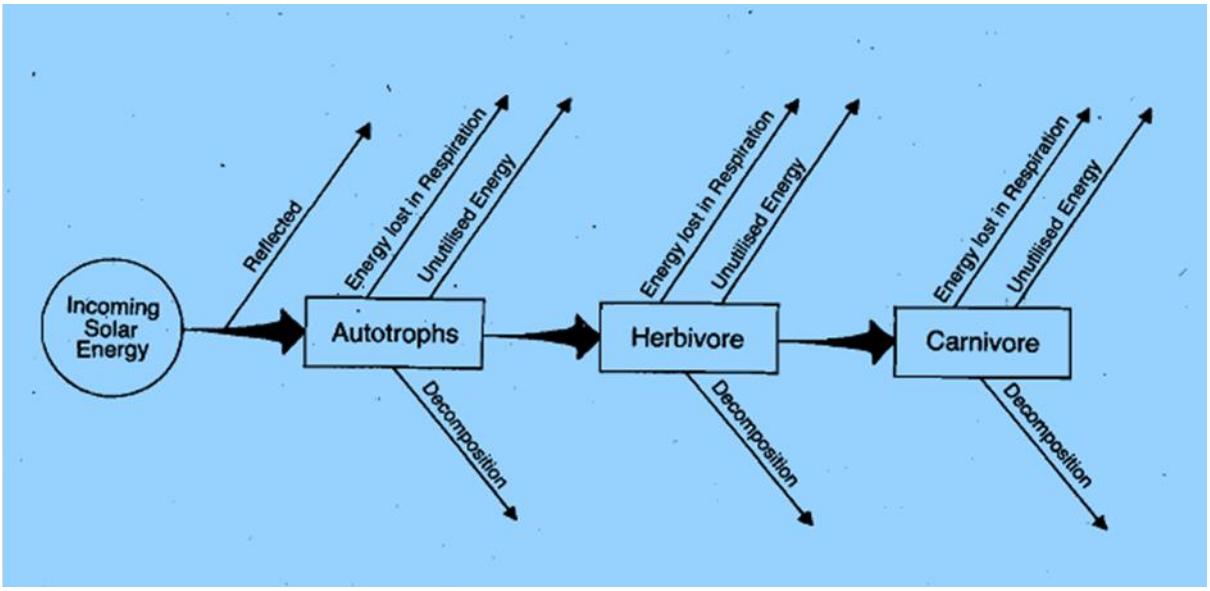

Fig: 1.5: the flow of energy in an ecosystem

From the diagram above, we can conclude the following:

- Energy flows in only one direction, unlike the nutrients or materials in an ecosystem. In other words, the initial energy trapped by an autotroph does not turn back into solar energy at the end of the process.
- Energy that passes from herbivore to carnivore does not pass back to herbivore from carnivore. Because of this unidirectional and continuous energy flow, the ecosystem is able to maintain its balance.

Set apart from one another by their means of obtaining energy, the three living components – producers, consumers and decomposers (also known as micro consumers) – form the three functional kingdoms of nature.

To remain healthy, an ecosystem must have self-sufficient and self-regulating systems in place to maintain its natural balance. Though a certain amount of instability is natural, all ecosystems use self-regulatory controls to keep the balance from tilting too far in any direction.

Food Chain and Food Web

You already know that energy in an ecosystem flows in only one direction. Thus, the order in which it is transferred between organisms can be illustrated with a simple **food chain**. For example, plants are eaten by insects, which are then eaten by frogs. The frogs are eaten by fish, which are then eaten by human beings. In this food chain, there are a total of five different trophic levels, each represented by a different organism.

The flow of energy in an ecosystem determines the number and biomass of organisms at each level. This flow, though constant, is not consistent. For instance, some energy is lost whenever a predator fails to capture its prey.

Several factors determine where an animal is listed in a food chain. Each species is assigned a specific place based on how it has evolved and adapted in relation to other members of the food chain. In addition, ecosystems often contain more than one food chain. Some animals belong to only one food chain because they only eat one kind of food. Other animals have diets with more variety and therefore belong to multiple food chains. They may even appear in different positions in each chain. For example, an animal may be a primary consumer in one chain because it eats plants, but it may also be labelled as a secondary or tertiary consumer in other chains because it also feeds on herbivorous animals or other carnivores.

Humans appear at the end of many food chains. Imagine a man eating a big fish. That big fish probably used to eat smaller fishes. Those smaller fishes probably ate small invertebrates, which fed on algae.

The size of an organism's population is limited by several factors. These include the number of links in the food chain, how efficiently energy is transferred through the chain, and, finally, how much solar energy reaches the region where the population is located.

Food Web

Although food chains are useful for understanding how energy flows through an ecosystem, they are too simple to fully illustrate the complex relationships between organisms in an ecosystem. As you have already learned, organisms may appear in more than one chain and may play different roles in each chain. To show multiple food chains and how they are connected, we can use a more thorough type of diagram known as a **food web** (Fig. 1.6).

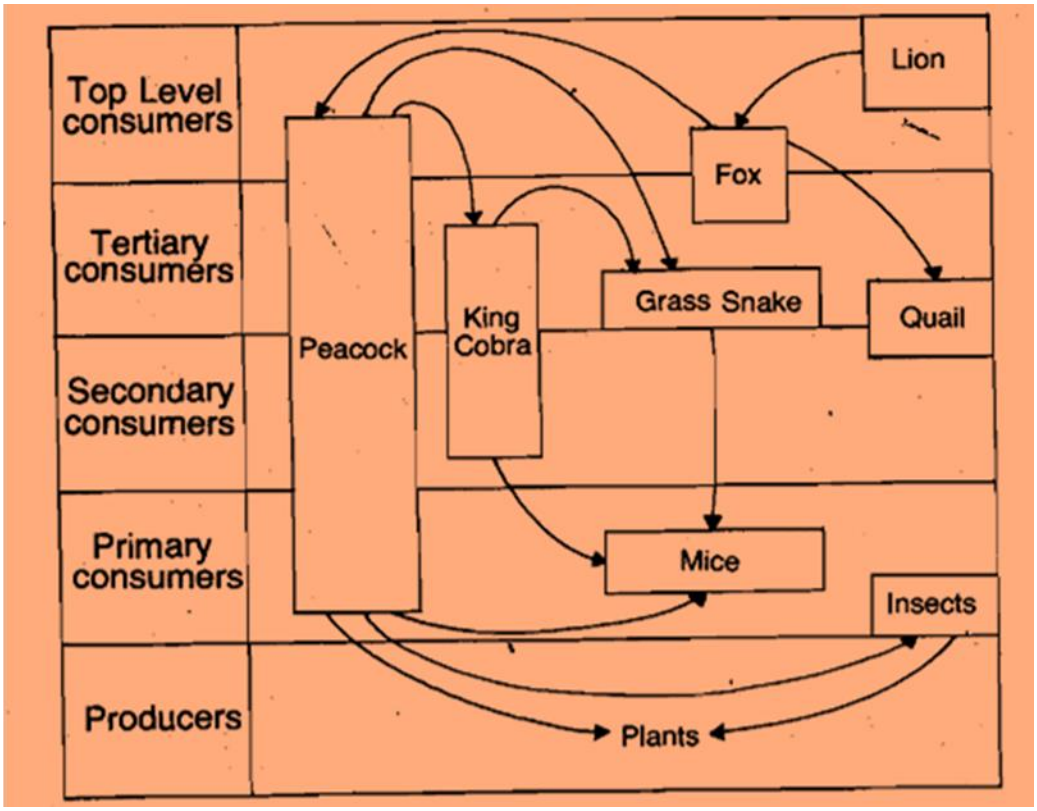

Fig: 1.6: a food web

Man-made Environment

So far, we have only talked about the natural environment. What about the man-made environment – farms, cities, industrial areas, and so on? These are places which have been designed and created by humans. To understand the artificial nature of this environment, let's take a look at one man-made environment in particular: the city.

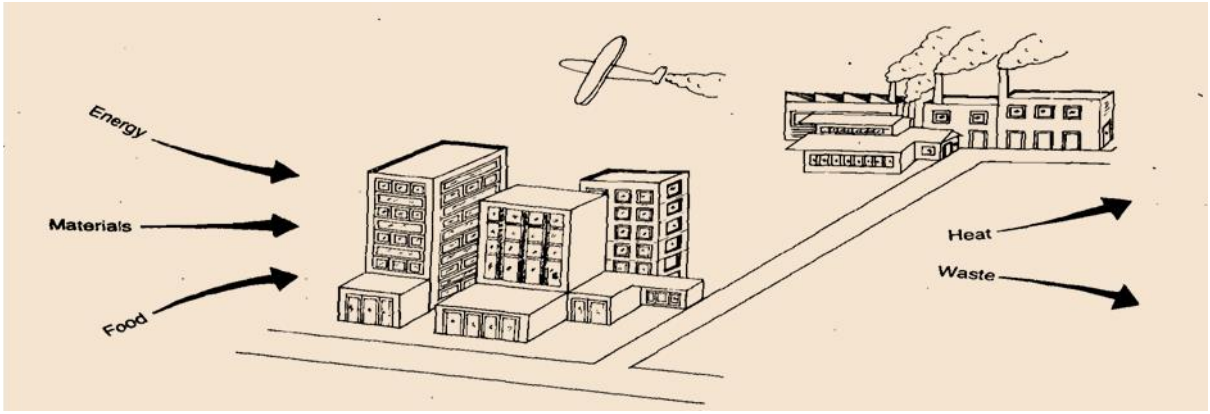

Fig: 1.7: the city, a man-made environment

In cities, one of the most important components of an environment, water, is not consumed directly from natural sources such as streams or lakes. It is first filtered and purified until it is clean enough (by

human standards) to use safely, and it is then used for drinking and other everyday purposes. Metabolic waste and garbage is also not disposed of directly into the local environment. Instead, it is carried away from households via pipes to treatment plants, or dumped somewhere far away from the city. The food consumed in cities also often comes from rural areas located outside of the city limits.

Most people who live in the city reside in buildings made of brick and cement, not mud and thatched roofs. These materials are often transported into the city from distant rural areas via cars, buses, trains and other methods of transportation, which tend to consume large amounts of energy. These vehicles, along with factories and power plants, clog the atmosphere with massive amounts of pollution.

Unfortunately, man-made environments often consume excessive amounts of both materials and energy, and often negatively impact nearby natural environments. Supervision and careful management are required in order to avoid causing drastic damage. Developed countries can have an especially strong influence on their surroundings because of the wealth of their populations compared to those of less-developed regions. Let's take a look at how different types of man-made residential areas compare.

Human Settlements

The term **human settlement** can refer to a wide variety of places occupied by humans, including cities, towns and villages. Despite their obvious differences, these places all have something in common: they all function within organized social, economic, and cultural structures. They also all contain the basic requirements for a human settlement, which include shelter, water, food, sanitation, transportation, communication, energy, education and some form of healthcare. Shelter is one of the most important necessities for human survival, followed closely by potable water and sanitation.

In the early days, most human settlements were agrarian, or rural. They could usually be found along riverbanks, which provided a reliable source of water that could be used for drinking, bathing and, frequently, food in the form of aquatic life. As populations grew and trade and commerce evolved, people began to flock to new kinds of settlements: towns and cities.

These new settlements, however, introduced a whole new set of problems. Due to massive population growth and density, air pollution due to traffic, factories, mills and domestic smoke soon began taking a toll on the atmosphere.

Sustainable Development

"The world we have created as a result of our thinking thus far has problems which cannot be solved by thinking the way that we thought when we created them." (attributed to Albert Einstein, Wikiquote)

Industrialization has already used up much of the earth's natural resources. We now know that we cannot continue repeating the mistakes of the past if we want to protect the future of this planet and those who call it home.

Improvements in technology have made the extraction of both known and previously undiscovered resources easier. Additionally, the material intensity of production – that is, the amount of a certain material needed to make a particular product – has gradually declined over the years. However, many of these resources and methods may create more problems than solutions.

For instance, lead is abundant. However, its negative effects on the health of various populations and their environments make for a convincing case against its use. The same can be said of fossil fuels. Although still used in combustion engines and power stations, the burning of fossil fuels such as gas, coal, and oil results in carbon emissions. These emissions are so plentiful that we will probably exceed acceptable levels of air pollution long before we run out of fuel.

Concern over the rate at which we are using up Earth's natural resources has resulted in a movement towards a concept you may already be familiar with: **sustainable development**. The most widely used definition of sustainable development, which you should keep in mind, is the one outlined by the World Commission on Environment and Development (WCED) in its milestone report "Our Common Future" (also known as the "Brundtland Report") in 1987:

- Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs. (p. 43)

The United Nations Environment Programme (UNEP) defines sustainable development more simply as "Development which improves people's quality of life, within the carrying capacity of earth's life support systems" (UNESCAP). The International Union for Conservation of Nature (IUCN), on the other hand, provides this description:

- The guiding rules are that people must share with each other and care for the Earth. Humanity must take no more from nature than nature can replenish. This in turn means adopting lifestyles and development paths that respect and work within nature's limits. It can be done without rejecting the many benefits that modern technology has brought. Provided that technology also works within those limits. (UNESCAP)

The leaders of some underdeveloped countries are suspicious of this concept. They worry that they, too, will be penalized for past mistakes made by more developed countries.

It is true that sustainable development will require a huge change in both corporate and domestic daily activities and technologies around the world. In other words, we all need to create and maintain a new, more conscientious attitude towards our environmental responsibilities. Rather than demonizing industrial development, we must recognize that both business and industry have vital roles to play in working towards a sustainable future for our planet. The WCED report alludes to this idea when it states, "Many essential

human needs can be met only through goods and services provided by industry . . . It has the power to enhance or degrade the environment; it invariably does both" (WCED, 1987, p. 182).

While sustainable development presents a particular challenge for wealthier nations, which tend to consume the most resources and create the most pollution, it is because of their prosperity that these nations also have the greatest capacity to make the changes necessary to begin sustainable development. Similarly, businesses will also find sustainable development difficult at first. It will require them to produce higher levels of output while using lower levels of input and generating less waste.

The Earth Summit

In 1992, 176 governments sent delegates to the UN Conference on Environment and Development in Rio, also known as **the Earth Summit**. The Earth Summit reinforced the importance of increased education and focus on environmental issues in every sector of the economy. Agenda 21 (UN, 1992) was a global plan of action adopted at the Earth Summit. The plan contains an entire chapter on sustainable development. In this chapter, Agenda 21 states that businesses should participate in a wide range of environmental management tasks, including environmental auditing.

You've seen how worldwide developments in environmental consciousness have led to major changes in the way in which governments, investors, and the community at large perceive the importance of caring for the environment. For individual organisations, these developments have included:

- tighter legislative controls,
- constraints on the use of natural resources,
- increasing pressure from customers and suppliers, and
- greater employee and management interest in the way the organization approaches its environmental responsibilities.

These changes have prompted organizations to look for new ways of integrating environmental considerations into all aspects of their businesses. In some cases, this change in attitude has been forced upon them by external authorities. In other cases, the decision to improve environmental performance has been voluntary.

Between 26 August and 4 September 2002, the UN held a follow-up conference to the 1992 Earth Summit. This conference, **the World Summit on Sustainable Development** (WSSD), was held in Johannesburg, South Africa. The goal of the WSSD was to ratify, reinforce and carry out numerous international agreements and conventions related to sustainable development. One of the key outcomes of the conference was the creation of a number of commitments aimed at more effectively fulfilling sustainable development objectives (UN/DESA 2003).

Further Reading:

- ✓ ***An Introduction to Environment , Evelyn Talbott, Gunther F. Craun (1995)***
- ✓ ***Introduction to Environment, M. M. Sulphey, M. M. Safeer (2014)***