Ecosystem

Components of Ecosystem

In order to understand the ecosystem, a group of students were asked to study a small field carefully.

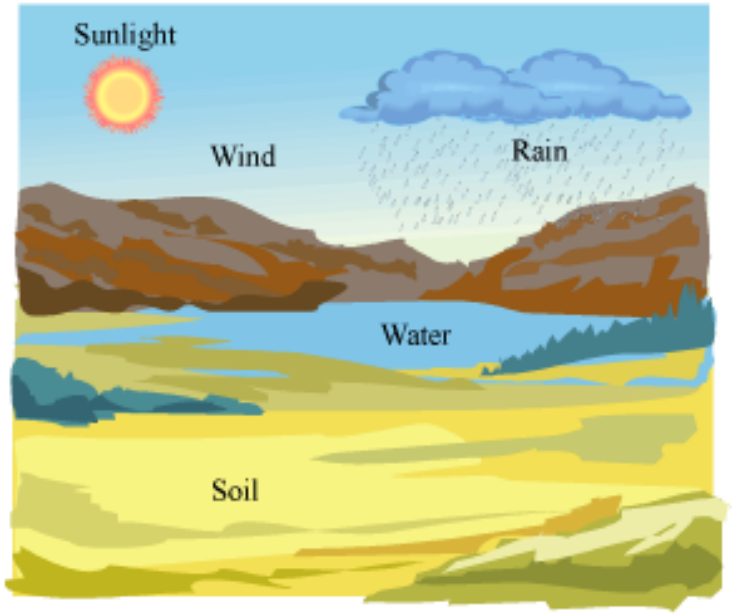
The teacher explained the students that an **ecosystem** includes both living and non-living components of an area. Thus, an ecosystem includes both the biological community and non-living components of an area. Ponds, forests, grasslands, etc. are a few examples of ecosystems.

The students were divided into two groups. **Group I** collected data about the non-living components found in the environment while **Group II** collected data about the living components in the environment.

Let us understand the components constituting the environment.

Group I listed the non-living components as water, air, soil, inorganic nutrients, etc. One of the students started feeling hot and wanted to drink water. He wondered whether temperature is also a component of the environment. The teacher explained that temperature, light, and other physical factors that affect life are also non-living components of the environment.

- **Sunlight**: Source of energy for sustenance of life on earth; required for production of food through photosynthesis
- **Air**: Provides oxygen for respiration and carbon dioxide for photosynthesis; act as a medium to disperse seeds and pollens
- **Water**: Important constituent of all living cells; act as medium for all the biochemical reactions occurring inside a cell; consumed by plants and animals to sustain life
- **Temperature**: Temperature conditions of an area influence the body functions of plants and animals living at that area.
- **Soil**: Contains water and minerals required for the growth of plants; act as dwelling place for several microbes, and burrowing animals like rats, snakes, and earthworms. The type of soil and its nature influence the type of vegetation found in an area.



Group II listed the living components of an ecosystem, which included the following organisms:

Autotrophs are organisms that can manufacture their own food from inorganic raw materials. They are also known as producers. They include all green plants and some bacteria.

Heterotrophs:

The organisms which cannot synthesise their own food and are therefore, dependent upon other organisms are known as **heterotrophs**.

Heterotrophs are classified further as shown below:

- Heterotrophs
  - Consumers
    - Herbivores
    - Carnivores
  - Decomposers

Consumers:

These organisms mainly obtain food either directly from autotrophs or indirectly from other heterotrophs. They include animals that generally ingest and then digest their food.

Consumers are divided into herbivores, carnivores, and omnivores.

Herbivores	Carnivores	Omnivores
The animals that feed only on plants are called **herbivores**. They are also known as primary consumers.	The animals that eat other animals are called carnivores. They are also known as secondary consumers. Those carnivores, which feed on herbivores, are called primary carnivores.	There are some animals that feed on both plants and animals.
Examples include deer, rabbit, goat, horse, sheep, etc.	Examples include frog, cat, spider, etc.	Examples include bear, turtle, monkey, mice, squirrel, humans, etc.

Decomposers: This group includes microorganisms such as bacteria and fungi, which obtain nutrients by breaking down the remains of dead plants and animals.

Do you know that cats are purely obligate carnivores? They cannot digest fruits, vegetables, pulses, grains, etc. They require a high level of protein in their diet. They lack an efficient system for digesting plant products. A cat's digestive system is specialized to suit a carnivorous eating habit.

Decomposition can be better understood by the following activity.

Vermicomposting

Take a wooden box. Place it where it is neither too hot nor too cold. Put a layer of sand (about 2-3 cm thick) at the bottom of the wooden box.

Then, spread some vegetable waste, plant parts, weeds, and garden waste over the sand.

Sprinkle some water on this layer and place a few earthworms on it. Water is sprinkled to provide moisture for the survival of earthworms. Cover the wooden box with a sheet of cloth. After 2 - 3 days, gently mix the top layers of matter in the wooden box. After 3 - 4 weeks, observe the contents of the wooden box.

Precautions:

- Do not add plastic bags, broken glass, or other such materials.
- Do not add food items containing salt, oil, vinegar, meat, etc. These items can lead to the growth of disease-causing organisms.
- Do not add excess water.
- Keep the layer of wastes loose, so that it has enough air and moisture for the earthworms to survive.

After 3 - 4 weeks, you will observe that the vegetable waste is converted into a loose soil-like material. This soil-like material is the nutrient-rich castings left behind by the earthworms. This is called v**ermicomposting.** This can be used as a natural fertilizer, after being dried in the sun.

Do you know why vegetable waste was added to the box?

The earthworms use this waste as food. They grind this food with the help of a structure called gizzard and break it down into smaller fragments.

Conclusion:

Organic home waste can be easily converted into a great natural fertilizer. The organic matter or biomass involved in decomposition includes dead plants and animals.

Therefore, biotic and abiotic components can be summarized as follows:

Abiotic factors	**Biotic factors**
Sunlight Temperature Water Air Soil Humidity	Autotrophs Heterotrophs: Consumers (Herbivores, Carnivores); Decomposers

What will happen if an aquarium contains dead plants and animals and is not cleaned properly?

In nature, scavengers and decomposers such as bacteria and fungi recycle matter by breaking down the organic remains and waste products of plants and animals.

However, this does not occur in a man-made ecosystem. Thus, an aquarium will have a high growth of bacteria and fungi.

This can lead to the death of fishes. The turbidity in water will not allow light to penetrate and without light, plants will die. Thus, the stability of an ecosystem i.e., of the aquarium will be disturbed.

Are all environments similar? Can we identify different types of environments?

Ecosystems can be divided into **natural** and **man-made ecosystems**.

Lakes, forests, grasslands, etc. constitute **natural ecosystems**.

An aquarium or a crop field is a **man-made ecosystem**. Since humans control the type of organisms, amount of light, water, etc. in an aquarium or a crop field, they are called man-made ecosystems.

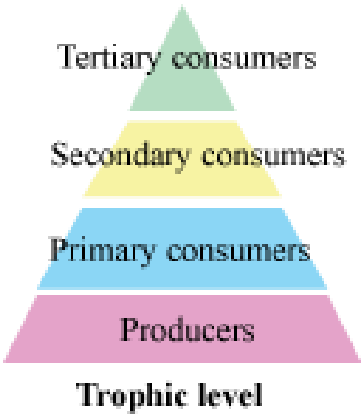
We learned about the various components of the ecosystem. Now let us find out how these components interact with each other and how energy flows within an ecosystem.

Interactions within an ecosystem

If a carnivore eats an herbivore, then does it mean that the carnivore has higher energy than the herbivore?

Producers (all green plants and some bacteria) convert solar energy into chemical energy in the form of organic compounds. The primary consumers derive nutrients from the producers. Therefore, energy passes to the next trophic level from the producers.

A trophic level is the level of species in an ecosystem based on its main source of nutrition. Producers, herbivores, primary carnivores, secondary carnivores, etc. are at different trophic levels.



The producers form the first trophic level as they manufacture food. The primary consumers form the second trophic level, the secondary consumers form the third, and the tertiary consumers form the fourth trophic level.

These trophic levels are connected through **food chains.** A food chain is a linear sequence of organisms in which each organism is eaten by the next member in the sequence. This interaction among organisms involves the transfer of energy from one organism to another.

Do you know that detrivores are animals such as sea urchins, crabs, starfishes, etc., which feed on dead parts of organisms (detritus)? A food chain that starts with this dead organic matter is called a detritus food chain.

For example, tree leaves → detrivores → small fishes → large fishes

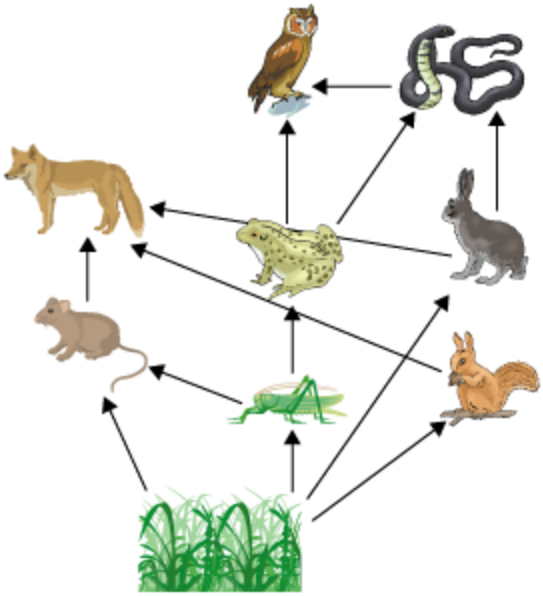
Do you know that parasites are the organisms that live on or inside the body of other living organisms called host and obtain food from them. The food chain that involves the transfer of energy through series of parasites is called **parasitic food chain.**

For example, Trees → parasitic bird → bird lice → flagellate protozoans.

Food web

Food chains are not isolated, but rather interconnected with each other.

An interconnected network of food chain, which forms a multitude of feeding connections among different organisms of a biotic community, is called a **food web**.



Depending upon the constituent organism and environment, many different food webs exist.

The given illustration shows a common food web.

Flow of energy in an ecosystem

Energy enters the ecosystem from the sun. Solar radiations pass through the atmosphere. Most of these radiations are absorbed by the Earth's surface, which helps in the process of photosynthesis as well as maintaining a temperature suitable for the survival of living organisms.

Thus, 1,000 kg of plant material converts into 100 kg of herbivore tissue. This converts into 10 kg of carnivore tissue and 1 kg of second level carnivore tissue.

Therefore, the maximum energy is present in plants, followed by the herbivores, then the carnivores. Hence, the top predator or the tertiary consumer has the least amount of energy. The graphical representation of energy exchange in the ecosystem is known as "**Pyramid of energy**".

Biomagnification

Do you know that a larger amount of pesticides are accumulated in top carnivores?

Let us study why this happens.

A large number of pesticides and chemicals are used to protect crops from several pests and diseases. These pesticides reach the soil because of rain or sprinkling of water on crops and are absorbed by plants along with water and minerals from the soil.

Due to rain, these chemicals enter the water sources and bodies of aquatic plants and animals. This is how these chemicals enter the food chain.

Since these chemicals cannot decompose, they accumulate continuously at each trophic level. As the food chain proceeds, concentrations of the pesticides also increase. Thus, their maximum concentration is among the top carnivores. The increase in the concentration of pollutants or harmful chemicals with each step of the food chain is called **biomagnification**.

Organisms and Environment

- **Ecology** deals with interactions among different organisms and their environment.
- Organisms get adapted to their environment for their survival and reproduction.
- The rotation of the earth about its axis brings about changes in the environment, leading to different seasons. This leads to the formation of various biomes such as desert, grassland, etc.
- Life not only exists in favourable habitats, but also in harsh and extreme conditions.
- The environment of an organism can be divided into:
- **Abiotic factors**
- **Biotic factors**

Abiotic Factors

- Some of the major abiotic factors that interact with the organisms are:
- **Temperature** − It is the most relevant abiotic factor since all organisms require an optimum temperature for their metabolism and other body functions. Depending upon their ability to tolerate temperature range, organisms are of two types- stenothermal (restricted to a narrow range of temperature) and eurythermal (can tolerate a wide range of temperature).
    - **Water** − Water also is a major influencing factor. Life on earth is impossible without water as it forms the major constituent of all living cells. In oceans where quantity of water is not a limitation, the quality of water becomes one. Depending upon the

ability to tolerate salinity, organisms can be stenohaline (restricted to narrow range of salinity) and euryhaline (tolerant to wider range of salinity).

- **Soil** − The nature and composition of soil differs from one place to another depending upon the climate, weathering process, and soil development method. The characteristic features such as soil composition, grain size, percolation, water holding capacity, etc. determine the native of the organisms it can support.

- **Light** − The major source of light on earth is the Sun. Light is essential for plants to perform photosynthesis. Certain plants become adapted to perform photosynthesis under very low light since they are constantly overshadowed by tall trees. Many plants also depend on light for their flowering (photoperiodism). The availability of light on land is comparatively higher than that in water.

Components of Forests

Forests are home to a large number of plants and animals. **What kind of plants and animals are seen in these forests?** Let us explore the various components of forests.

Forests have several types of trees, shrubs, herbs, and grasses. Climbers and creepers are also found on the trees of these forests. Small animals such as spiders, squirrels, and ants can be seen on the branches of the trees. **Can you think of more plants and animals that inhabit these forests?**

The floor of a forest is dark in colour and is covered with dead and decaying matter. **What forms the dead matter on the floor of the forest?** This dead and decaying matter on the floor of the forest consists of dead and decaying leaves, fruits, seeds, twigs, small herbs, and animals.

Mushrooms and microorganisms are also found in the forests. They act as decomposers, which decompose organic matter and convert it to **humus**.

Humus is the top layer of soil that is rich in nutrients. It is dark in colour. The decomposers convert the dead plants and animals into humus that is utilized by the plants.

Layers of a Forest
The different layers of the forest include

The Emergent Layer:
This layer is very sunny because it is the very top and only the tallest trees reach this level. It is also known as the overstory. In the emergent layer, the top of the tree is called crown. Crown is defined as the branchy part of a tree above the stem. These crowns can be of different types - pyramidal crowned, vase crowned etc.
Animals found in this layer include birds, butterflies, small monkeys, bats, snakes and bugs.

The Canopy Layer:
This is the thickest layer and much of the rain is stopped by the thick foliage. Most trees in the forest grow to this height. There are plants that grow in the canopy layer whose roots don't reach the ground. These are called air plants.
Animals found in this layer include birds, monkeys, frogs, and sloths, lizards, snakes and many insects.

The Understory:
This layer has many vines, dense vegetation but not much sunlight as it is all blocked by the canopy.
Animals found in this layer include birds, butterflies, frogs and snakes.

The Forest Floor:
This layer is dark, damp, full of many dead leaves, twigs and dead plants. It is usually clear of vegetation, with little or no winds and rains reaching there. The forest floor is dark due to the trees above stopping the sunlight from entering the forest. It is estimated that only 2% of the sunlight actually reaches the floor.

Animals found in this layer include jaguars in South America, gorillas, leopards in Africa, tapirs, tigers and elephants in Asia.

A trip to a forest

Visit a forest with your parents. Observe the trees and the animals living in the forest. Make a list of the plants and animals that you see. **Do you see any useful plants in the forest?**

How do these various components of a forest interact with each other?

Types of interactions in a forest

In a forest, there are various types of interactions that occur between the living and the non-living components.

The plants and animals living in a forest interact with each other. All the animals, whether they are herbivores or carnivores, are directly or indirectly dependent on the plants for food. The organisms that feed on the plants are eaten by other animals.

For example, insects feed on grass and frogs feed on insects. Frogs in turn are eaten by snakes, and snakes form the prey for eagles. This is known as a **food chain**.

$$\text{Grass} \rightarrow \text{Insects} \rightarrow \text{Frog} \rightarrow \text{Snake} \rightarrow \text{Eagle}$$

All food chains in the forests are linked. What happens if one food chain is disturbed? If a single food chain is disturbed, then it affects all the other food

chains. Therefore, if we remove one component from the forest, then all the other components will also be affected.

Plants and animals are also dependent on each other. Plants utilize the carbon dioxide that is released by the animals during the process of respiration. This carbon dioxide is used by the plants to prepare food by the process of photosynthesis.

The oxygen released during photosynthesis is used by the animals for **respiration**. In this way, plants and animals help in maintaining **the balance of oxygen and carbon dioxide in the atmosphere.**

Plants also provide animals with shelter. They protect the animals from their predators that live in the forests. In return, animals help the plants by dispersing their seeds to other parts of the forests, thereby helping the forest to grow and regenerate.

Animal droppings are also important for plants. They are a rich source of nutrients that enable the plants to grow and flourish.

Decomposers are yet another important component of the forests**. What is the role of decomposers in the forests?** Decomposers are the organisms that convert the dead plants and animals into humus.

We know that humus is the nutrient-rich, top most layer of the soil. The nutrients released by the decomposers are taken up by the roots of the plants. In this way, the decomposers help in recycling the nutrients.

Can you now explain why decomposers are a very important component of the forests?

They are important because they recycle the organic matter and return the nutrients from the dead plants and animals to the soil. This is then utilized by the plants.