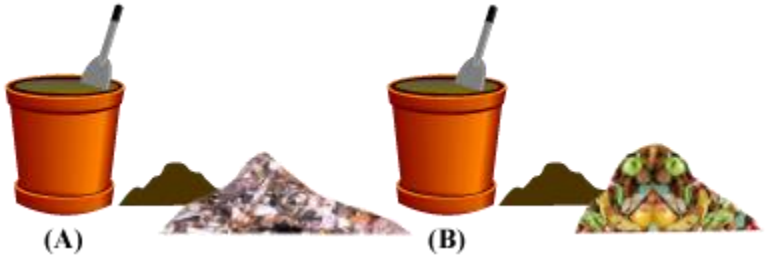
Our Environment

Biodegradable and Non-Biodegradable Substances

Garbage collection



Collect garbage from your house before it is thrown into the dustbin. Separate the garbage into two groups.

In one group, include wastes such as polythene bags, broken glass, aluminium foil, metal pieces etc. In the second group, include only kitchen wastes like peels of fruits and vegetables, waste food, newspaper, and garden wastes like dead leaves and other plant parts.

Bury this material separately in two pots and label them as **A** and **B**. Remove the top soil after one week, and check the status of the garbage. Then, approximately after four weeks, check the condition of the garbage again.

Observation

It will be observed that the waste in pot **B** decomposes, while the waste in pot **A** does not decompose.

The waste in pot **B** does not rot completely. However, it gives a bad odour after one week. But, after four weeks the waste rots almost completely and becomes odourless. It no longer has the original material and is now dark brown in colour.

What is the reason for making this observation? What is the difference between the waste kept in pot A and waste kept in pot B?

The difference is that the waste kept in pot **A** is non-biodegradable, while the waste kept in pot **B** is biodegradable. **But what does this mean?** Let us find out.

Biodegradable substances: It includes substances mainly from plant and animal sources, which can be broken down by living organisms.

Non-biodegradable substances: It includes substances such as plastic, metal, broken glass etc., which cannot be broken down by living organisms.

Micro-organisms in soil break down (or decompose) the organic matter of pot **B** and convert it into useful compost.

This compost is very useful, as it adds nutrients to soil and increases the soil fertility. Thus, it helps in enhancing the growth of plants.

Can you tell why only the waste present in pot B got decomposed?

The waste is food for micro-organisms.

When we eat food, it is digested by various enzymes present in our body. However, these enzymes cannot digest everything. This is why we cannot eat stone, plastic, or other such material.

Micro-organisms make use of enzymes to digest the wastes (organic matter). However, these micro-organisms cannot digest certain substances, which we classify as non-biodegradable substances.

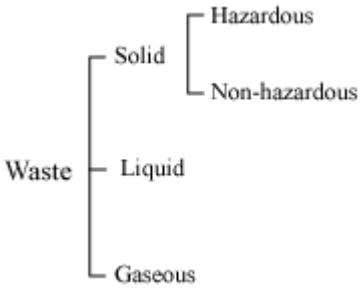
Waste Management

The existence of human beings depends upon the environment. Human interaction with the environment has resulted in many environmental changes. Let us learn about the changes and study the methods of controlling them.

Wastes generated by human beings have affected the environment. **What are wastes? How do they affect the environment?**

Waste, is any unwanted, unused, and rejected material. Waste can be categorized according to its source – municipal, agricultural, industrial etc.

In general, wastes are of three types – **liquid, gaseous, and solid.**



1. Liquid waste: It includes sewage, contaminated ground water, and industrial wastewater. These are transported through pipes or in containers. This wastewater has to be treated, before discharging it into the water sources. For example, wastewater from our sewage pipe reaches the water treatment plant. This water is then purified using various

techniques such as filtration, deionising, and water softening. This water is then released into streams, rivers, and other water bodies.

2. Gaseous waste: It includes gases produced by combustion and industrial processes. These gaseous wastes are responsible for global warming, ozone depletion etc.

Global warming may be defined as an increase in the average temperature of the Earth's surface because of greenhouse gases.

3. Solid waste: It refers to the waste that does not flow like gas or water. It includes paper, food waste, plastic, glass, metal etc. A lot of solid waste is generated from homes, offices, hospitals, schools etc. It is collected and disposed by the municipality.

Solid waste can be categorized broadly as:

- Domestic waste: Waste coming from a common household. Examples, kitchen wastes, plastics, papers, glass, etc
- Industrial waste: Waste coming out from factories and other industries. Examples, wash-offs containing harmful chemicals and other substances, fly-ash, left overs from mining operations, etc
- Agricultural wastes: Include agricultural left-overs, bagasse, pesticides, fertilizers, animals wastes, etc
- Municipal wastes: Include household discharge of excreta, kitchen washings, sewage from public toilets, hospitals, hotels, offices, etc
- *e*-Waste (Electronic wastes): Consists of discarded electrical appliances and their parts, such as TVs, radios, refrigerators, mobile phones, batteries, etc. The *e*-waste is a serious health hazard as most of the times it contains harmful substances such as lead, cadmium and mercury.

On the basis of their degradability, solid wastes can be categorised as biodegradable and non-biodegradable wastes as well.

Management of solid wastes

Waste management includes collection, transport, processing, and disposal of waste materials.

Measures for waste management

- Separate bins (blue and green) can be used for disposing non-biodegradable and biodegradable wastes respectively.
- Reduction in the use of non-biodegradable products like plastic.
- Separation of material, which can be reused or recycled.

Principles of Solid waste management

The 7 principles of waste management are:

- Reuse: The used materials should be reused for some other purposes.
- Refuse: The materials made up of non-biodegradable substances like plastic etc. should be avoided.
- Recycle: The waste materials should be converted into some useful material.
- Rethink: Rethinking about reusing a product or article.
- Reduce: The use of resources should be limited in order to reduce the waste production.
- Research: A research regarding the reuse of materials that are temporarily out of use should be carried out.
- Regulation and public awareness: The people should be made aware of the laws and rules related to waste management.

How can we reduce waste production?

Use of recyclable material reduces the generation of wastes to a large extent. Reduced usage of materials, reusing of materials, and using recycled material will reduce the generation of wastes.

Using refills, using empty jars instead of purchasing new ones, using rewashed material instead of disposable one, composting etc. are some measures which can reduce the generation of wastes. **Can you think of some more?**

Causes and Effects of Ozone Depletion

Ozone is a protective layer of gas in the stratosphere. Sunlight that reaches the Earth consists of ultraviolet radiations, visible radiations, and infrared radiations.

The **visible** part of solar radiation can be detected by the human eye, which enables us to see. The heat that we feel, not just from sunlight, but also from fire, heating devices, etc., is due to **infrared radiation.** The **ultraviolet radiations** from sunlight can cause skin burns and darkening of skin, while prolonged exposure can lead to skin cancer. These radiations have to be prevented from entering the Earth's surface. Their entry is prevented by the ozone layer present in the stratosphere.

In recent years, the ozone layer has depleted rapidly. This is mainly due to an increased concentration of chlorine in the stratosphere. One atom of chlorine can destroy around 100,000 molecules of ozone, which results in its depletion.

Do you know from where this chlorine is released?

This chlorine is mainly produced by chlorofluorocarbons, commonly called freons, which are widely used as refrigerants.

$$CFCl_3 + h\nu \rightarrow CFCl_2 + Cl$$

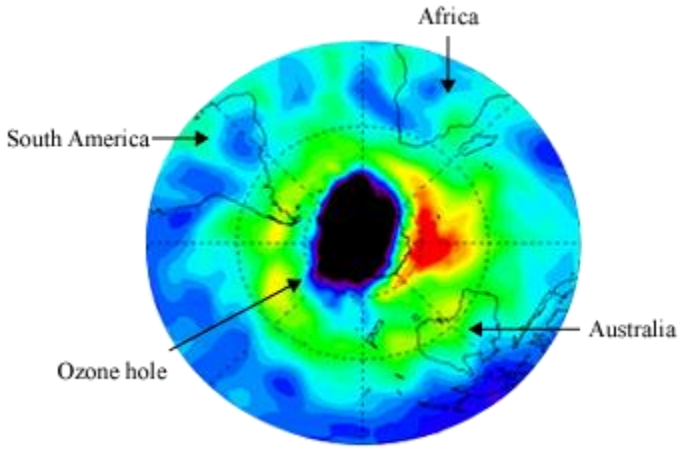
Ultraviolet light acts on CFCs in the stratosphere and releases chlorine atoms.

These chlorine atoms destroy the ozone molecules.

$$Cl + O_3 \rightarrow ClO + O_2$$

Consequences of Ozone depletion

Ozone depletion has occurred widely in the stratosphere, but is more prominent over the Antarctic region. The depletion of ozone in this region has created an **ozone hole.**



It causes skin darkening, skin cancer, ageing, and corneal cataracts in human beings. It can even result in the death of many phytoplanktons.

Components of Ecosystem

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

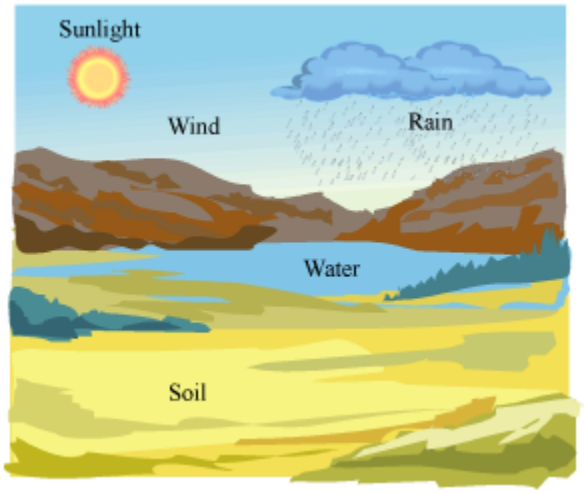
The teacher explained the students that an **ecosystem** includes both living and non-living components of an area. Thus, an ecosystem includes both the biological community and non-living components of an area. Ponds, forests, grasslands, etc. are a few examples of ecosystems.

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.

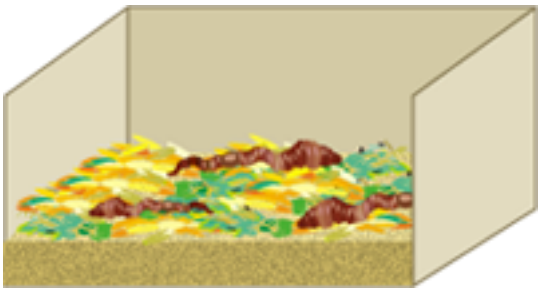
Herbivores	**Carnivores**	**Omnivores**
The animals that feed only on plants are called herbivores. They are also known as primary consumers.	The animals that eat other animals are called carnivores. They are also known as secondary consumers. Those carnivores, which feed on herbivores, are called primary 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.

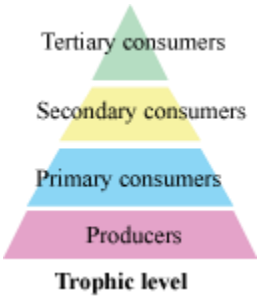
We learned about the various components of the ecosystem. Now let us find out how these components interact with each other and how energy flows within an ecosystem.

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.

Let us consider an example of a simple food chain.

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

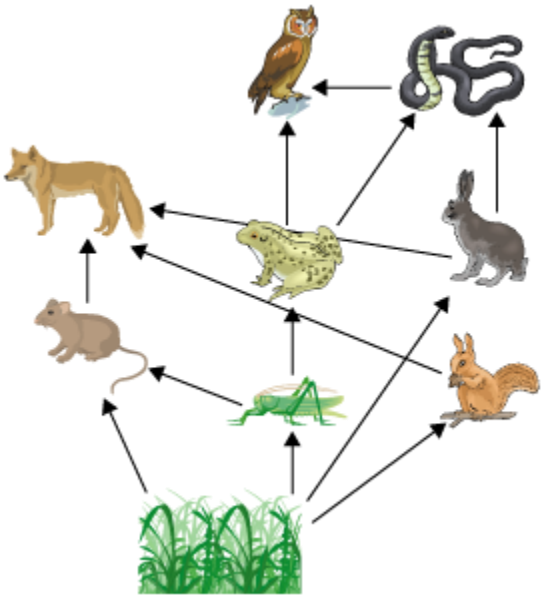
Do you know that parasites are the organisms that live on or inside the body of other living organisms called host and obtain food from them. The food chain that involves the transfer of energy through series of parasites is called **parasitic food chain.**

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**.