ENVIRONMENTAL APPLICATION (STUDY MATERIAL)

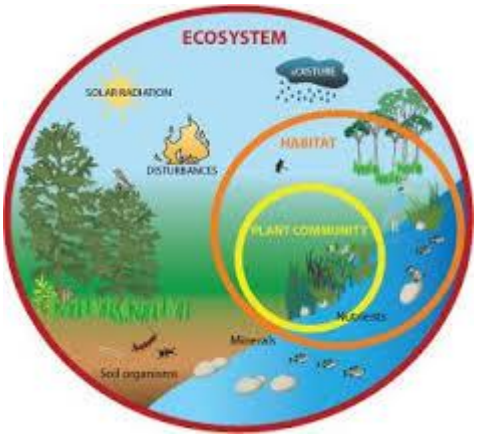
SESSION :2020-‘21

CLASS : IX

TEACHER : SHUBHA CHOUBEY

UNIT 2 : Basic Ecology

ECOSYSTEM



An ecosystem is a group or community composed of living and non-living things and their interactions with each other. They can be natural as well as artificial.

➢ COMPONENTS OF ECOSYSTEM

Biotic components are the living things that have a direct or indirect influence on other organisms in an environment.
For example - plants, animals, and microorganisms

Abiotic components of an ecosystem include all chemical and physical elements i.e. non-living components. Abiotic components can vary from region to region, from one ecosystem to another. They mainly take up the role of life supporter.

For example - air, water, soil, sunlight, temperature, humidity, atmospheric pressure etc.

➢ CLASSIFICATION OF BIOTIC COMPONENTS

Biotic components can be classified into three categories:

Producers: These include all the autotrophs. They use light energy and synthesize food on their own, e.g. plants, green algae, etc.

Consumers: These include all the heterotrophs that directly or indirectly depend on producers for their food. Consumers are further categorized as herbivores, carnivores, omnivores and parasites.

Decomposers: These include saprophytes which act on dead matter and decay them for their nutrition.

➢ RELATIOSHIP BETWEEN BIOTIC AND ABIOTIC COMPONENTS

Biotic factors are the living components of an ecosystem. They comprise of plants, animals & microorganisms. Abiotic factors are the non living components of an ecosystem. They comprise of air, water, soil, temperature, humidity, atmospheric pressure etc. The abiotic factors are the support for life.

Both the factors are interdependent and complete the cycle of life in an ecosystem.

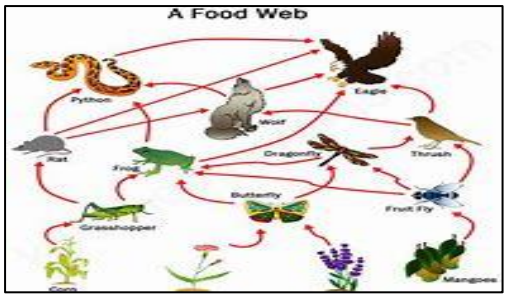
Plants are the food producers. They prepare food by the process of photosynthesis in which they use carbon dioxide from air, water from the soil and energy from sun. The consumers (herbivores & carnivores), directly or indirectly obtain their food from plants. Thus all living beings depend on the abiotic factors.

When any of the living being dies, their dead bodies are decomposed by the decomposers (bacteria & fungi), present in the soil and return the nutrients like carbon and nitrogen back to the soil. These nutrients again get circulated into the living beings through carbon and nitrogen cycles. Thus even abiotic factors are dependent on biotic factors.

- **FOOD CHAIN**

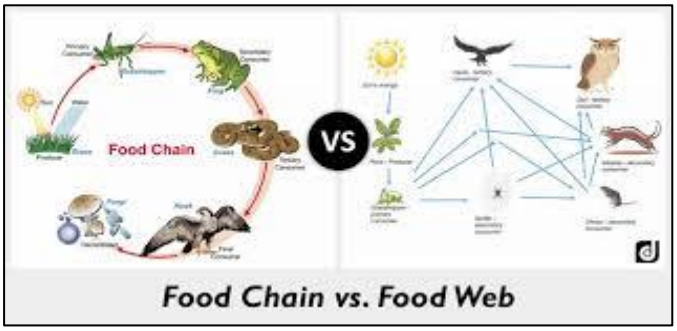
A food chain is a linear sequence of organisms through which nutrients and energy pass as one organism eats another.
It is a chain which shows how organisms are linked to each other through food.
It starts from producer organisms and ends with top carnivores.

- **FOOD WEB**



A food web is a connection of multiple food chains. It shows the interactions between different organisms in an ecosystem.
It provides alternative food to organisms and thus provides stability in an ecosystem.

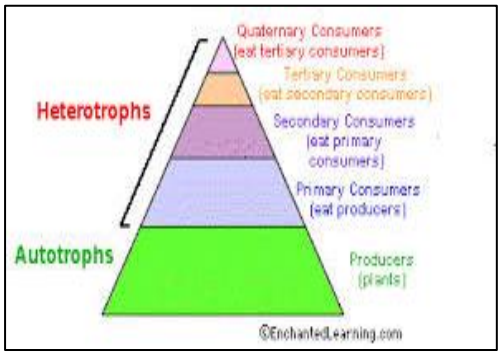
➢ DIFFERENCES BETWEEN FOOD CHAIN AND FOOD WEB

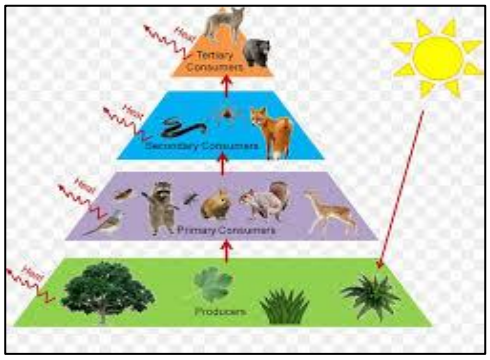


Food chain and food web form an integral part of this ecosystem.

- Food chain follows a single path whereas food web follows multiple paths.
- From the food chain, we get to know how organisms are connected with each other whereas a food web shows how two food chains are connected.

➢ TROPHIC LEVEL



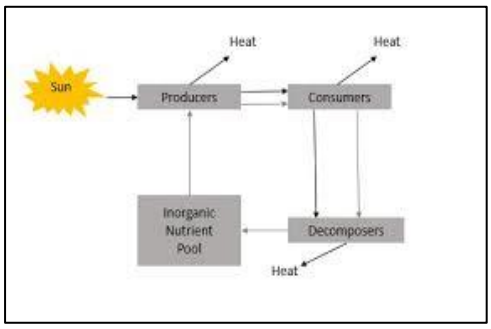


Each step in the food chain is called a "Trophic level". The trophic level to which an organism belongs, indicates how far it is away from plants in the food chain.

1. green plants (producers) = trophic level I
2. herbivores (primary consumers) = trophic level II
3. carnivores (secondary consumers) = trophic level III
4. top carnivores (tertiary consumers) = trophic level IV

The producers (green plants who produce food by the process of photosynthesis), come at first trophic level followed by herbivores (plant eating animals / primary consumers), then small carnivores (secondary consumers) and large carnivores (tertiary consumers) occupy the fourth trophic level.

FLOW OF ENERGY THROUGH AN ECOSYSTEM



Energy moves life. Our ecosystem is maintained by the cycling energy and nutrients obtained from different external sources. The flow of energy is **linear** in nature and the flow of nutrients is **cyclic** in nature.

◆ CYCLIC FLOW OF NUTRIENTS

The materials like water, carbon (as carbon dioxide) and nitrogen (as minerals) are taken up by the plants from soil, air and water bodies, etc., and made into food. This food is then passed on to the animals like herbivores and carnivores in a food chain.

After the death and decay of plants and animals, the materials like water, carbon and nitrogen present in their bodies are returned to soil, air and water, from where they were taken originally.

These materials can then be reused for the growth of new plants. In this way, the same materials are used again and again, the materials are not lost from the environment. So, the flow of materials like water, carbon and nitrogen, etc., in the ecosystem is said to be cyclic.

◆ LINEAR FLOW OF ENERGY

The cycle of energy is based on the flow of energy through different trophic levels in an ecosystem. The flow of energy in the ecosystem is linear. The energy enters the plants (from the sun) through photosynthesis during the making of food. This energy is then passed on from one organism to another in a food chain.

Energy given out by the organisms as heat is lost to the environment, it does not return to be used by the plants again. This makes the flow of energy in ecosystem '**unidirectiona**l'. Thus, the flow of energy in the ecosystem is said to be unidirectional because the energy lost as heat from the living organisms of a food chain cannot be reused by plants in photosynthesis.

TEN PERCENT LAW OF ENERGY

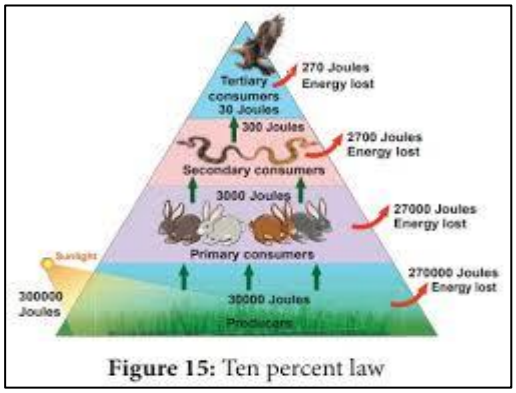


Figure 15: Ten percent law

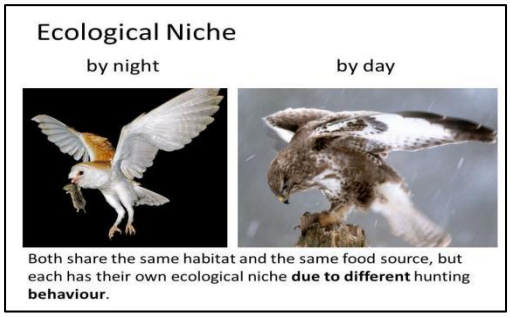
During the transfer of energy through successive trophic levels in an ecosystem, there is a loss of energy all along the path. No transfer of energy is 100 per cent.

The 10 per cent law which was given by Lindeman in the year 1942. According to ten per cent law, only 10 per cent of the energy entering a particular trophic level of organisms is available for transfer to the next higher trophic level.

All the energy transfers in food chains follow the 10% law which in simple terms means that the energy available at each successive trophic level is 10 per cent of the previous level. Thus, there is a progressive decline (gradual reduction) in the amount of energy available as we go from producer level to the higher trophic levels of organisms.

ECOLOGICAL NICHE

An **ecological niche** is the role and position a species has in its environment; how it meets its needs for food and shelter, how it survives, and how it reproduces.
The niche of a species depends on both biotic and abiotic factors, which affect the ability of a species to survive and endure.



❖ IMPORTANCE OF ECOLOGICAL NICHE

Ecological niches allow species to exist in their environment. Under the right conditions, the species will thrive and play a unique role. Without the ecological niches, there would be less biodiversity, and the ecosystem would not be in balance.
An example of an ecological niche is that of the dung beetle. The dung beetle, as its name suggests, consumes dung both in larval and adult form. Dung beetles store dung balls in burrows, and females lay eggs within them.This allows hatched larvae immediate access to food. The dung beetle in turn influences the surrounding environment by aerating soil and releasing beneficial nutrients. Therefore, the dung beetle performs a unique role in its environment.

HABITAT AND MICROHABITAT

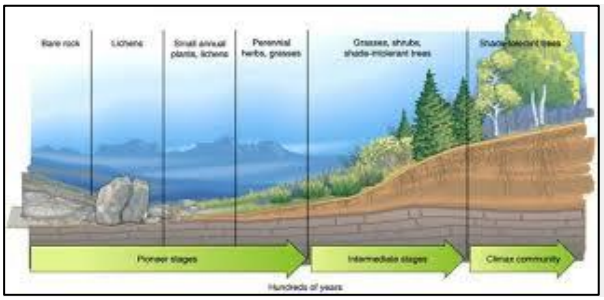
- In ecology, a habitat is the kind of natural environment in which a particular organism species lives. It is characterized by both physical and biological features. A species' habitat is those places where it can find food, shelter, protection and mates for reproduction.

  For example, habitat of a tiger is the forest, of a shark is the sea, and of Plasmodium are the red blood cells. More than one animal or plant may live in the same habitat. For example, tiger, deer, wolf, fox, lion, etc. may be found in the same forest.

- A microhabitat is not necessarily a geographical area. It is a very small area where a living organism lives.

  It can be the interior of a stem, a rotten log, a rock or a clump of moss, and for a parasitic organism it is the body of its host, part of the host's body such as the digestive tract, or a single cell within the host's body.

ECOLOGICAL SUCCESSION

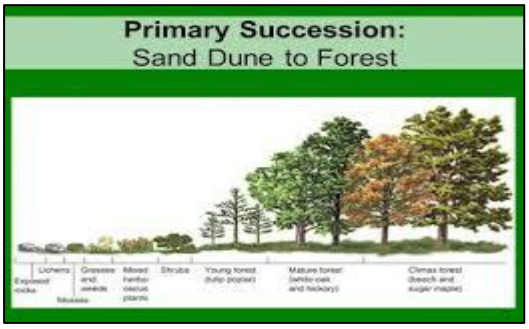


Ecological succession is the steady and gradual change in a species of a given area with respect to the changing environment. It is a predictable change and is an inevitable process of nature as all the biotic components have to keep up with the changes in our environment.

The ultimate aim of this process is to reach equilibrium in the ecosystem. The community that achieves this aim is called a climax community. In an attempt to reach this equilibrium, some species increase in number while some other decreases.

➢ KINDS OF SUCCESSION

❖ Primary Succession



Primary succession is the succession that starts in lifeless areas such as the regions devoid of soil or the areas where the soil is unable to sustain life.

When the planet was first formed there was no soil on earth. The earth was only made up of rocks. These rocks were broken down by microorganisms and eroded to form soil. The soil then becomes the foundation of plant life. These plants help in the survival of different animals and progress from primary succession to the climax community.

If this primary ecosystem is destroyed, secondary succession takes place.

❖ Secondary Succession

Secondary succession occurs when the primary ecosystem gets destroyed. For eg., a climax community gets destroyed by fire. It gets recolonized after the destruction. This is known as secondary ecological succession. Small plants emerge first, followed by larger plants. The tall trees block the sunlight and change the structure of the organisms below the canopy. Finally, the climax community arrives.

SPECIES

A species is a group of organisms that are able to interbreed and produce fertile offsprings.

Critical Minimum Size Of A Species

Critical minimum size of a species refers to the smallest number of organisms in a species which can exist without facing extinction.

- **FACTORS CAUSING EXTINCTION OF SPECIES**

1. Habitat Loss

The most common cause of endangerment is habitat loss. Plants and animals need space to live and energy provided by food, just as humans do. As human population and consumption increase, wildlife habitat is converted to houses and highways. Forests are cut down for building materials, fuel, and paper.

2. **Introduced Species**

Humans often move species around, introducing species that are not native to an ecosystem and disrupting the delicate balance that evolved among species in that ecosystem. Species can be moved both accidentally and intentionally. The introduced species may compete with native species for food or nest sites, or they may prey on native species.

3. **Overexploitation**

Humans also deplete wildlife populations by capturing or killing individuals for their own use. Animals are killed for food, fur, feathers, oil, medicines, crafts, and a host of other uses. They are also shot to stop them from killing livestock, or simply for sport.Animal eggs are taken for food, and species are captured for pets or to use in medical experiments.

4. Pollution

One of the ways habitat is degraded is by pollution. Creatures that depend on either freshwater or saltwater for all or part of their life cycles, like fish, frogs, marine mammals, and many invertebrates, are especially vulnerable to pollution. Water is polluted by run-off of fertilizers and pesticides from farms, oil and other chemicals from roads, and human sewage that flows untreated into rivers, lakes, and oceans.

5. Disease

Disease and insect infestations, which are natural and nonthreatening phenomena in many ecosystems, can bring a death blow to populations weakened or depleted by other pressures.

6. **Climate Change**

Changes in atmosphere like global warming or ozone depletion, causing rise in earth's temperature is resulting in destruction of habitat and loss of lives.

➢ KINDS OF SPECIES

1. Introduced Species

An **introduced species**, **alien species**, **exotic species**, **foreign species**, **non-indigenous species**, or **non-native species** is a species living outside its native distributional range, but which has arrived there by human activity, either deliberate or accidental.

For example, Peaches originated in China, and have been carried to much of the populated world. Tomatoes are native to the Andes, Squash (pumpkins), maize (corn), and tobacco are native to the Americas

➢ IMPACTS OF INTRODUCED SPECIES

◆ Economic Impacts

- Value and quality of land degraded
- Lower crop productivity
- High cost of controlling pests, weeds and diseases
- Routes to domestic and global markets blocked

◆ Social Impacts

- Livelihood options narrowed
- Food security decreased
- Recreational and social opportunities limited
- Risks to human and animal health
- Increased social challenges

◆ Environmental Impacts

- Reduced biodiversity
- Decreased availability and quality of key natural resources
- Water shortages
- Increased frequency of wildfires and flooding

2. Endemic Species

Endemic/Native species are those plants and animals that are found in just one geographical region and nowhere else in the world. They may confined to small or large area of the world.

Usually the endemic species are found in areas without human influence, so they remain isolated and have difficulty in spreading to other areas. These species are often confined to certain area because they are highly adapted to the particular niche. They may eat only a certain type of plant that is found nowhere.

Because of inability to move into new habitats, some endemic species are at particular risk of destruction when a new disease hits, when the habitats quality is threatened or if an invasive species enters its region and becomes a competitor or predator. These species are important because they are in habitats restricted to a particular area due to climate change, urban development and other factors. Endemic species are often endangered so it is important to save these species.

For example, kangaroos are originally endemic to Australia and are found nowhere else in the world.

Endemic species in India - Asiatic Lion, Gir Forest, Kashmir Stag, Kashmir Valley etc.

3. Keystone Species

Keystone species are organisms which occupy the topmost position in an ecosystem. They are least in number but play a pivotal role in an ecosystem. Without a keystone species, an ecosystem would cease to exist. The presence of these dominant or apex predators keep a balance in an ecosystem.

Examples of Keystone Species

1. Sharks

This fish is one of the largest in size in deep waters. It is an avid predator that feeds on fishes of all kinds making it the keystone species in deep waters. Sharks have been the regulators of life in the deep water ecosystem given that they feed on living fishes in water, the sick and the weak thus not only keeping the count of fishes manageable but also reducing the chances of diseases from the sick and dead fishes respectively.

4. The African Elephant

The biggest mammal on land is also a keystone species. It is found in Africa. Its role is in its destructive force on trees and consumption of young saplings of the savannah grasslands. The savannah grasslands are home to a lot of grass-eating herbivores such as the zebras, buffaloes and antelopes.The consumption of the saplings by the elephant ensures that the grassland remains the same rather than turn to woodland.

➢ KINDS OF ECOSYSTEM

The different types of the ecosystem include:

- Terrestrial ecosystem
- Forest ecosystem
- Grassland ecosystem
- Desert ecosystem
- Tundra ecosystem
- Freshwater ecosystem
- Marine ecosystem

The biotic components of few ecosystems are -

POND ECOSYSTEM

Producers : algae and other aquatic plants, such as Azolla, Hydrilla, Potamogeton, Pistia, Wolffia, Lemna

Primary consumers : tadpole larvae of frogs, fishes and other aquatic animals

Secondary consumers: Frogs, big fishes, water snakes, crabs

Tertiary consumers: water-birds, turtles, etc.

FOREST ECOSYSTEM

Producers : herbs, shrubs & trees

Primary consumers : insects, birds, rodents and larger herbivores that eat mainly plants, grasses, seeds and berries

Secondary consumers : predatory birds, such as owls and hawks, and other small predators like foxes and skunks, which eat insects and rodents

Tertiary consumers : top carnivores like lion, tiger, leopard etc.

DESERT ECOSYSTEM

Producers : Cacti and other succulent plants store water in their spines, desert shrubs and trees

Primary consumers : lizards, rodents & insects

Secondary consumers : snake, lizard, scorpion etc

Tertiary consumers : fox, hawk

EXERCISE

1. Define ecosystem. What are the the components of an ecosystem ?
2. Name and define the various categories of biotic components.
3. How are biotic & abiotic components interdependent ?
4. Differentiate between Food Chain & Food Web.
5. What are trophic levels in a food chain ?
6. Explain ecological niche and its importance.
7. Define habitat & microhabitat.
8. What is ecological succession ? Name & explain the two kinds of successions.
9. What does Critical minimum size of a species mean ?
10. What are the factors that cause extinction of species ?
11. Define Introduced, Endemic & Keystone species.
12. How does introduced species effect the environment ?
13. Explain how every organism is dependent on plants for energy ?
14. What is 10% law of energy ? Who gave this theory ?