MODULE 1- FUNDAMENTALS OF ENVIRONMENTAL EDUCATION
UNIT 1: CONCEPT OF ENVIRONMENT, ECO SYSTEM AND ECOLOGY

a) Environment: Meaning, Components (Biotic and Abiotic)

Introduction

History reveals that human race was once afraid of nature and the natural forces. So, human beings worshiped nature and considered nature as superior to human race. But enormous increase in human population raised the demand for development and increased the consumption of various natural resources resulting in environmental deterioration.

Definition

'Environment is anything immediately surrounding an object and exerting a direct influence on it'

- **P.S. Gilbert**

'The term environment is used to describe, in the aggregate, all the external forces, influences and conditions, which affect the life, nature behavior and the growth, development and maturity of living organisms'

- **Douglas and Holland**

'Environment refers to the sum total of all conditions which surround man at a given point in space and time'

- **C. C. Park**

The entire range of external influence acting on an organism, both the physical and biological, and other organisms, i.e. forces of nature surrounding an individual.

- **Encyclopedia Britannica**

Total environmental system includes not only the biosphere, but also his interactions with his natural and man-made surroundings.

- **US Council on Environmental quality**

Meaning of Environment

- Everything that surrounds or affects an organism during its life time is collectively known as its environment or simply put everything surrounding a living organism like people; place and things constitute its environment which can be either natural or man-made.
- The word environment has been derived from a French word 'environner' meaning to encircle or to surround.
- In the beginning, environment of early man consisted of only physical aspects of the planet earth such as land (lithosphere), air (atmosphere) and water (hydrosphere) along with

biotic communities but, with the passage of time and advancement of society man extended his environment to include his social, economic and political functions too.

- At the organismic level it is essentially physiological interaction which tries to understand that how different organisms are adapted to their environment in terms of not only survival but also reproduction and propagation of their population.
- All organisms (from virus to man) are obligatorily dependent on the environment for various essential needs such as food, shelter, water, oxygen etc.
- The surrounding that affects an organism during its lifetime is collectively known as its environment.
- In another words "Environment is sum total of water, air and land inter-relationships among themselves and also with the human being, other living organisms and material goods". More specifically, the sum of those portions of the hydrosphere, lithosphere, and atmosphere into which life penetrates is the biosphere.
- It comprises all the physical and biological surrounding and their connections. Environmental studies give an approach towards understanding the environment of our globe and the impact of human life upon the environment and vice-versa.
- The physical and the biological environments are interdependent. For example, deforestation leads to decline in wildlife population (biological environment) as well as increase in atmospheric temperature (physical environment).
- Thus, environment is actually universal in nature and it is a multidisciplinary subject counting physics, chemistry, geology, geography, history, economics, physiology, biotechnology, remote sensing, geophysics, soil science and hydrology etc.

<u>Components of Environment</u>

Many factors influence every part of our environment: things like how tall trees grow, where animals and plants are found, and why birds migrate. On the basis of basic structure, the environment may be divided into

1. Biotic environment
2. Abiotic environment

Biotic Components

- It consists of the living parts of the environment.
- The populations are those of the animal community, the plant community and the microbial community.

The biotic community is divided into:

1. Autotrophs
    - Auto means 'self' and trophos means 'nourishment'.
    - Plants are called autotrophs because they make their food themselves.
    - The making of food for themselves is called the Autotrophic nutrition.
    - Autotrophic nutrition is found in green plants, and in some bacteria.

2. Heterotrophs
    - Hetero means ‘others’ and trophos means ‘nourishment’.
    - If organisms depend on others for their food, it is called Heterotrophic Nutrition.
    - Animals cannot make their food themselves.
    - They depend for food upon plants.
    - Animals are known as Heterotrophs.

3. Saprotrophs
    - The uptake of nutrients by organism from dead and decaying matter in the form of solution is called the saprotrophic nutrition.
    - The organisms which use saprotrophic mode of nutrition are called saprotrophs.
    - For example: fungi.

These living things interact with one another in many ways. Biotic factors and their interactions can be broken down into three groups:

1. Producers:
    - All plants, such as grass and trees, are producers.
    - These organisms absorb the sun’s energy and convert the energy into food for themselves, allowing them to grow larger, make flowers and seeds, etc.

2. Consumers:
    - These organisms, mostly animals, eat producers and/or other animals.
    - They may also eat decomposers.
    - Two examples of consumers are deer (eat plants) and wolves (eat animals).
    - Consumers that only eat plants (herbivores) are often known as primary consumers. Eg: rabbit, cow.
    - Consumers that only eat other animals (carnivores, eg: tiger, lion) or feed on both plants as well as the flesh of other animals (omnivores, eg: humans, bear) are often known as secondary consumers.

3. Decomposers:
    - These organisms break down dead material (such as a fallen tree) into soil and return nutrients to the soil so they can be re-used by producers to create food.
    - An example of a decomposer is a mushroom.

Abiotic Components

- Are the non-living parts of the environment that can often have a major influence on living organisms.
- Abiotic components originate from the lithosphere, hydrosphere and atmosphere
- Abiotic factors include water, sunlight, oxygen, soil and temperature.

The basic components of the abiotic environment are atmosphere or the air, lithosphere or the rocks and soil, hydrosphere or the water, and the living component of the environment or the biosphere.

1. Atmosphere:
    - The thick gaseous layer surrounding the earth.
    - It spreads up to 300 km. above the earth's surface.
    - Apart from gases there are water vapor, industrial gases, dust and smoke particles in suspended state, microorganism etc.

2. Lithosphere:
    - The Core which is around 7000 kilometers in diameter (3500 kilometers in radius) and is situated at the Earth's center.
    - The Mantle which environs the core and has a thickness of 2900 kilometers.
    - The Crust floats on top of the mantle and is composed of basalt rich oceanic crust and granitic rich continental crust.

3. Hydrosphere:
    - The hydrosphere includes all water on or near-earth surface and includes oceans, lakes, rivers, wetlands, icecaps, clouds, soils, rock layers beneath surface etc.
    - Water exist in all three states: solid (ice), liquid (water), and gas (water vapor)
    - 71% of planet surface is covered with water
    - Freshwater- 2.53%
    - Freshwater in glaciers-1.74%
    - Water as water vapor in atmosphere-12,900 km^3
    - living organism contain- 1100 km^3

These living things and non-living things interact with one another in many ways. This is known as **Interdependence.** It can be stated as follows:

1. Abiotic + Abiotic (eg. soil + climate)
2. Biotic + Biotic (eg. Plants + animals)
3. Biotic + Abiotic (eg. Plants + soil or animals + climate)

Interdependence Between Abiotic Components (Abiotic + Abiotic)

- Soils that are wetter or denser, hold heat and stabilize the surroundings from temperature changes.
- As the climate heats up, there is a reduction in the amount of water (water scarcity).
- The process of decay uses up oxygen and produces carbon dioxide (Carbon Cycle).
- The amount water in various water bodies is constant due to hydrological cycle.
- Atmosphere has a fixed composition of gases present in it and any excess change in this composition is likely to cause air pollution.

Interdependence Between Biotic Components (Biotic + Biotic)

Plants and animals depend on each other for various needs:

- Plants (producer) utilize the sun's energy and make their own food through photosynthesis.
- Herbivores (primary consumer) such as rabbit and cow feed on plants.
- Carnivores (secondary consumer) such as tiger and lion feed on herbivores.
- Omnivores (secondary consumer) such as human beings and bear feed on both plants as well as the flesh of other animals.
- Scavengers and decomposers feed on dead plants and animals and release the nutrients trapped inside their bodies into the soil.

Interdependence Between Biotic and Abiotic Components (Biotic + Abiotic)

- Plants use light to prepare their food. Animals and human beings depend on plants for their food. Thus, the life of all the organisms is made possible because of sunlight.
- The temperature of a place determines the type of animals or plants that live there. Some parts of the Earth are very cold (e.g. polar regions) and some parts very hot (e.g. desert). In colder regions of the earth, we find animals like polar bears and penguins and plants like conifers trees. In hot regions like the desert, animals such as camels and desert foxes and plants like thorny bushes and date palms can live.
- We all need water to live. About three –fourth parts of the earth's surface is covered with water. About 70%of our body weight is due to water. Plants would dry if they did not get water. The amount of water in nature is maintained by water cycle.
- All living things require oxygen for respiration. Without respiration, they cannot utilize food to produce energy. Air contains 21% oxygen, which is released by green plants during photosynthesis. Carbon dioxide, which forms 0.03% of air, is used as a raw material for photosynthesis.
- The soil is the basic medium for growth in plants. Some animals and microorganisms also live in the soil. Soil also provides necessary minerals like sodium, potassium, calcium, phosphorus, and water. Animals such as earthworm and snail also make the soil loose by turning it.

Conclusion

The relationship and interaction between organism and environment are multidimensional. No organism can live alone without interacting with other organisms or other biotic/abiotic forms. So, each organism has other organisms as a part of its environment. Each and everything with which we interact or which we need for our sustenance forms our environment. It may be safely argued that environment is an inseparable whole and is constituted by the interacting system of physical, biological and cultural elements which are interlinked individually as well as collectively in myriad ways. The environment is not static; rather it's a very dynamic entity. Various factors (biotic & abiotic) are in a flux and keep changing the environment continuously.

b) Concept of Ecosystem & Types of Eco System

Introduction

Whether underwater in a tropical reef, deep in a lush rainforest or high on a snow-capped mountain range, an ecosystem is composed of plants, animals and smaller organisms that live in a shared environment. Ecosystems range in size from microscopic to the whole of Earth, which is known as the biosphere. The ecosystems on this planet are countless, and each is distinct.

Definition

"Ecosystem is an unit that includes all the organisms, i.e., the community in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity and material cycles, i.e., exchange of materials between living and non-living, within the system"

- **Eugene Odum**

Concept of Ecosystem

- The term "Ecosystem" was first coined by A. G. Tansley, an English botanist, in 1935.
- The ecosystem is the functional unit of ecology (scientific study of how living organisms interact with each other and the environment) where the living organisms interact with each other and the surrounding environment.
- In other words, an ecosystem is a chain of interaction between organisms and their environment. Thus, Ecosystem = Ecology+ Environment.
- The living and non-living components of an ecosystem are known as biotic and abiotic components, respectively.
- An 'Ecosystem' is a region with a specific and recognizable landscape form such as forest, grassland, desert, wetland or coastal area.
- The nature of the ecosystem is based on its geographical features such as hills, mountains, plains, rivers, lakes, coastal areas or islands.
- It is also controlled by climatic conditions such as the amount of sunlight, the temperature and the rainfall in the region.
- The geographical, climatic and soil characteristics form its non-living (abiotic) component.
- These features create conditions that support a community of plants and animals (biotic components) that evolution has produced to live in these specific conditions.

Characteristics of an Ecosystem

- Structural and functional unit of ecology. Structure (species diversity), Function (energy flow and materials)
- The amount of energy needed to maintain an ecosystem depends on its structure. Simpler the structure, less energy is needed to maintain.
- An ecosystem can maintain itself if the energy flow is maintained.
- Any change or imbalance leads to the destruction of ecosystem.

Types of Ecosystem

Ecosystems are broadly divided into:

- Natural
  - ✓ Natural ecosystems are those that are exist in nature.
- Artificial
  - ✓ Artificial ecosystems are simple, human-made, unstable and subjected to human intervention and manipulation.
  - ✓ They are also called man-made or man-engineered ecosystems.
  - ✓ They are maintained artificially by man where, by addition of energy and planned manipulation, natural balance is disturbed regularly.
  - ✓ e.g. croplands such as sugarcane, maize, wheat, rice-fields; orchards, gardens, villages, cities, dams, aquarium and manned spaceship
  - ✓ Many man-made ecosystems are built for conservation purposes, aesthetics, and studying biology and ecology.

There are two types of Natural ecosystem:

- Terrestrial Ecosystem
- Aquatic Ecosystem

Terrestrial Ecosystems

Terrestrial ecosystems are exclusively land-based ecosystems. There are different types of terrestrial ecosystems distributed around various geological zones. They are as follows:

1. Forest Ecosystems
   - A forest ecosystem consists of several plants, animals and microorganisms that live in coordination with the abiotic factors of the environment.
   - Because of the abundance of plants that serve as producers, this ecosystem abounds in life.
   - Not only plants but also animals are teeming in a forest.
   - They are also a great source of fruits, wood,
   - Forests help in maintaining the temperature of the earth and are the major carbon sink.
   - Eg: Tropical Rain Forest, Tropical Savannas Forest, Taiga or Boreal forest

2. Grassland Ecosystems
   - In a grassland ecosystem, the vegetation is dominated by grasses and herbs.
   - They are typically found in tropical or temperate regions.
   - The animals commonly found in this type of ecosystem are grazing animals, such as cattle, goats, and deer.
   - Eg: The steppes of Asia and Europe, The Prairies of USA and Canada, The Veldts of Africa

3. Tundra Ecosystems
    - Tundra ecosystems are devoid of trees and are found in cold climates or where rainfall is scarce.
    - These are covered with snow for most of the year.
    - The ecosystem in the Arctic or mountain tops is tundra type.
    - The snow melts briefly in spring and summer, producing shallow ponds.
    - During this time, lichens and flowering plants typically grow.
    - Because of the ice that covers the land in the tundra, this type of ecosystem is important in regulating the earth's temperature.
    - It also serves as a water reservoir (in the form of ice or frost)
    - Eg: Arctic *tundra*, alpine *tundra*, and Antarctic *tundra*

4. Desert Ecosystem
    - These are regions with very little rainfall.
    - The days are hot and the nights are cold.
    - Deserts are typically arid and windy.
    - Some of them contain sand dunes, others, mostly rock.
    - Organisms in the desert are not as diverse as those in forests but they possess adaptations that make them suited to their environment.
    - Plants that are commonly found in the desert are cacti.
    - Desert animals include insects, reptiles, and birds.
    - Eg: Sahara Arabia, Gobi deserts

Aquatic Ecosystem

Aquatic ecosystems are ecosystems present in a body of water. These can be further divided into two types, namely:

1. Freshwater Ecosystem
    - The freshwater ecosystem is an aquatic ecosystem that includes lakes, ponds, rivers, streams and wetlands.
    - They are home to algae, plankton, insects, amphibians, and fish.
    - These have no salt content.
    - There are three basic types of freshwater ecosystems:
      a. *Lentic:* slow-moving water, including pools, ponds, and lakes.
      b. *Lotic:* rapidly-moving water, for example streams and rivers.
      c. *Wetlands:* areas where the soil is saturated or inundated for at least part of the time.

2. Marine Ecosystem
    - The marine ecosystem includes seas and oceans.
    - These have a more substantial salt content and greater biodiversity in comparison to the freshwater ecosystem.
    - They are an important source of atmospheric oxygen due to the vast population of autotrophic algae that release oxygen through photosynthesis.

- Marine ecosystems are regarded as the most abundant type of ecosystems in the world.
- Eg: mangroves, the open ocean, rocky shores

Conclusion

Ecosystems are created by the interrelationships between living organisms and the physical environments they inhabit (land, water, air). Human beings are part of ecosystems, as well as manipulators of ecosystems. As such we are dependent on, as well as responsible for, the ecological health of the ecosystems we inhabit.

c) Concept of Ecology, Ecological Pyramids (Numbers, Mass, Energy), Food Web & Ecological Energy Dynamics

Concept of Ecology

- Ecology is the scientific study of the distributions, abundance and relations of organisms and their interactions with the environment.
- Ecology includes the study of plant and animal populations, plant and animal communities and ecosystems.
- Since ecology refers to any form of biodiversity, ecologists research everything from tiny bacteria's role in nutrient recycling to the effects of tropical rain forest on the Earth's atmosphere.
- The discipline of ecology emerged from the natural sciences in the late 19th century.
- Ecology is closely related to the disciplines of physiology, evolution, genetics and behavior.
- Thus, ecology involves the study of-
    - ✓ life processes explaining adaptations
    - ✓ distribution and abundance of organisms
    - ✓ the movement of materials and energy through living communities
    - ✓ the successional development of ecosystems, and
    - ✓ the abundance and distribution of biodiversity in context of the environment.

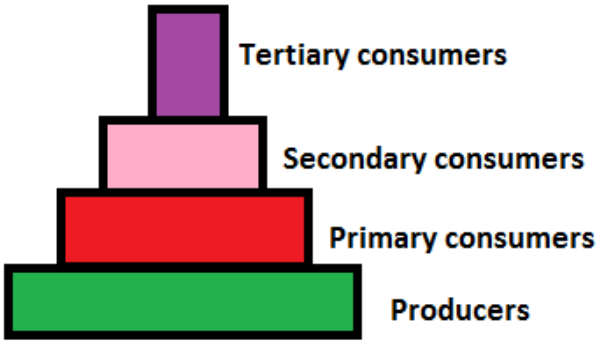
Ecology deals primarily with the descriptive study of organisms. It is a sub-discipline of biology, which is the study of life.

Ecological Pyramids

- Ecological pyramids are pictorial representation of relationship between organisms at different trophic levels within a food chain.
- Ecological pyramids are in the shape of a pyramid.
- The pyramid is formed on the basis of the number of organisms, energy and biomass.
- The concept was first introduced by Charles Elton, the pioneer British Ecologist.
- These pyramids are also known as Eltonian pyramids.
- Ecological pyramids begin with the producers at the bottom like plants and they proceed to various trophic levels like herbivores consume plants, carnivores' prey on herbivores and so on.
- The ecological pyramid is also used to explain how various organisms in an ecosystem are related to one another.
- The pyramid ideally shows who is consumed by whom while also showing the order in which the energy flows.
- The flow of energy in an ecological pyramid is from bottom to top, which means energy from the autotrophs who are the primary producers, goes to the primary consumers, meaning those who consume these plants. At the nest step, the energy goes to the secondary consumers who eat the primary consumers.

- The ecological pyramids are of three kinds. These are as follows:
    1. Pyramid of number
    2. Pyramid of biomass
    3. Pyramid of energy

1. <u>Pyramid of Number</u>

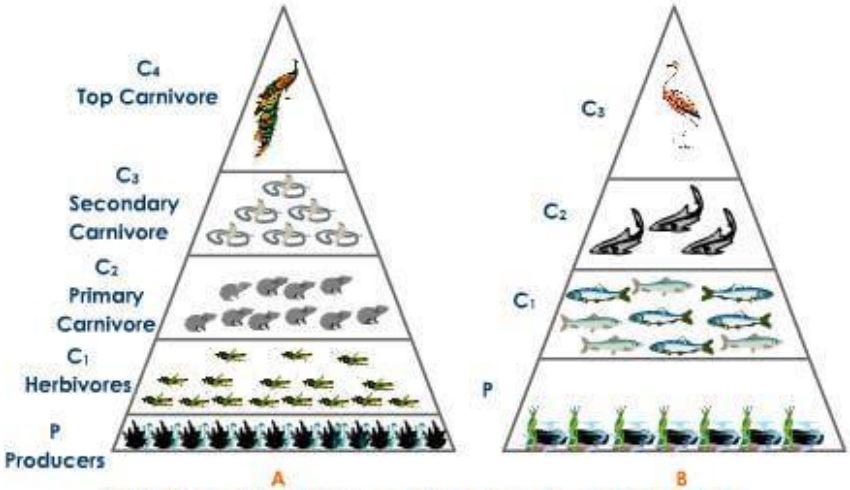


Pyramid of numbers

- A pyramid of numbers shows the total number of individual organisms at each level in the food chain of an ecosystem.
- The number of organisms decreases while going higher up the pyramid.
- The ones at the bottom are the producers who are present in the largest number form the base of the pyramid.
- When plotted the relationships among the number of producers, primary consumers (herbivores), secondary consumers (carnivore of order 1), tertiary consumers (carnivore of order 2) and so on in any ecosystem, it forms a pyramidal structure.
- The shape of this pyramid varies from ecosystem to ecosystem.
- There are three types of pyramid of numbers
    a. Upright
    b. Partly upright
    c. Inverted

a. Upright pyramid of numbers

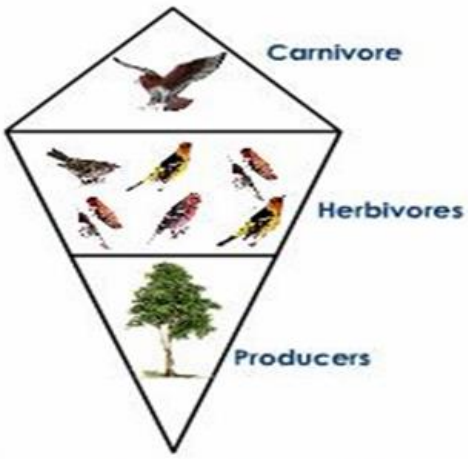
- ✓ This type of pyramid can be seen in the grassland ecosystem and pond ecosystem.
- ✓ The grasses occupy the lowest trophic level (base) because of their abundance.
- ✓ The next higher trophic level is primary consumer – herbivores like a grasshopper.
- ✓ The individual number of grasshoppers is less than that of grass.
- ✓ The next energy level is a primary carnivore like rats.
- ✓ The number of rats is less than grasshoppers, because, they feed on grasshoppers.
- ✓ The next higher trophic level is secondary carnivore like snakes. They feed on rats.
- ✓ The next higher trophic level is the top carnivore like Hawk.
- ✓ With each higher trophic level, the number of individual decreases.



Upright Pyramids of Numbers. (A) In a Grass Land (B) In a Pond

b. Partly upright pyramid of numbers

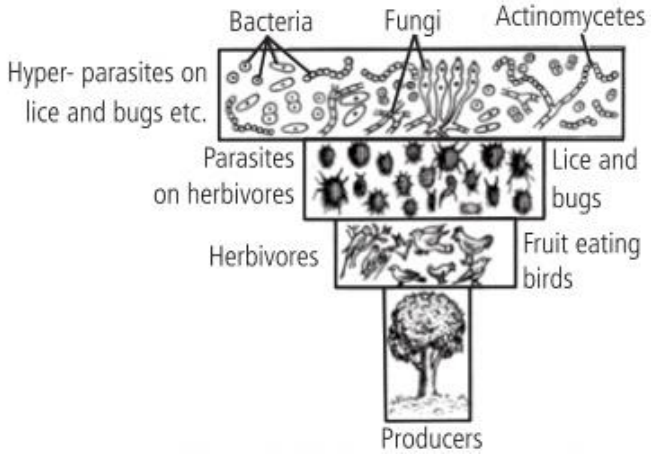
- ✓ This type of number pyramid is typical of the forest ecosystem.
- ✓ In this ecosystem, the producers are large-sized trees, which sit at the base of the number pyramid.
- ✓ The herbivores, such as elephants and fruit-eating birds, make the primary consumers.
- ✓ They are more in number than the producers.
- ✓ Afterward, the number of individual organisms reduces at each successive trophic level.
- ✓ It forms a spindle -shaped pyramid.



Partly Upright
Pyramid of Number

c. Inverted pyramid of numbers

- ✓ An inverted number pyramid is found in parasitic food chains.
- ✓ In these food chains, there's normally one producer supporting numerous parasites.
- ✓ The parasites, in turn, support more hyper-parasites.
- ✓ In short, in this pyramid, number of individuals at each level is increased from lower level to higher level.

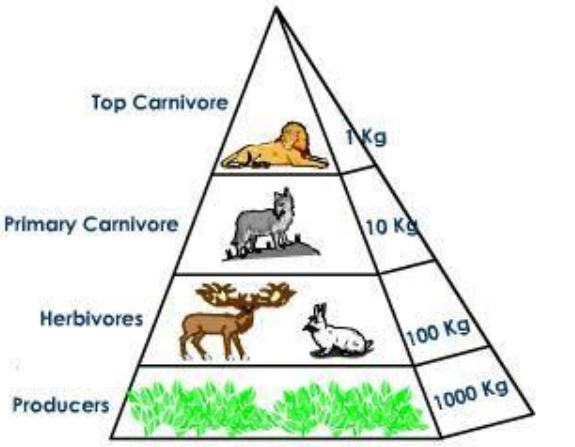


2. Pyramid of Biomass

- Pyramid of biomass is the graphic representation of biomass present per unit area of different trophic levels, with producers at the base and top carnivores at the tip.
- Pyramid of biomass is usually determined by collecting all organisms occupying each trophic level separately and measuring their dry weight (weight of living matter).
- This overcomes the size difference problem because all kinds of organisms at a trophic level are weighed.

Pyramid of Biomass (Terrestrial Biomass) – Upright

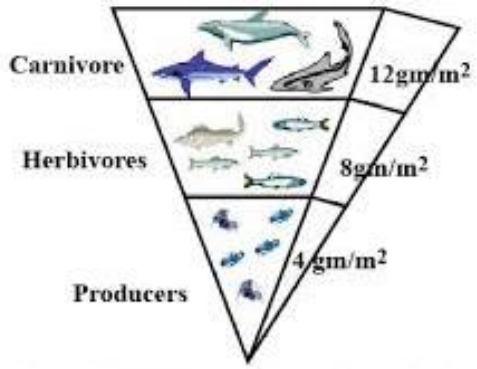
- ✓ For most ecosystems on land, the pyramid of biomass has a large base of primary producers with a smaller trophic level perched on top.
- ✓ The biomass of producers (autotrophs) is at the maximum.
- ✓ The biomass of next trophic level i.e. primary consumers is less than the producers.
- ✓ The biomass of next higher trophic level i.e. secondary consumers is less than the primary consumers.
- ✓ The top, high trophic level has very less amount of biomass.



Upright Pyramid of biomass in a Terrestrial Ecosystem

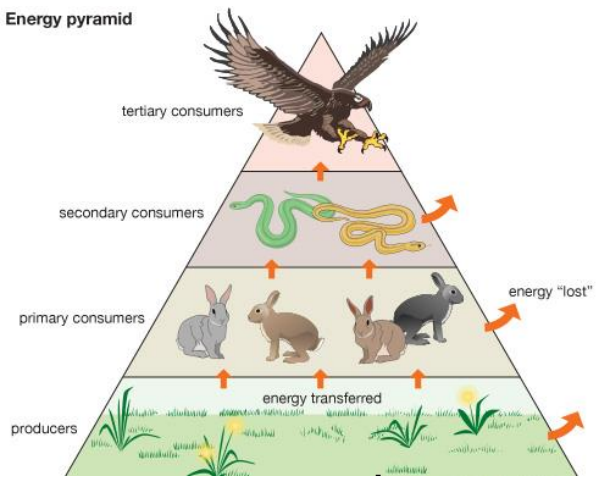
Pyramid of Biomass (Aquatic Biomass) – Inverted

- ✓ In contrast, in many aquatic ecosystems, the pyramid of biomass may assume an inverted form.
- ✓ This is because the producers are tiny phytoplankton that grows and reproduces rapidly.
- ✓ Here, the pyramid of biomass has a small base, with the consumer biomass at any instant exceeding the producer biomass and the pyramid assumes an inverted shape.



Inverted Pyramid in an Aquatic Ecosystem

3. <u>Pyramid of Energy</u>
   - The pyramid of energy shows the relationship between the total quantity of energy utilized by producers, herbivores and the carnivores at successive trophic levels.
   - Energy flow is unidirectional which means energy always flows from the lowest trophic level to the next successive level. During transfer there is loss of energy.
   - Eg: Suppose an ecosystem receives light energy. Most of the energy is not absorbed; of the energy absorbed only a small portion is utilized by green plants for respiration and store as energy-rich materials. Now suppose a deer, eats the plant. The deer use some of it for its metabolism and stores some as food energy. A lion that eats the deer gets an even smaller amount of energy. Thus, usable energy decreases from sunlight to producer to herbivore to carnivore.
   - Thus, there is a decrease in the total available energy at each higher trophic level and hence the PYRAMID OF ENERGY IS ALWAYS UPRIGHT



Food Web

- A food web can be described as a "who eats whom" diagram that shows the complex feeding relationships in an ecosystem.
- The concept of a food web, previously known as a food cycle, is typically credited to Charles Elton.
- In a food web, organisms are arranged according to their trophic level.
- The trophic level for an organism refers to how it fits within the overall food web and is based on how an organism feed.
- Broadly speaking, there are two main designations: autotrophs and heterotrophs.
- Autotrophs make their own food while heterotrophs do not.
- Within this broad designation, there are five main trophic levels: primary producers, primary consumers, secondary consumers, tertiary consumers, and apex predators.
- A food web shows us how these different trophic levels within various food chains interconnect with one another as well as the flow of energy through the trophic levels within an ecosystem.
- But in an ecosystem, one doesn't find simple independent food chains, but many interdependent and complex food chains that look more like a web and are therefore called food webs.
- Food web shows how different animals are interconnected by different paths.

Trophic Levels in a Food Web

1. **Primary producers**
   - Make their own food via photosynthesis.
   - Photosynthesis uses the sun's energy to make food by converting its light energy into chemical energy.
   - These organisms are also known as autotrophs.
   - Primary producer examples are plants and algae.

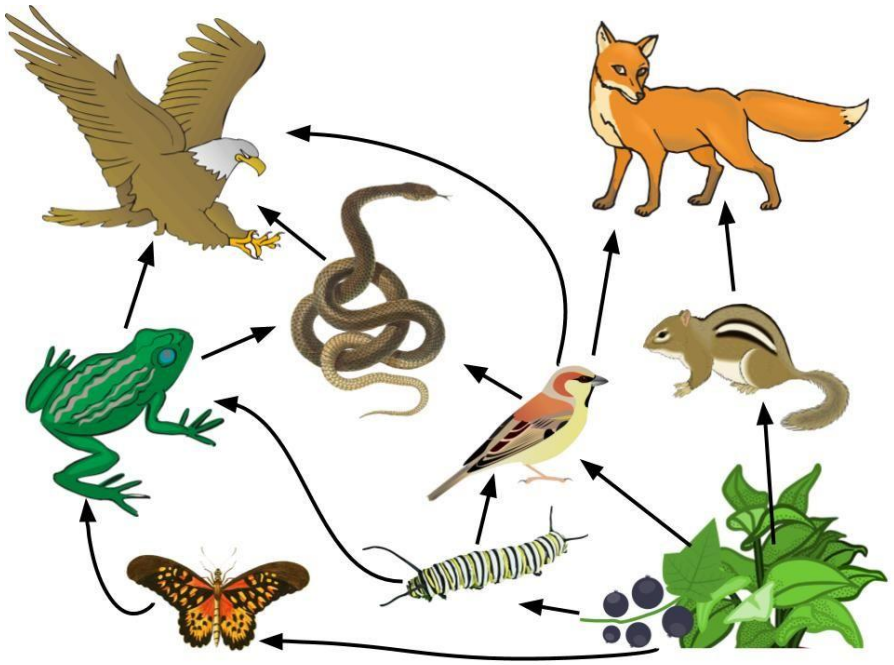
2. **Primary consumers**
   - Are those animals that eat the primary producers.
   - They are called primary as they are the first organisms to eat the primary producers who make their own food.
   - These animals are also known as herbivores.
   - Examples of animals in this designation are rabbits, beavers, elephants, and moose.

3. **Secondary consumers**
   - Consist of organisms that eat primary consumers.
   - Since they eat the animals that eat the plants, these animals are carnivorous or omnivorous.
   - Carnivores eat animals while omnivores consume both other animals as well as plants.
   - Bears are an example of a secondary consumer.

4. **Tertiary consumers**
    - Can be carnivorous or omnivorous.
    - The difference being that secondary consumers eat other carnivores.
    - An example is an eagle.

5. **Apex predators**
    - Apex predators are at the top because they do not have natural predators.
    - Lions are an example.

Decomposers consume dead plants and animals and break them down. Eg: Fungi.
Detritivores consume dead organic material. Eg: Vulture.



Ecological Energy Dynamics

- Energy is one of the most important abiotic factors in an ecosystem and organisms in an ecosystem are connected by the flow of energy and matter among one another.
- Energy can be neither created nor destroyed, it can only change form or be transferred to the next organism in a food chain.
- Energy gained from food sources is used to build the tissues of these consumers which, in turn, become sources for the next organisms in the food chain.
- Understanding the dynamics of energy flow in an ecosystem provides a clearer picture of the delicate balance of our natural world.
- At the base of the ecosystem, primary producers unlock the energy for the rest of the organisms in the environment.
- Primary producers are autotrophic or self-feeding organisms because they can synthesize organic molecules from inorganic material.

- Examples of producers include chemosynthetic bacteria and photosynthetic plants.
- They become a resource for consumers, which are heterotrophic organisms that cannot create their own organic materials and obtain them from other organisms.
- The organisms that get their energy from autotrophs are called primary consumers. Next on the food chain are secondary consumers that can feed on primary consumers. Similarly, consumers that can feed on secondary consumers are called tertiary consumers.
- Energy flow in a food chain starts with the primary producers, thus the size of the community depends on the amount of energy captured into organic material by the primary producers.

Human Impacts on Energy Flow

- The trophic pyramid model of energy flow underscores the importance of the primary producers to the health of the ecosystem.
- This is especially important in the near future as human-induced changes will cause unprecedented variations in numerous ecosystems around the world.
- Therefore, understanding energy dynamics in food chains that are under threat can help mitigate negative effects of environmental changes and prevent secondary extinctions.