

SEMESTER II General  
CC Paper II- Plant  
Ecology and Taxonomy  
Unit-4

**Dr. Sunita Bandopadhyay  
(Mukhopadhyay)**

**Department of Botany**

**M.U.C. College, Burdwan**

# • Ecosystem

- Structure, Process; Trophic organization, basic sources of energy, Food chains and webs; Ecological pyramids; Standing crop; Commensalism;



Eco=Environment; System=Interaction

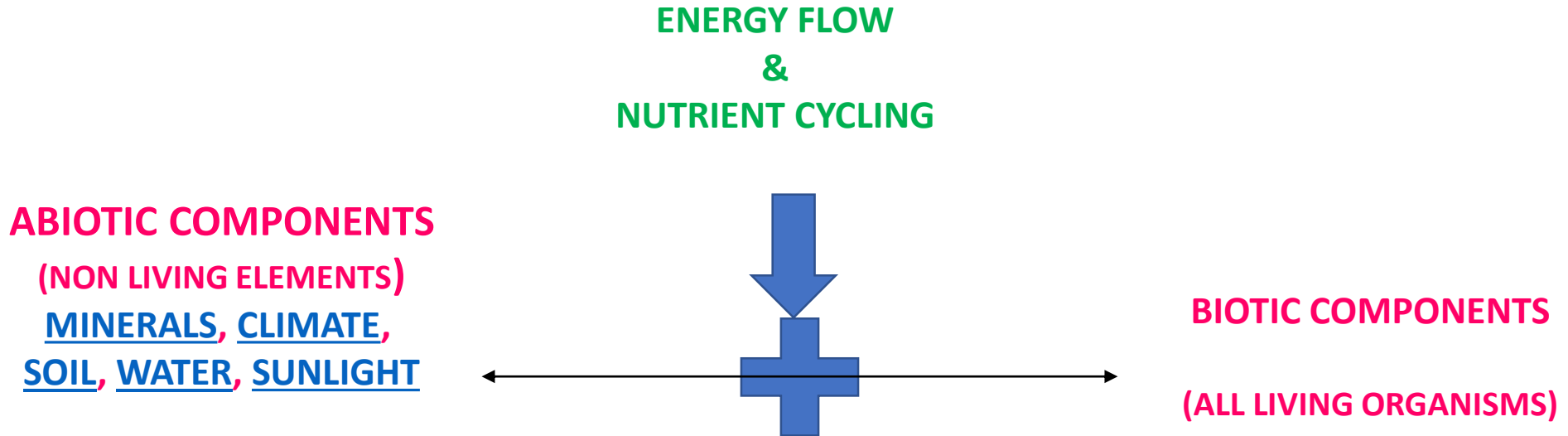
Living things  
+ Nonliving things  
ECOSYSTEM



# TYPES OF ECOSYSTEMS



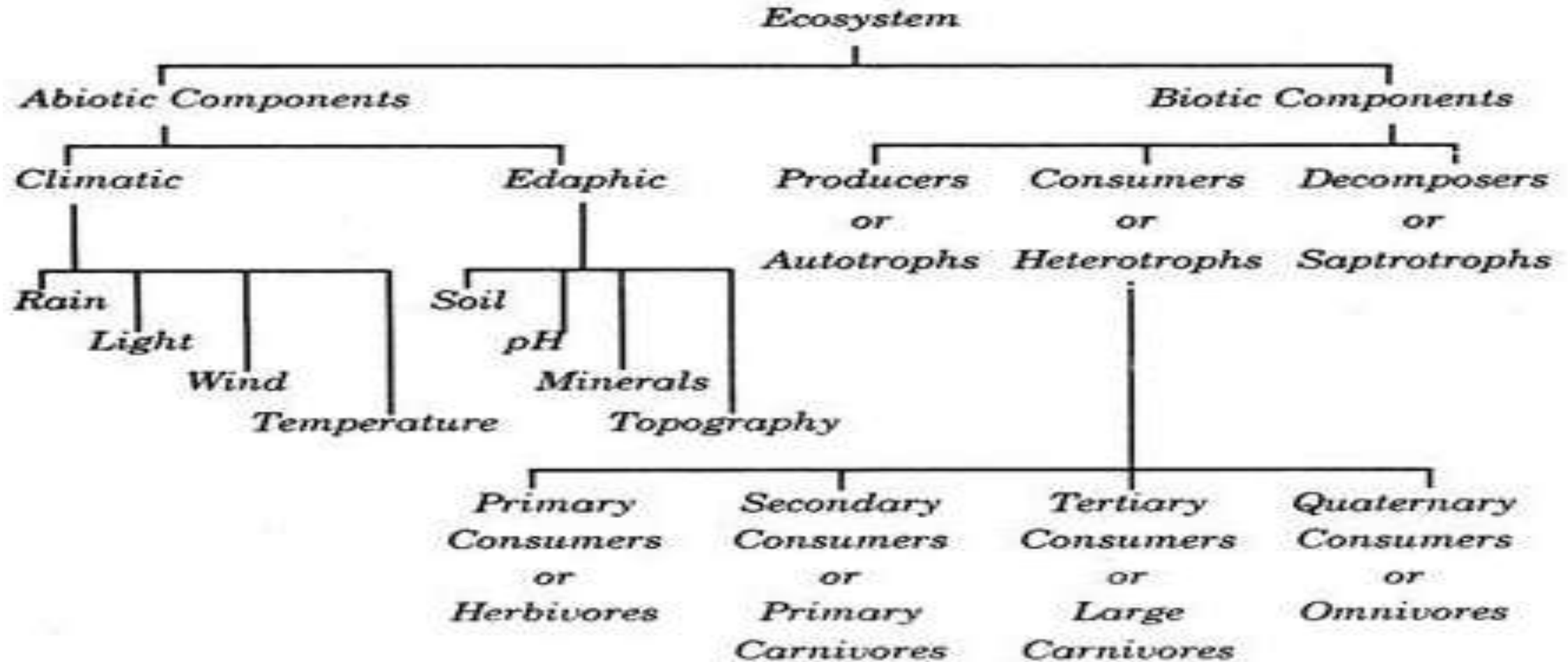
# Ecosystem -the structural and functional unit of ecology



## ECOSYSTEM (BIOME)

The relationship between the biotic components and abiotic components of an ecosystem is called 'holocoenosis'.

**Structure of Ecosystem:** a description of the organisms and physical features of environment including the amount and distribution of nutrients in a particular habitat.



**Schematic Representation of the Structure of an Ecosystem.**

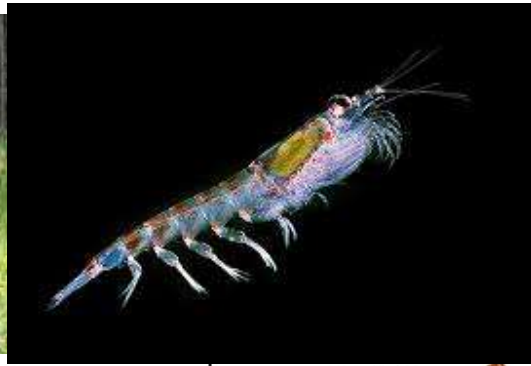
# Components of Ecosystem

## Abiotic component

- Abiotic component of ecosystem includes basic inorganic elements and compounds, such as soil, water, oxygen, calcium carbonates, phosphates and a variety of organic compounds (by-products of organic activities or death).
- It also includes such physical factors and ingredients as moisture, wind currents and solar radiation. Radiant energy of sun is the only significant energy source for any ecosystem.
- The amount of non-living components, such as carbon, phosphorus, nitrogen, etc. that are present at any given time is known as standing state or standing quantity.

## Biotic component = Autotrophic & Heterotrophic

1. **Producers (Autotrophic components):** chiefly green plants. They use radiant energy of sun in photosynthetic process whereby carbon dioxide is assimilated and the light energy is converted into chemical energy (ATP).
2. **Consumers:** living members of ecosystem which consume the food synthesized by producers
  - a) Consumers of the **first order or primary consumers**, b) Consumers of the **second order or secondary consumers** and c) Consumers of the **third order or tertiary consumers**
3. **Decomposers** or reducers and transformers : Parasites, scavengers and saprobes.

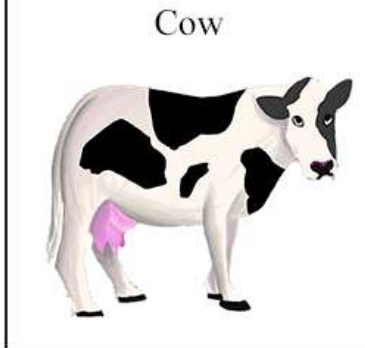


## Primary consumers

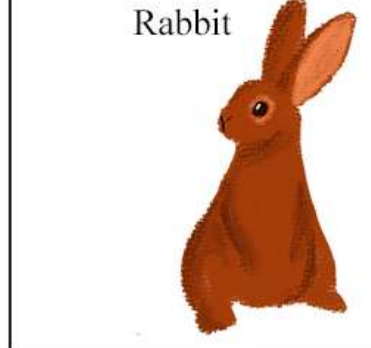
These are purely herbivorous animals that are dependent for their food on producers or green plants. Insects, rodents, rabbit, deer, cow, buffalo, goat are some of the common herbivores in the terrestrial ecosystem, and small crustaceans, molluscs, etc. in the aquatic habitat. Elton (1939) named herbivores of ecosystem as “key industry animals”. The herbivores serve as the chief food source for carnivores.



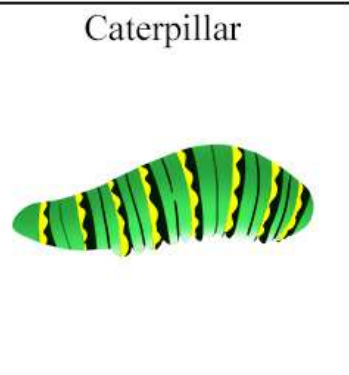
Shrimp



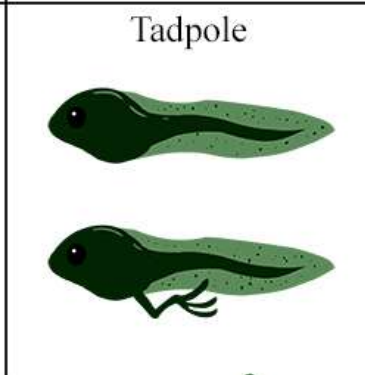
Cow



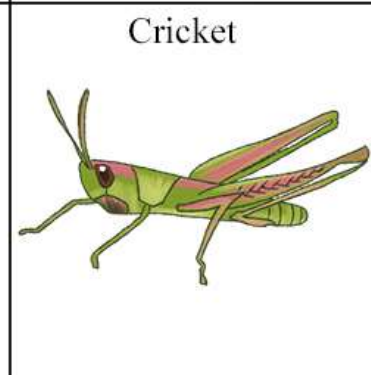
Rabbit



Caterpillar



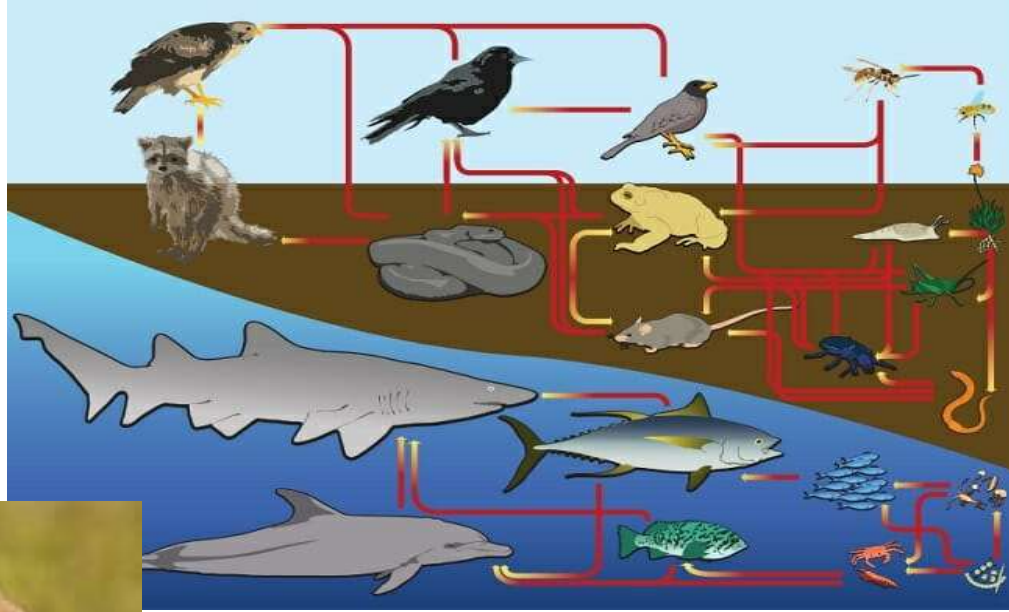
Tadpole



Cricket







## Secondary consumers

These are carnivores and omnivores. Carnivores are flesh eating animals and the omnivores are the animals that are adapted to consume herbivores as well as plants as their food. Examples of secondary consumers are sparrow, crow, fox, wolves, dogs, cats, snakes, etc.



## Secondary consumers

Secondary consumers are carnivores and omnivores that eat primary consumers.



# Tertiary Consumers



Cats



Eagles



Great  
Shark

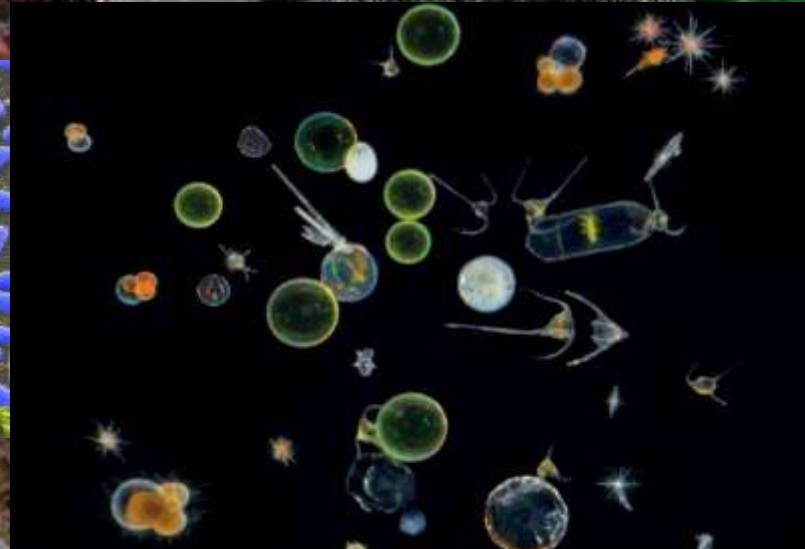
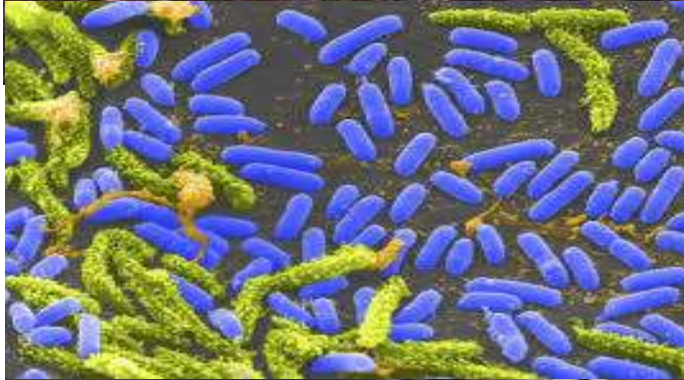
Tertiary consumers are carnivores and omnivores that eat secondary consumers.



## Tertiary consumers

These are the top carnivores which prey upon other carnivores, omnivores and herbivores. Lions, tigers, hawk, vulture, shark, humans are examples of tertiary or top consumers





Decomposers – Break down dead organic matter for food, thereby releasing nutrients ready for reabsorption by producers. Also build up hummus and improve nutrient retention capacity of soil.

## Decomposers and transformers

Decomposers and transformers are the living components of the ecosystem and they are fungi and bacteria.

Decomposers attack the dead remains of producers and consumers and degrade the complex organic substances into simpler compounds.

The simple organic matters are then attacked by another kind of bacteria, the transformers which change these organic compounds into the inorganic forms that are suitable for reuse by producers or green plants.

The decomposers and transformers play very important role in maintaining the dynamic nature of ecosystems.

## **Definition:**

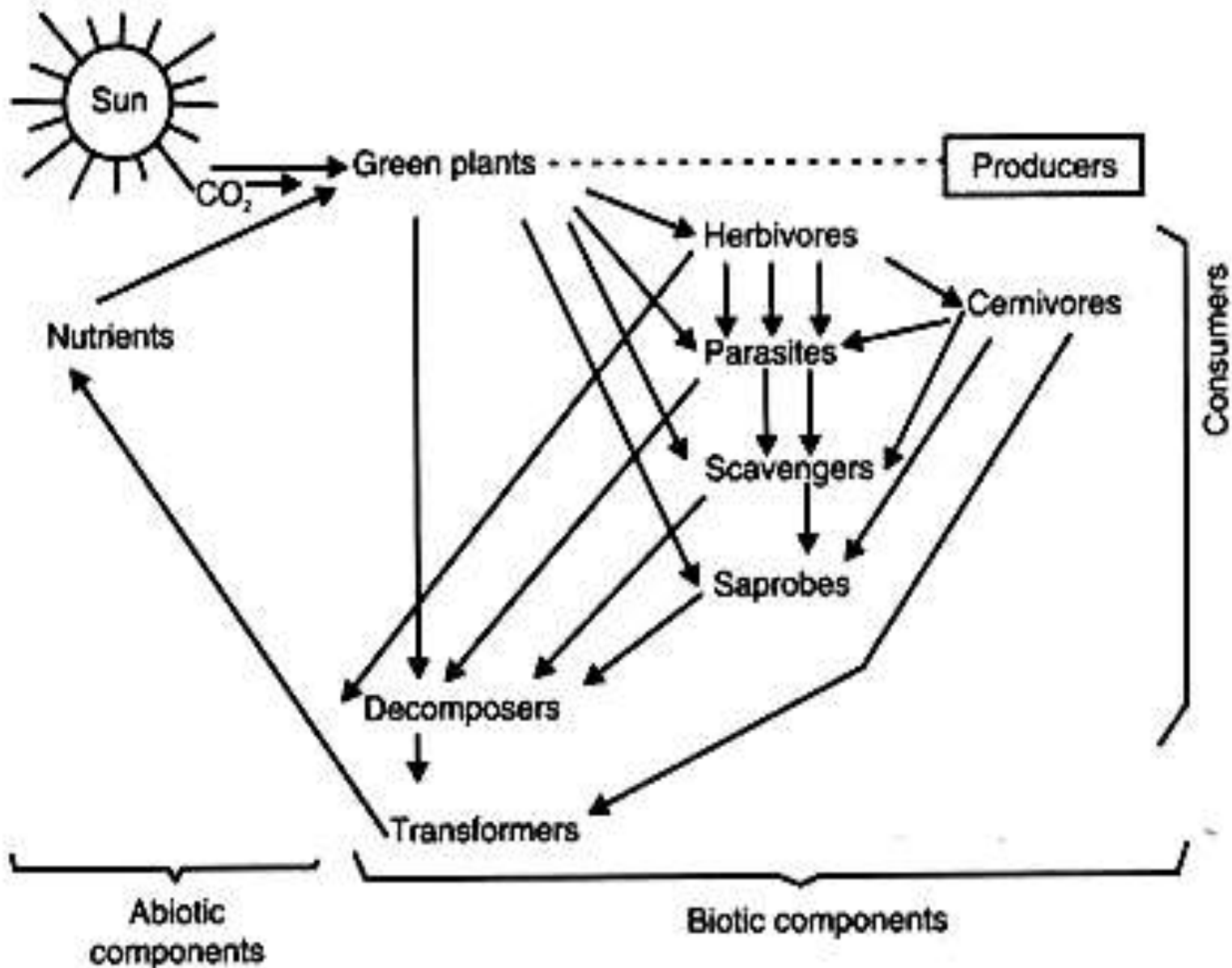
**AN ECOSYSTEM is a community or group of living organisms that live in and interact with each other in a specific environment.**

**OR**

**An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment, interacting as a system.**

**These biotic and abiotic components are linked together through nutrient cycles and energy flows.**

**The term ecosystem was first coined in the 1930s, by British botanist Roy Clapham , but it was British ecologist Arthur G. Tansley who fully defined the ecosystem concept.**



**The principal steps and components of ecosystem**

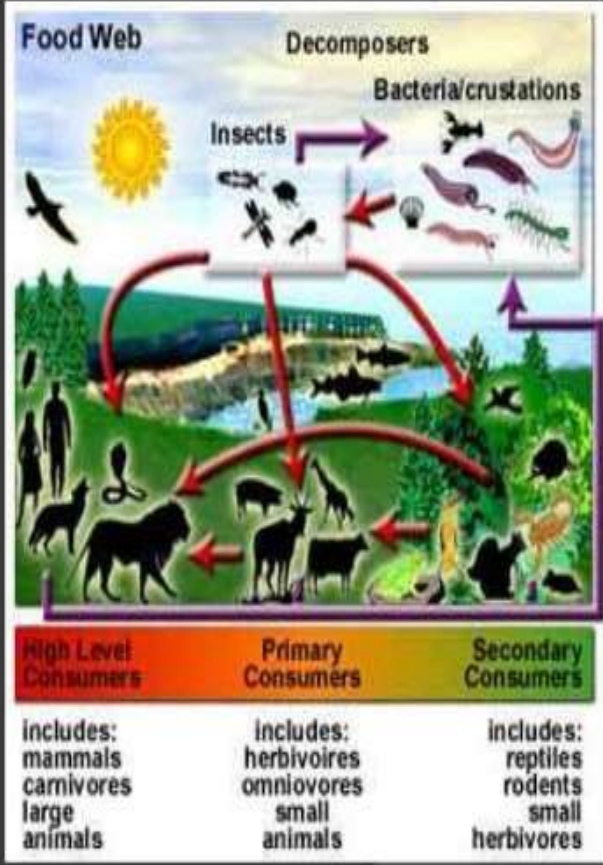
The flow of energy is unidirectional. The two ecological processes—energy flow and mineral cycling which involve interaction between biotic and abiotic components lie at the heart of ecosystem dynamics.

Fig. 3.1. Different components of ecosystem.



# Movement of Energy through Ecosystems

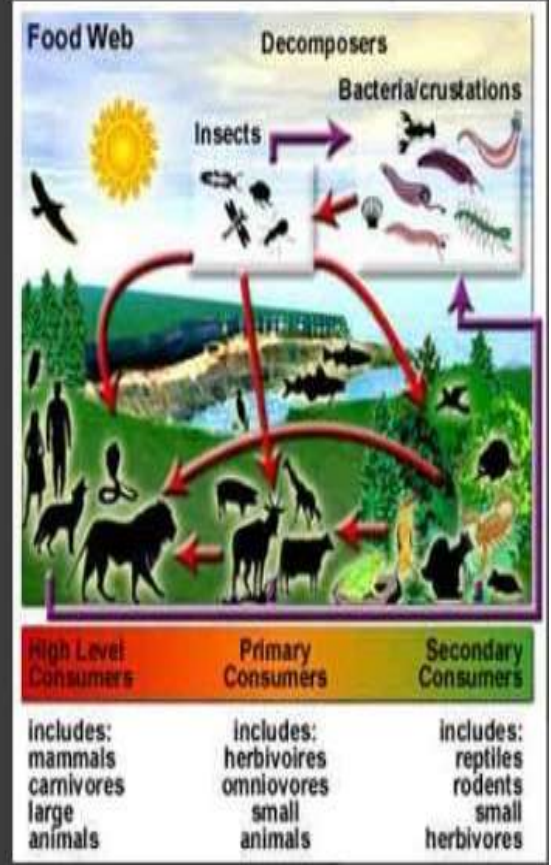
- Everything that organisms do in an ecosystem; running, breathing, burrowing, growing, requires energy.
- The **flow of energy** is the most important factor that controls what kind of organisms live in an ecosystem and how many organisms the ecosystem can support.



# Movement of Energy through Ecosystems

## Primary Energy Source

- Most life on Earth depends on **photosynthetic organisms**, which capture sunlight and convert it to chemical energy in organic molecules. These organic molecules are what we call **food**.
- The rate at which organic material is produced by photosynthetic organisms is called **primary productivity**.
- Primary productivity determines the amount of energy available in an ecosystem.



## Movement of Energy through Ecosystems

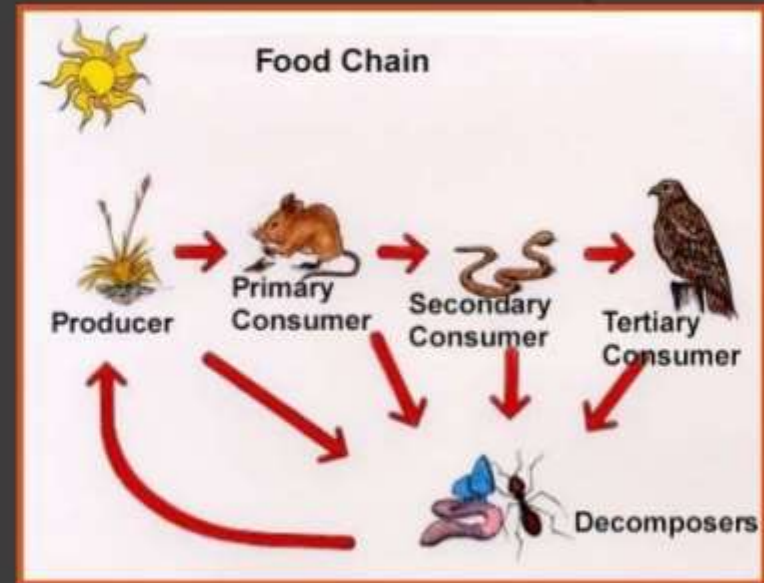
### Primary Energy Source

- Most organisms in an ecosystem can be thought of as chemical machines driven by the energy produced in photosynthesis.
- Organisms that first capture the energy are called **producers** and include plants, some kinds of bacteria, and algae.

## Movement of Energy through Ecosystems

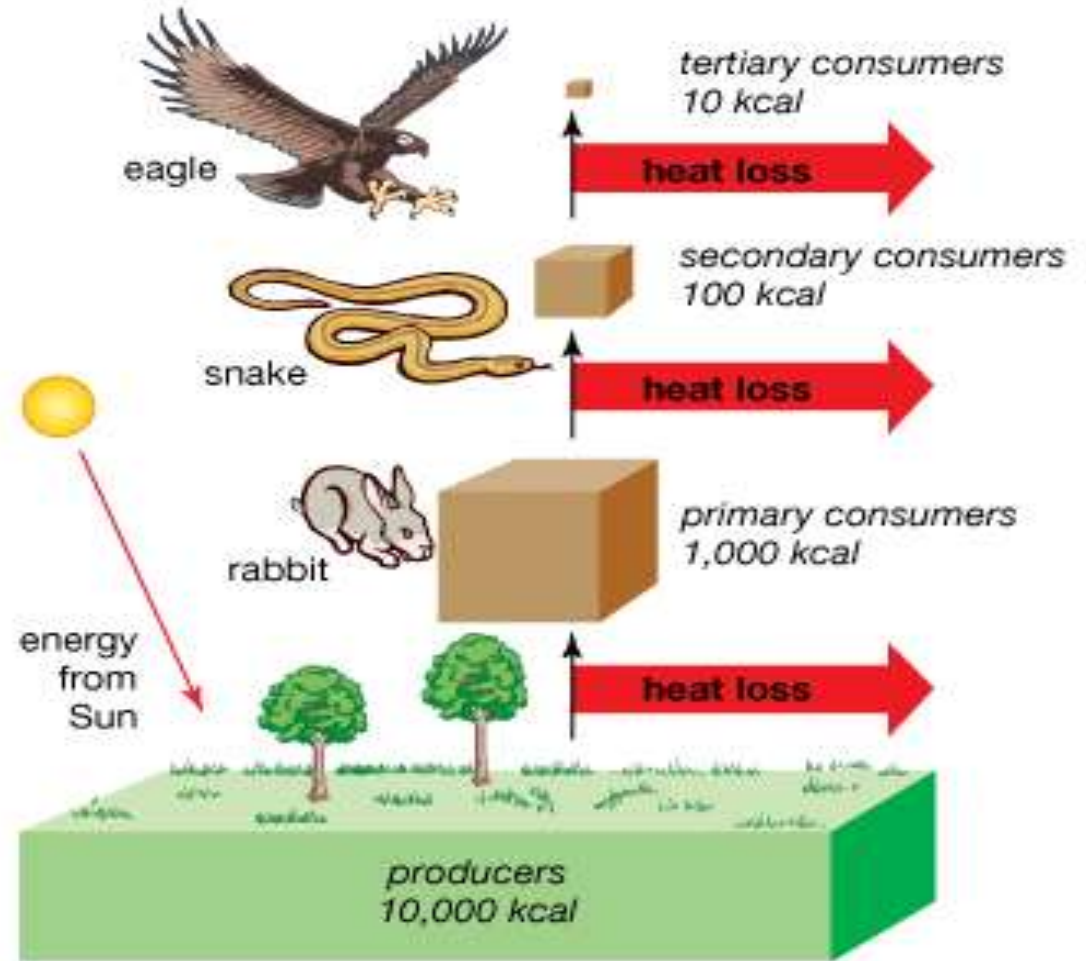
### Primary Energy Source

- Producers make energy-storing molecules.
- All other organisms in an ecosystem are consumers.
- Consumers** are those organisms that consume plants or other organisms to obtain their energy.



# Biomass & Energy Transfer

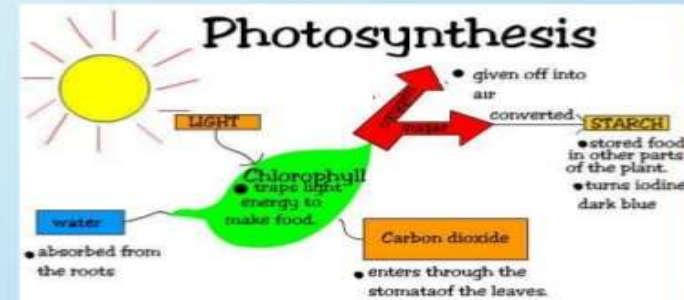
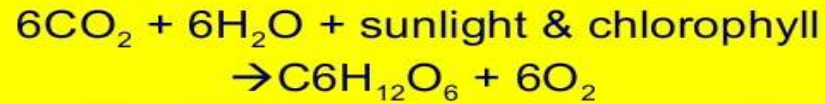
Energy flow and trophic levels







- Begins with the SUN
- Photosynthesis



- The chemical reaction by which green plants use water and carbon dioxide and light from the sun to make glucose.
- ENERGY is stored in glucose; glucose is stored as starch.



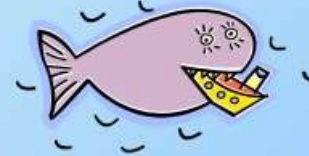
Organisms that can make glucose during photosynthesis are called **PRODUCERS.**



Producers use cellular respiration to supply the energy they need to live.



The energy that is not used by producers can be passed on to organisms that cannot make their own energy.



Organisms that cannot make their own energy are called **CONSUMERS.**



## Consumers that eat producers to get energy:

- Are first order or primary consumers
- Are herbivores (plant-eaters)



Some energy in the primary consumer is not lost to the atmosphere or used by the consumer itself.

This energy is available for another consumer.

## A consumer that eats another consumer for energy:

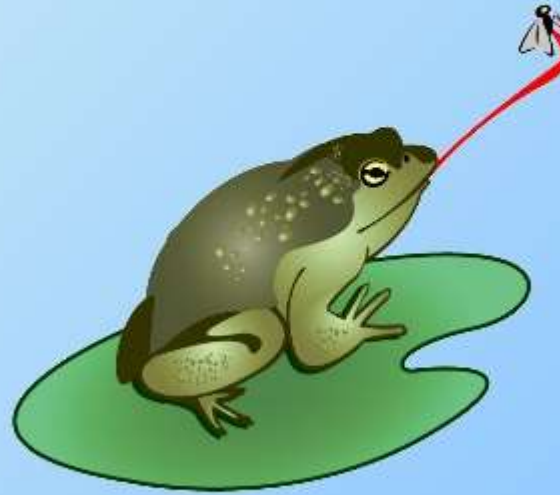
- Is called a secondary or second order consumer
- May be a carnivore or a omnivore
- May be a predator
- May be a scavenger





A consumer that eats a consumer that already ate a consumer:

- Is called a third order or tertiary consumer
- May be a carnivore or a omnivore
- May be a predator
- May be a scavenger



Consumers that hunt & kill other consumers are called predators. The animals that are hunted & killed are called prey.



Consumers that eat other consumers that have already died are called scavengers.

The transfer of energy from sun to producer to primary consumer to secondary consumer to tertiary consumer can be shown in a **FOOD CHAIN.**

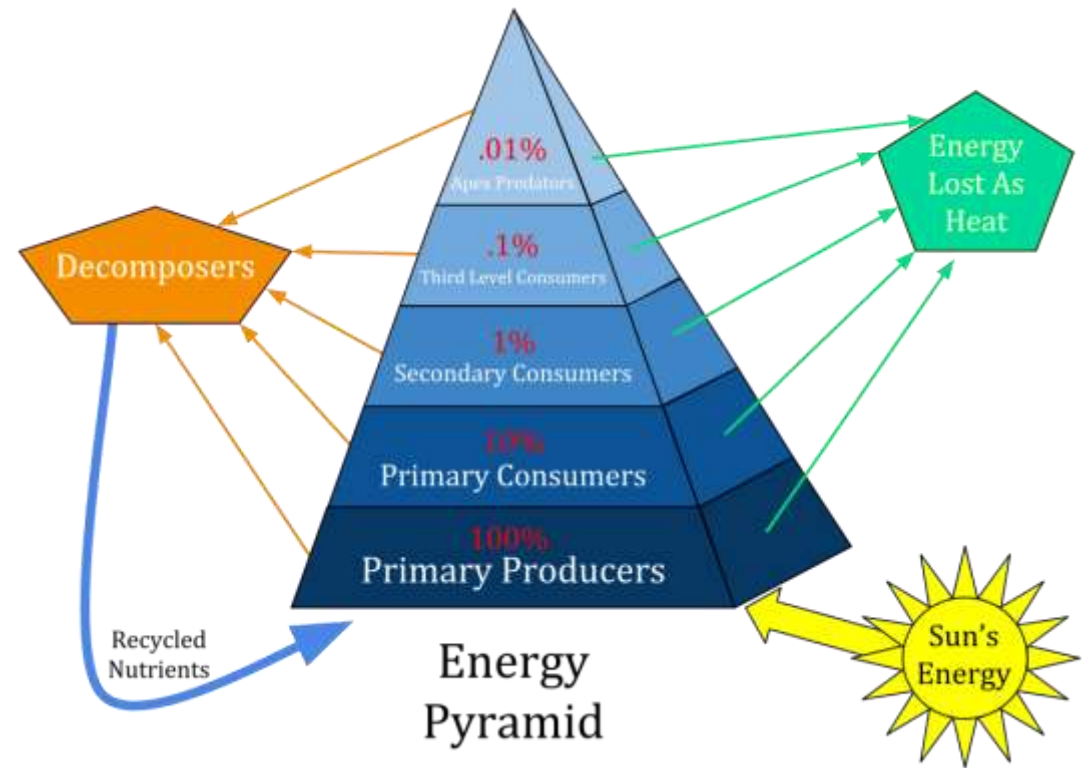
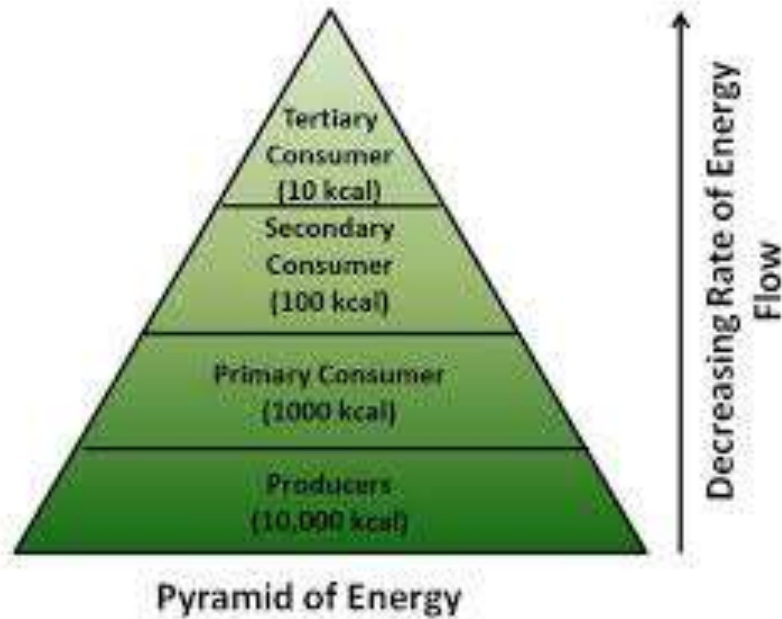


The principal steps in the operation of ecosystem are as follows:

- **(1) Reception of radiant energy of sun,**
- **(2) Manufacture of organic materials from inorganic ones by producers,**
- **(3) Consumption of producers by consumers and further elaboration of consumed materials; and.**
- **(4) After the death of producers and consumers, complex organic compounds are degraded and finally converted by decomposers and converters into such forms as are suitable for reutilization by producers.**
- **There is transfer of both energy and nutrients from producers to consumers and finally to decomposers and transformers levels. In this transfer there is a progressive decrease of energy but nutrient component is not diminished and it shows cycling from abiotic to biotic and vice versa.**



# Ecological Pyramid



# Trophic Organization

**Trophic level**

# Trophic level - step in a nutritive series, or food chain, of an ecosystem

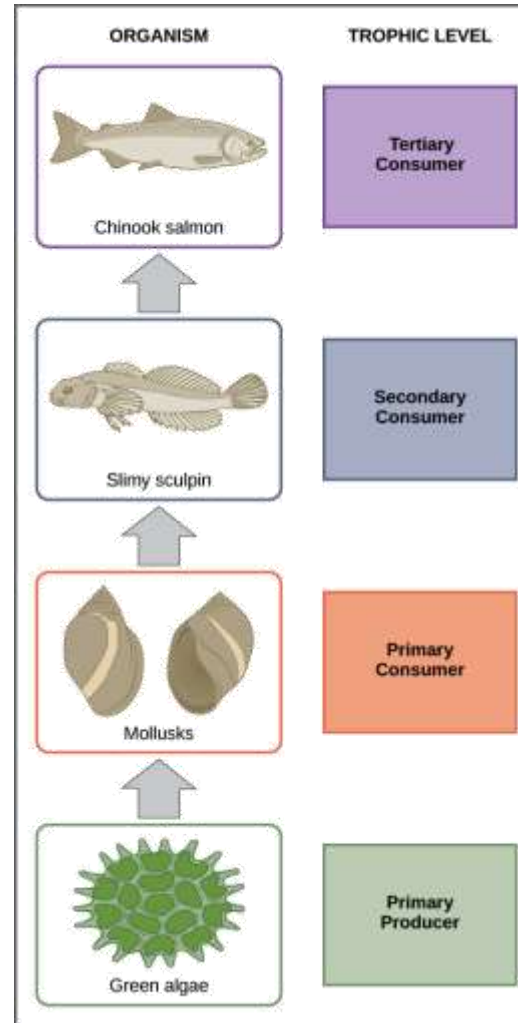
- A **trophic** level is the group of organisms within an **ecosystem** which occupy the same level in a food chain.
- The organisms of a chain are classified into trophic levels on the basis of their feeding behaviour:
- The first and lowest level - the producers, green plants.
- The second level organisms— the herbivores or plant eater; they consume the plants or their products.
- The third level organisms - primary carnivores or meat eaters, eat the herbivores; and
- The fourth level organisms - secondary carnivores eat the primary carnivores. These categories are not strictly defined, as many organisms feed on several trophic levels; for example, some carnivores also consume plant materials and are called omnivores, and some herbivores occasionally consume animal matter.
- A separate trophic level, the decomposers or transformers, consists of organisms such as bacteria and fungi that break down dead organisms and waste materials into nutrients usable by the producers.



## Trophic structure of aquatic food chain

Trophic level is the position it occupies in a food web.

Each of the categories in the image is called a **trophic level**, and it reflects how many consumption steps separate an organism from the food chain's original energy source, such as light.



Ecosystems have no definite sizes as they can be as small as a tree or as large as the whole land mass. Ecosystems are broken into different ranks called *trophic* levels.

Every organism then is classified based on different environmental factors like how they live in a certain ecosystem (what they eat and how they obtain energy).

Organisms that make their own food using the sunlight are called *producers*.



The **trophic** level of an organism is the position it occupies in a food web.

**First trophic level:** In this image, the plants, the algae and phytoplankton in the lake, are the primary producers. They absorb nutrients from soil and water, manufacture their own food by photosynthesis, using radiant energy from the sun.

Christine Westerback

<https://upload.wikimedia.org/>

## Apex Predators

The fifth trophic level is the final level in an ecosystem. It is composed of apex predators that prey on and eat the carnivores and herbivores in the fourth level. Apex predators are at the top of the food chain and have no predators of their own. They allow each different trophic level to sustain stable levels of animals. Lions, alligators, bears, anacondas, killer whales and hawks are common apex predators.



# What is exactly is trophic structure?

- Trophic structure describes the system or organization of organisms into different trophic levels based on the amount of energy the organism consumes.
- **Explanation:**
- Trophic structure describes the system or organization of organisms into different trophic levels based on the amount of energy the organism consumes. Organisms can be categorized into different trophic levels within the trophic structure.
- Essentially, trophic structure shows us the the feeding relationships between different organisms, both producers and consumers, within a set area and time.
- A trophic pyramid, a food web, and a food chain could all be used to describe trophic structure,

# What makes ecosystems different?

1



***Amount of water***

2



***Amount of sunlight***

3



***Type of soil***



# What causes ecosystems to change?

## Natural causes:

1



**Drought**

**Disease**

2



3



**Fire**

4

**Overpopulation**





# What causes ecosystems to change?

## Changes caused by humans:

1



**Water pollution**

2



**Air pollution**

3



**Land pollution**

4



**Construction**

# Ecological Pyramid

- In 1927, the concept of ecological pyramid was first proposed by English Ecologist named Charles Elton (1900-1991) (thus, they are also known as *Eltonian* pyramids).
- An ecological pyramid is basically a pyramidal depiction of the *number of organisms*, *biomass*, and *productivity* in each trophic level in an ecosystem.
- Typically, ecological pyramids start with producers located at the bottom and transcend through various trophic levels as you go up the pyramid. The top of the pyramid represents the highest level in the food chain.

# Ecological pyramid

- An **ecological pyramid** is a graphical representation of the relationship between different organisms in an **ecosystem**. Each of the bars that make up the **pyramid** represents a different trophic level, and their order, which is based on who eats whom, represents the flow of energy.



# Standing crop

- A **standing crop** is the total dried **biomass** of the living organisms present in a given environment. This includes both natural **ecosystems** and **agriculture**
- Gross Primary Production = Total amount of organic matter **in an** ecosystem including above ground (i.e., leaves and stems) and below ground (i.e., roots) **biomass**.  
... **Standing Crop** = The amount of **biomass** at a given time. Usually refers to the amount of above-ground plant **biomass**.

# Commensalism

- **Commensalism.**
- A **commensal relationship** can benefit the smaller species in many ways, including gaining nutrients, shelter, or support from the larger species. For instance, **many of the bacteria that inhabit our bodies seem to have a commensal relationship with us.**
- In a **commensalism**, two species have a long-term interaction that is beneficial to one and has no **positive or negative** effect on the other (+/0 interaction). For instance, many of the bacteria that inhabit our bodies seem to have a commensal relationship with us.