

# ECOSYSTEMS



# Ecosystem

An *ecosystem* is a natural unit consisting of all plants, animals, and micro-organisms in an area functioning together with all the non-living physical factors of the environment.

According to British ecologist Arthur Tansley (1935), an ecosystem is *a system that arises from the integration of all living and non-living factors of the environment.*

- An ecosystem is a self-sustained community of plants and animals existing in its own environment.
- The term *ecosystem* may be defined as a system resulting from the integration of all the living and non living factors of the environment. **Desert, Forest, Ocean, Grasslands, Mountains,** etc. are all ecosystems.

# What is an ecosystem?

Ecosystem is a system of living things that interact with each other and with the physical world.

# Classification of ecosystem

**(1) Based on NATURE**

**Natural**

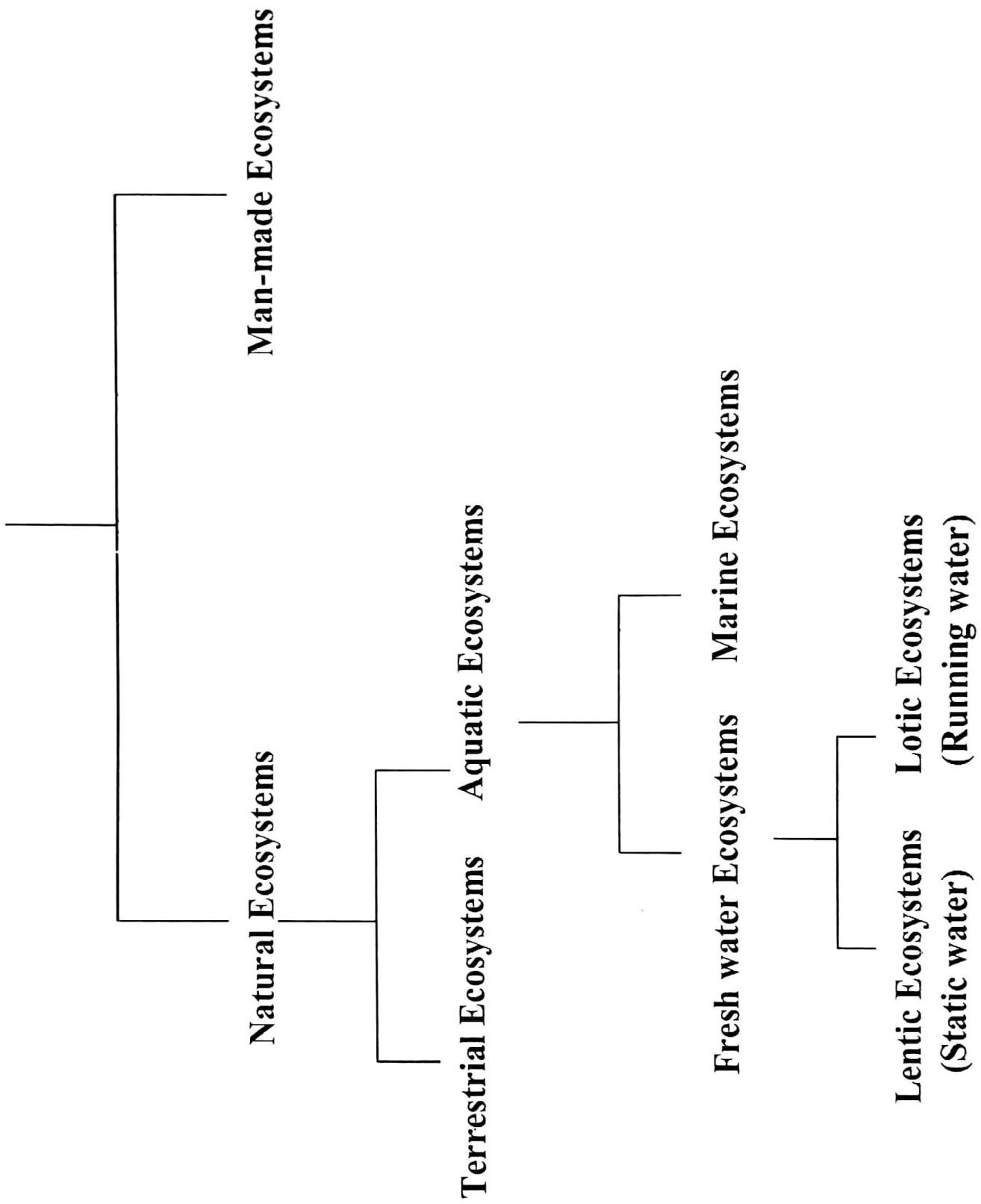
**Manmade/  
Artificial**

**Terrestrial :-**  
Forests, Grasslands,  
Deserts etc

**Aquatic :-**  
Marine: Seas, Oceans,  
Estuaries etc  
Freshwater: Ponds, Lakes,  
Rivers, Streams etc

**Aquariums, Crop fields,  
Flowerbeds, etc**

# Kinds of Ecosystems



# **Structure of an Ecosystem**

## **Living (Biotic) Components**

- Producers
- Consumers
- Decomposers

## **Non-living (Abiotic) Components**

- Physical factors
- Chemical factors
- Limiting factors

# **Biotic Components of Ecosystems**

## **Producers (or autotrophs)**

Green plants and some bacteria which manufacture their own food.

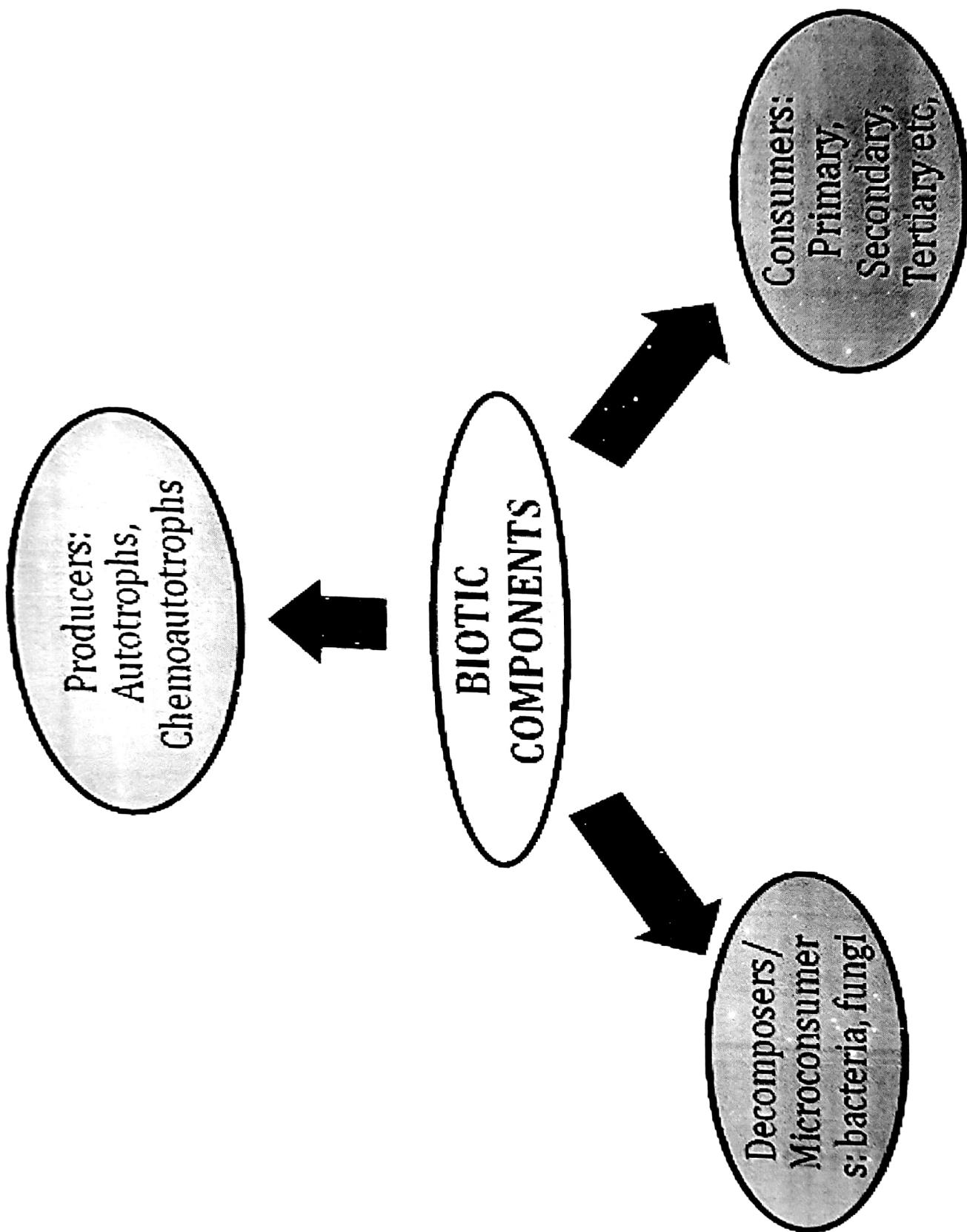
## **Consumers (or heterotrophs)**

Animals which obtain their food from producers

- Primary consumers
- Secondary consumers
- Tertiary consumers

## **Decomposers**

Bacteria and fungi that decompose dead organic matter and convert it into simpler parts



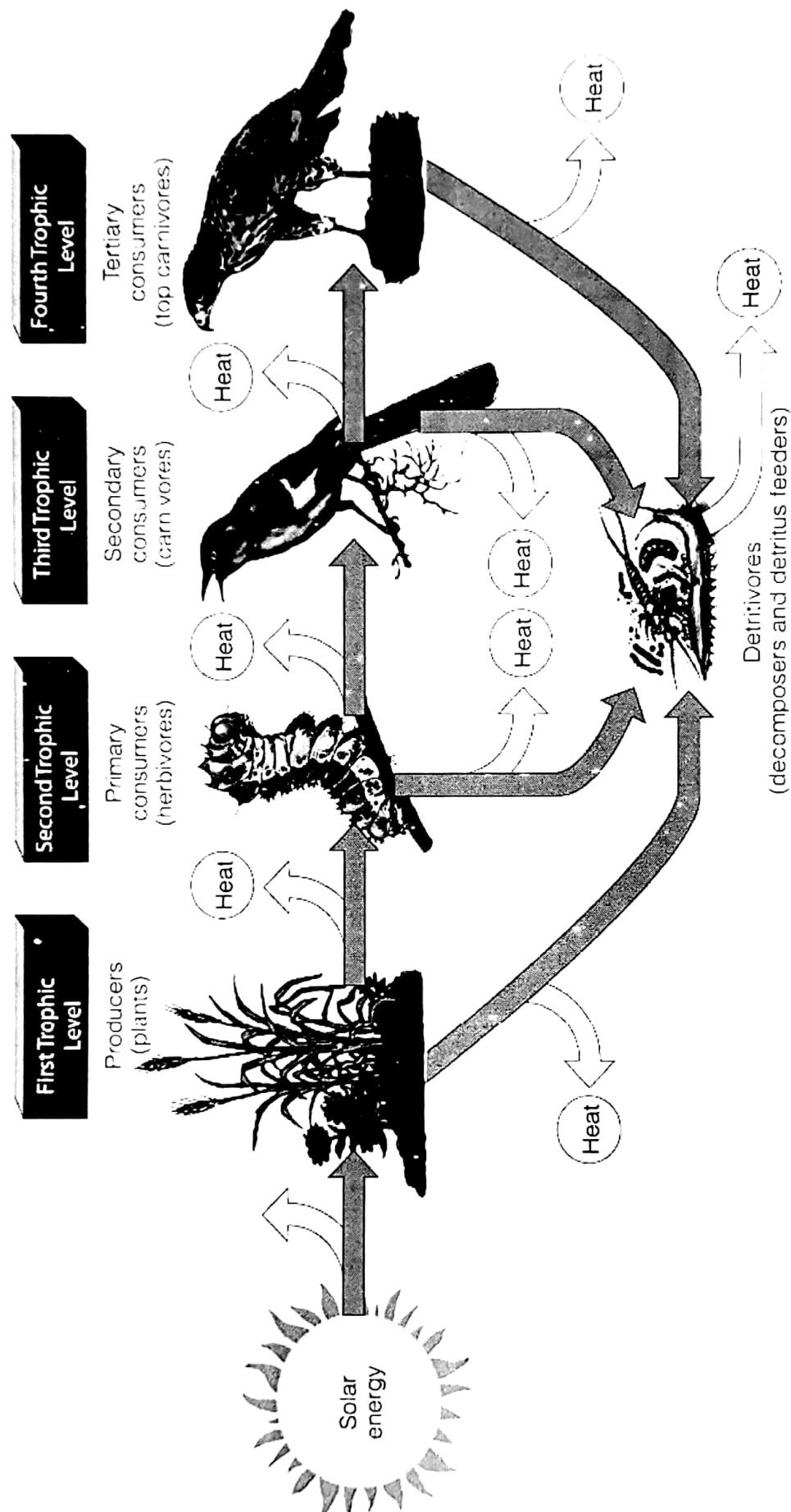
# Abiotic Components of an Ecosystem

<b>Physical Factors</b>	Rainfall Sunlight Humidity Temperature Nature of soil Water currents
<b>Chemical Factors</b>	Salinity of Water Nutrients present in soil Oxygen dissolved in water Percentage of water and air in soil
<b>Limiting Factors</b>	Food, water, shelter and space are limiting factors for the growth of population of human and animals.

# **Functions of an Ecosystem**

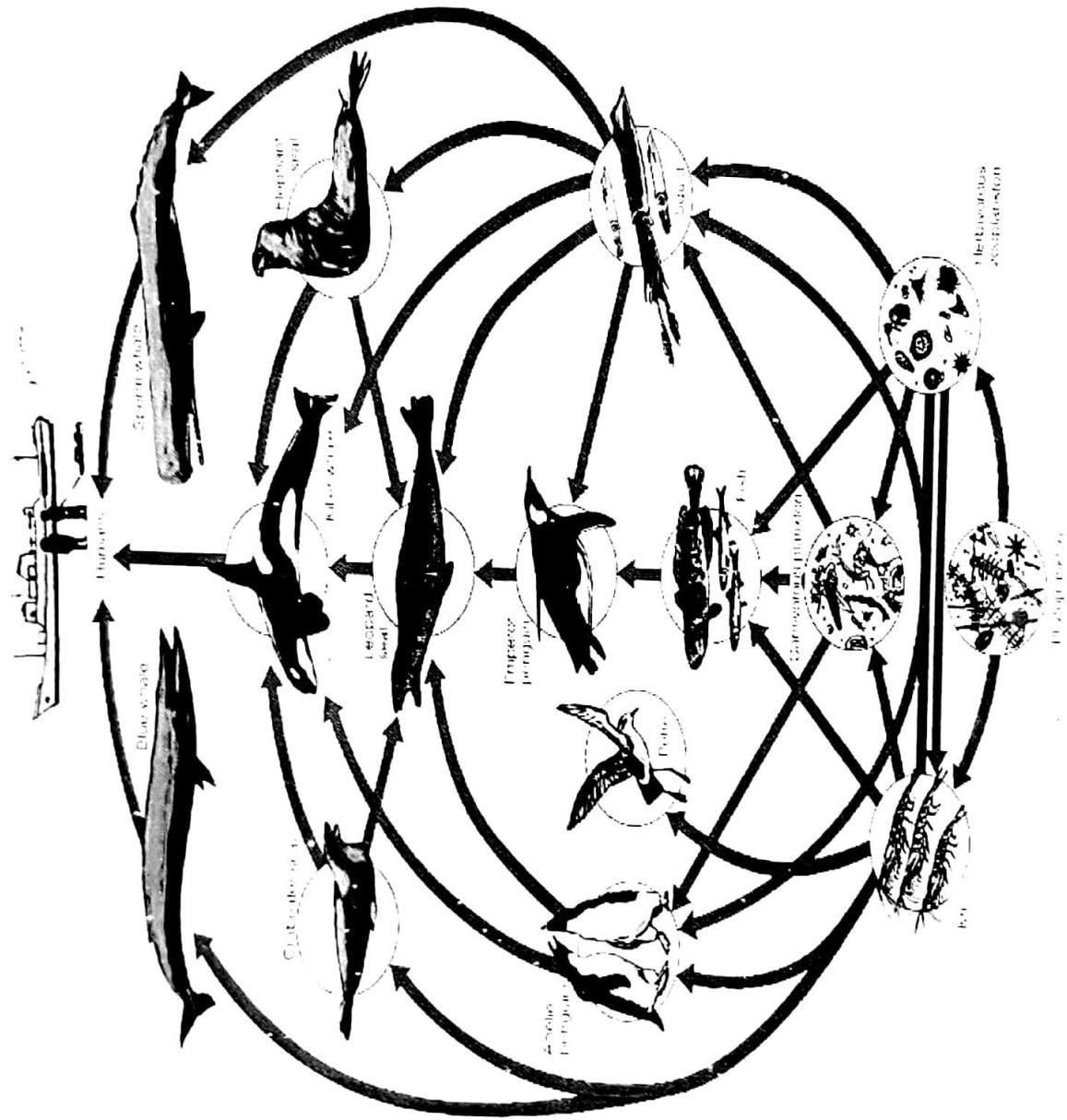
- Food chain and food web
- Energy flow
- Ecological pyramids

# Food Chain



The transfer of food energy from the source (plants) through a series of organisms by repeated **eating and being eaten up** is referred to as **food chain**.

# Food Web



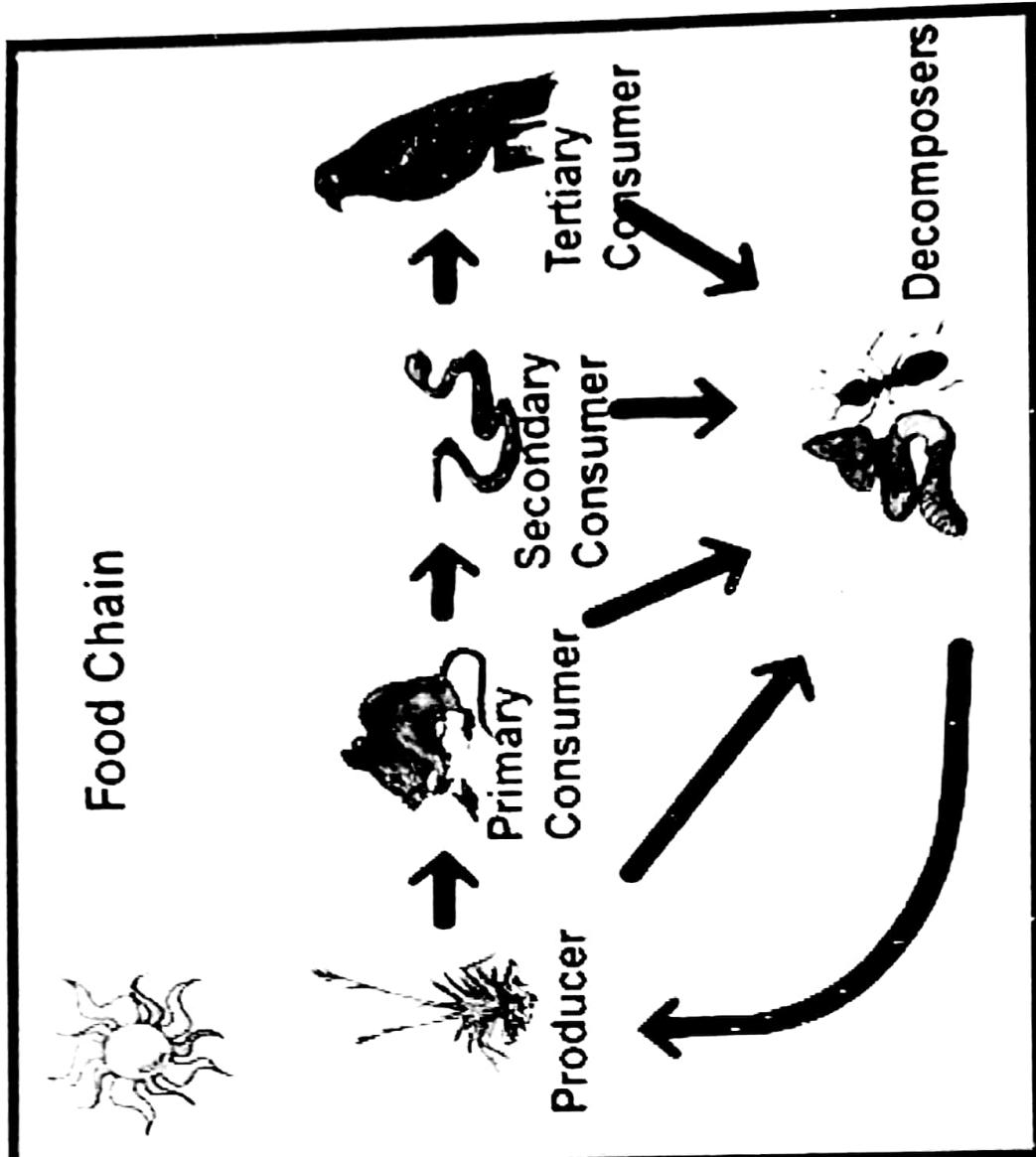
The interlocking pattern formed by several food chains that are linked together is called a *food web*.

# Food Chain

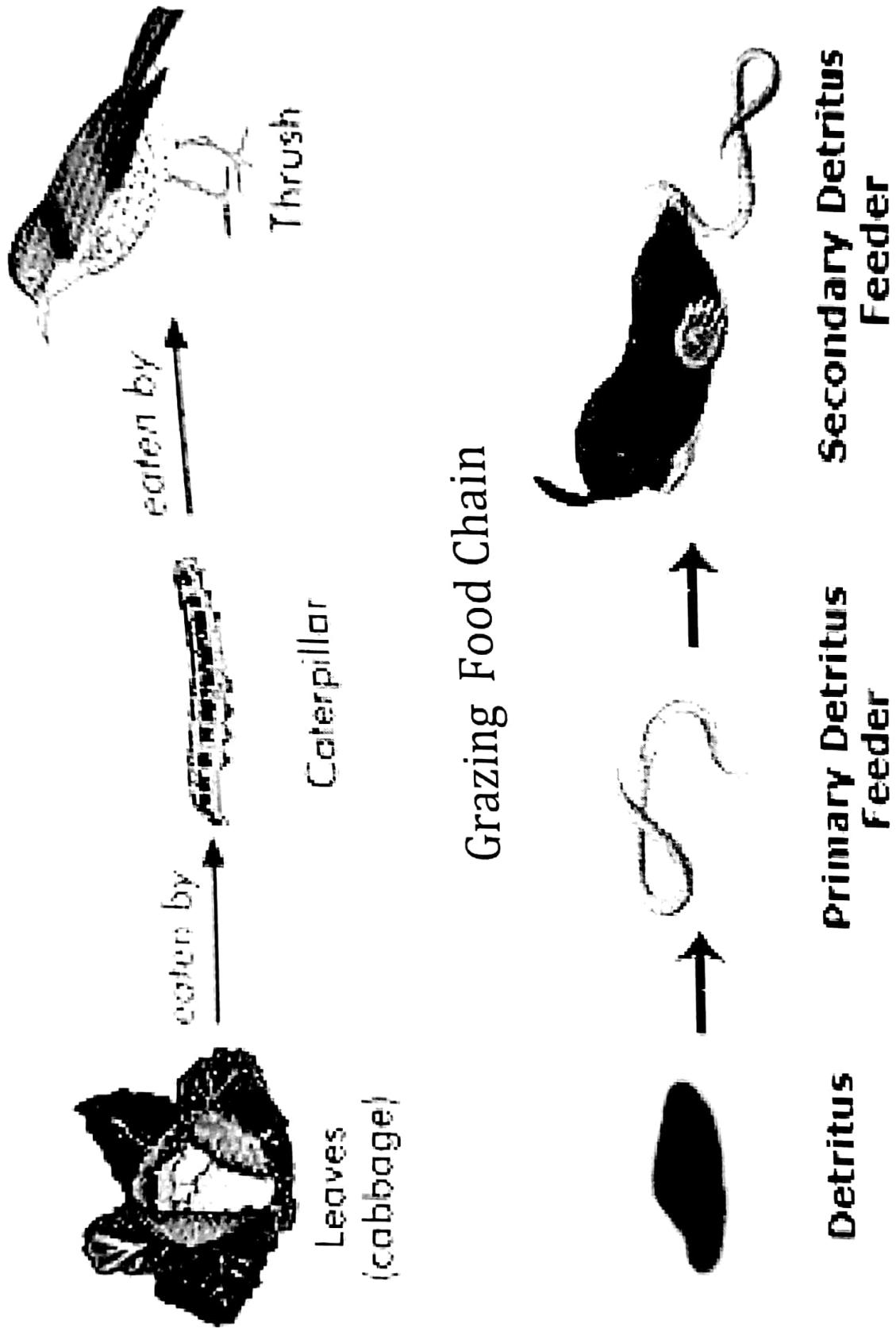
- A series of organism by repeated eating and being eaten up is referred as food chain.

## Types:

- Grazing food chain-a common chain
- Detritus food chain-chain derived by the organic wastes and dead matter from grazing food chains



# Grazing and Detritus Food Chain

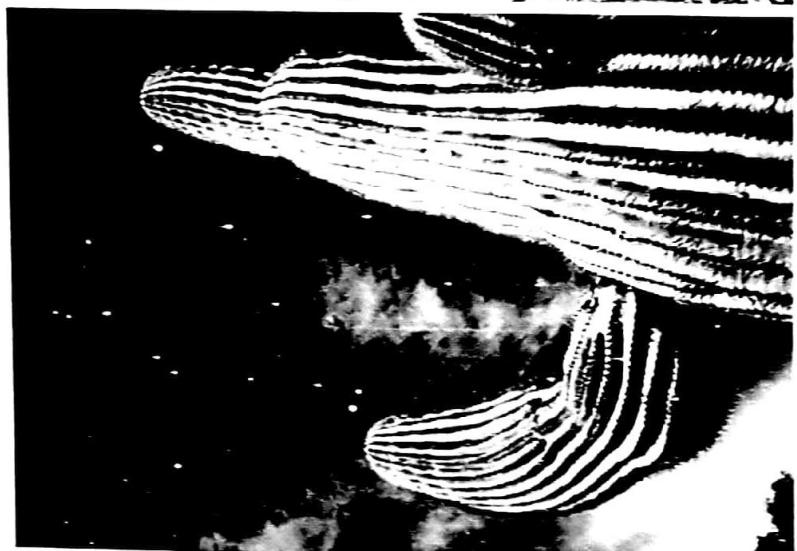
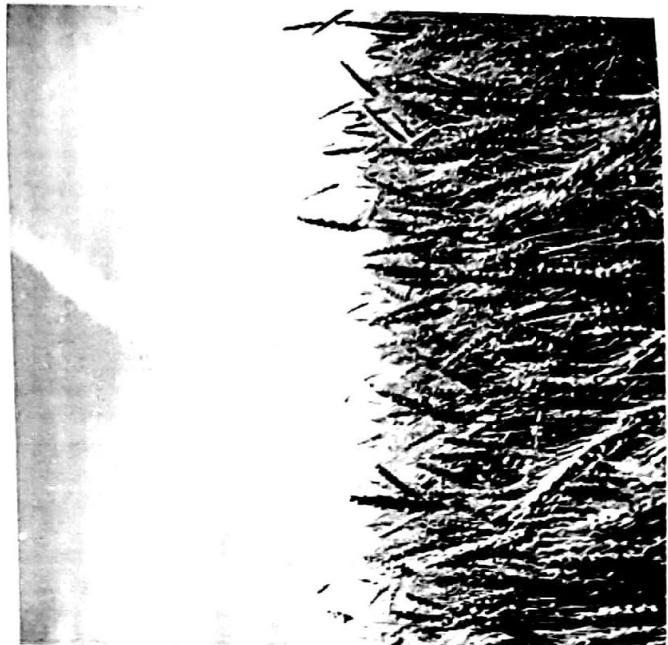


Detritus (Dead organic matter) Food Chain

You will see the terms **food chains** and **food webs**. They describe the same series of events that happen **when one organism consumes another to survive.**

# THE PRODUCERS

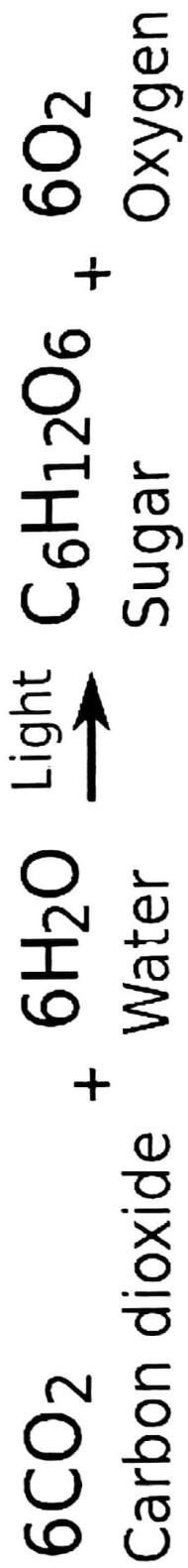
Producers are the beginning of a simple food chain. Producers are plants and vegetables.



## THE PRODUCERS



- All energy comes from the Sun and plants are the ones who make food with that energy. They use the process of photosynthesis.
  - Plants also make nutrients for other organisms to eat.



**Consumers are the next link in a food chain. There are three levels of consumers.**

# FEEDING RELATIONSHIPS

A food chain shows a simple feeding relationship.

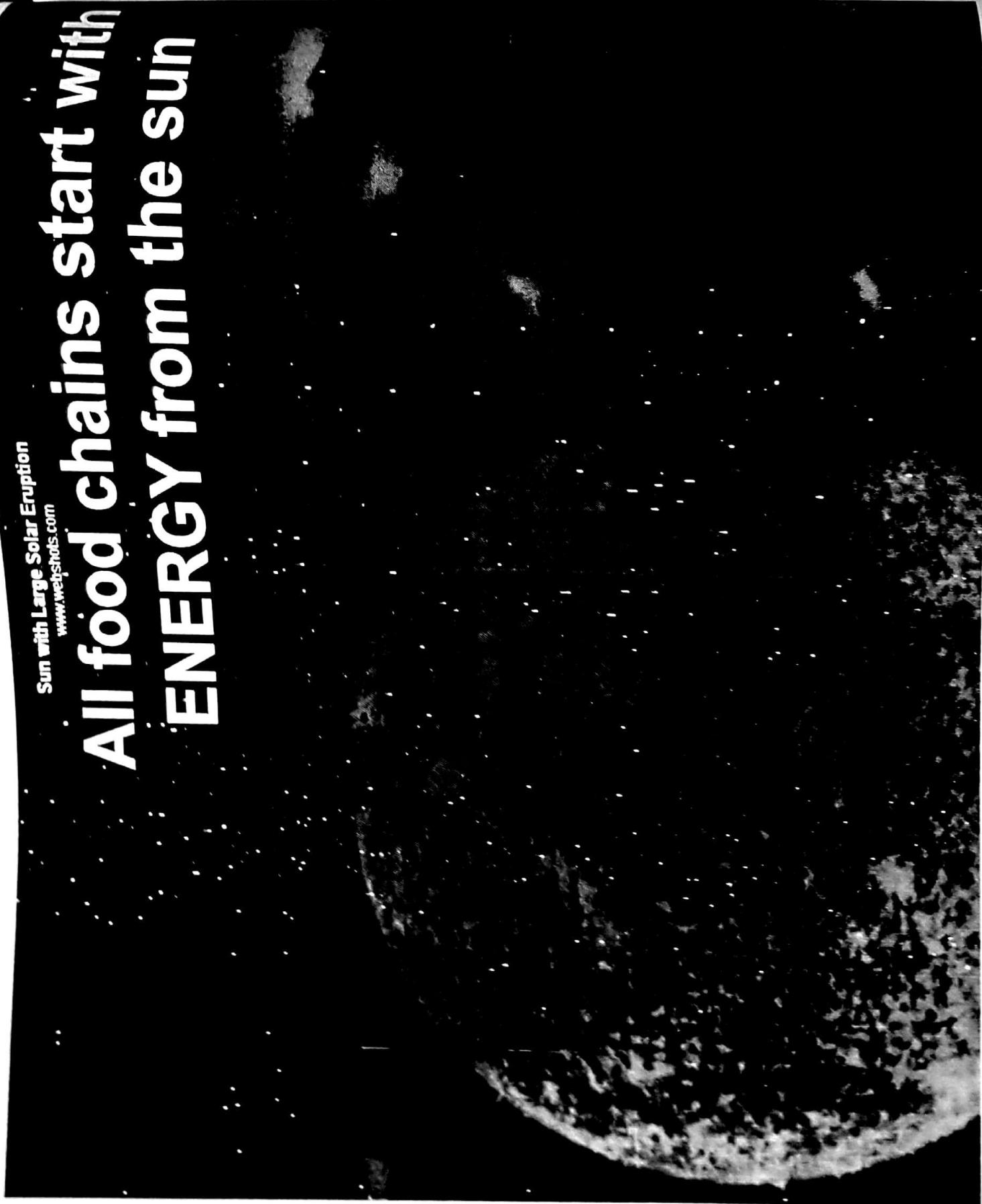
**Sun → grass → rabbit → fox**

**Note:** All food chains start with the sun



Sun with Large Solar Eruption  
[www.webshots.com](http://www.webshots.com)

All food chains start with  
ENERGY from the sun



# Biomagnification

“Result of the process of *bioaccumulation* and *bio-transfer* by which tissue concentrations of chemicals in organisms at one trophic level exceed tissue concentrations in organisms at the next lower trophic level in a food chain.”

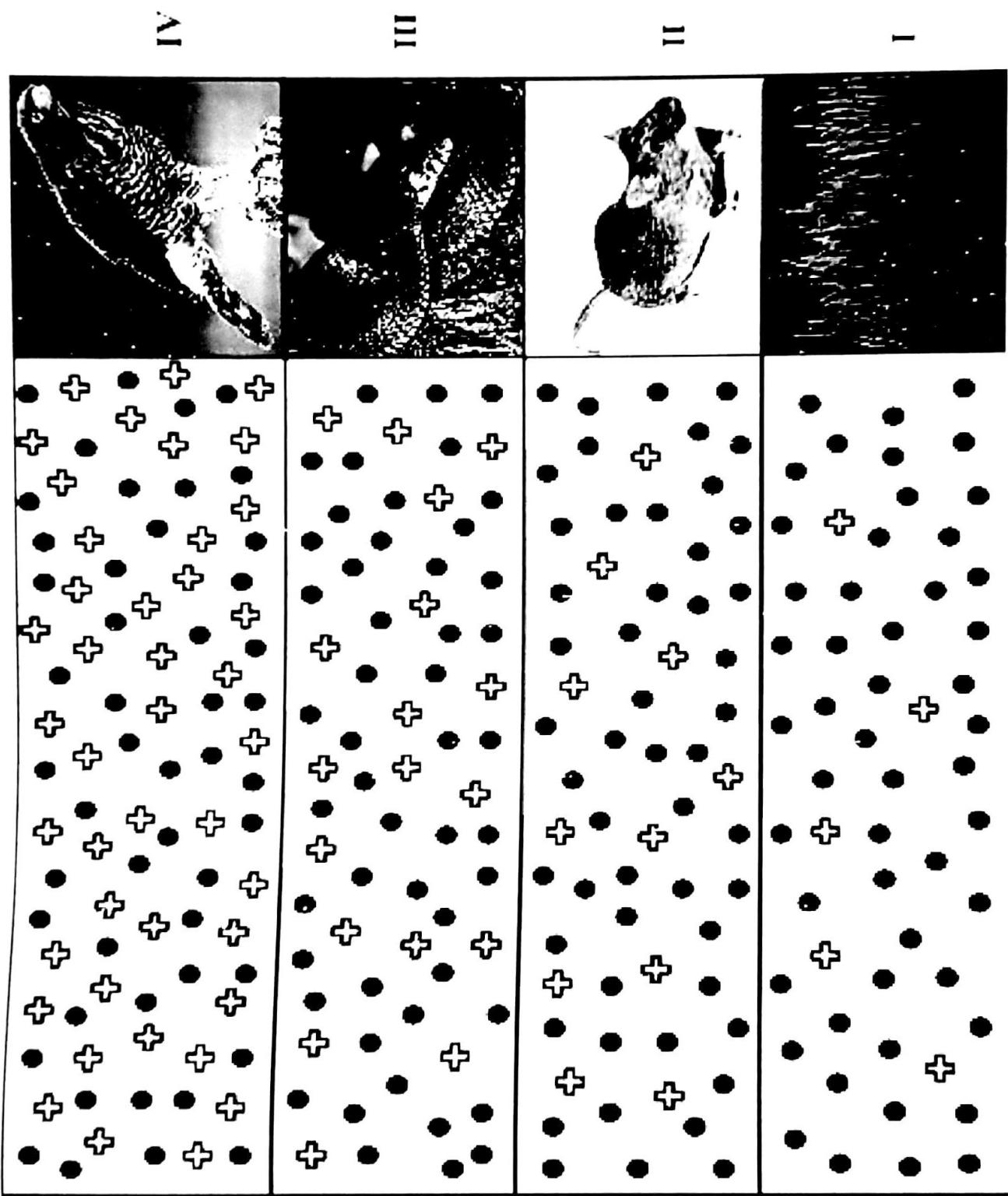
**OR**

**Biomagnification** refers to the accumulation of toxins through the trophic levels of a food chain. It results in an increased concentration of the toxin in the higher organisms of the food chain.

# Biomagnification

- Biomagnification is the increase in concentration of a substance, such as the pesticide, that occurs in a food chain. The pollutant enters the first organism in a food chain. When the second organism in the chain consumes the first one, the pollutant too moves into the second organism.
- As we go up the levels of the ecological pyramid, there is energy loss. Hence, at each succeeding level, the predator consumes more of the prey. As a result, the organisms at higher levels have greater concentrations of the pollutant.

In biomagnification the concentration of the persistent toxins (crosses) increase higher up the food chain.

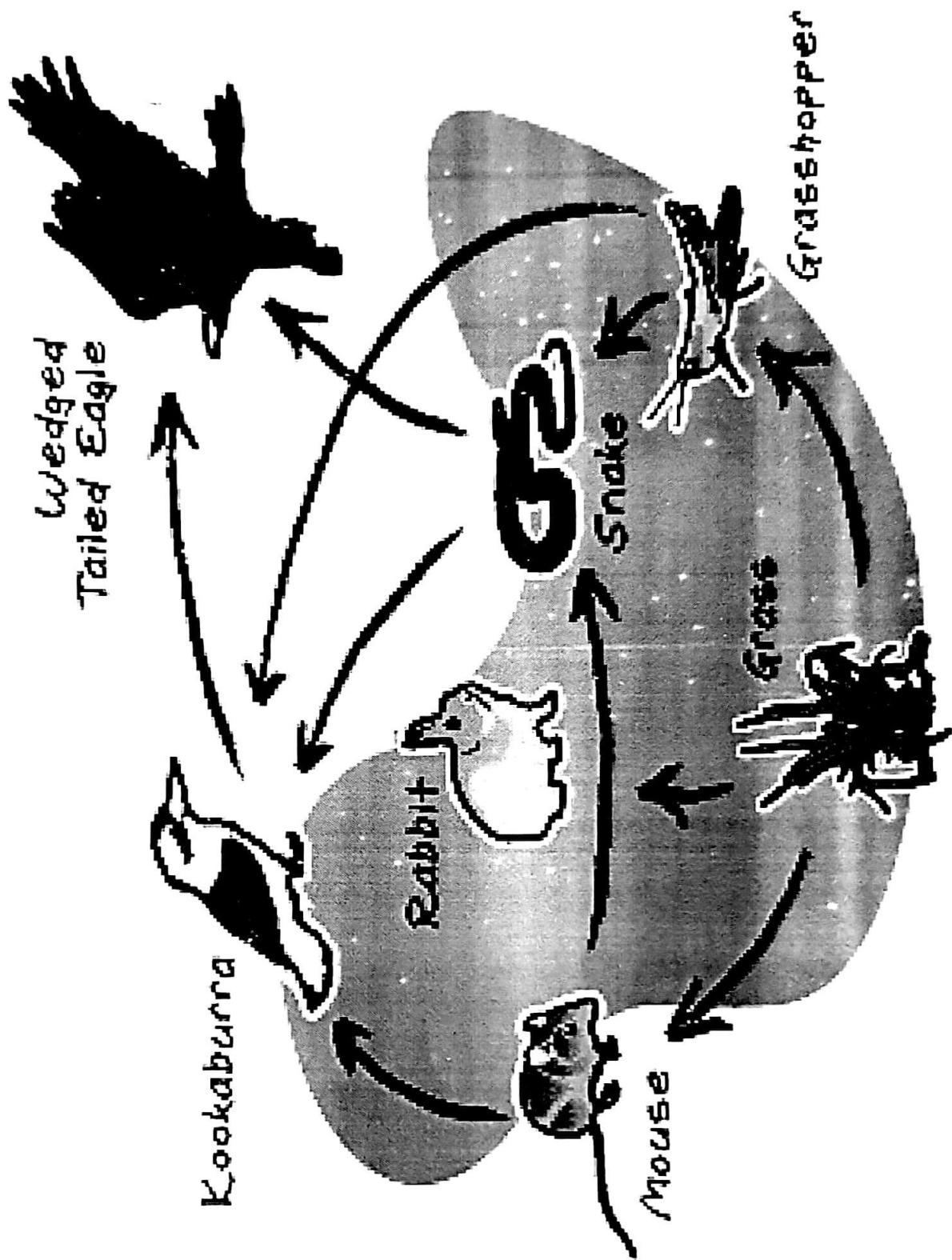


# A build-up of DDT concentration

- Biomagnification of DDT was observed in some birds like as Osprey, in the results of sharp decline in their population.
- The young ones of these bird were found to hatch in a premature condition which led to their death.
- This was later found to be due to biomagnification of DDT through the food chain.
- DDT is one of the pesticide, a chemical used to control pests in very low concentration.
- The concentration of DDT was magnified several thousands times in the birds which caused thinning of shells in the birds eggs, causing deaths.
- Means, animals occupying higher trophic levels are at a greater risk of biomagnification of toxic chemicals.

# Food web

## Intermixing of food chains



# Energy Flow in Ecosystems

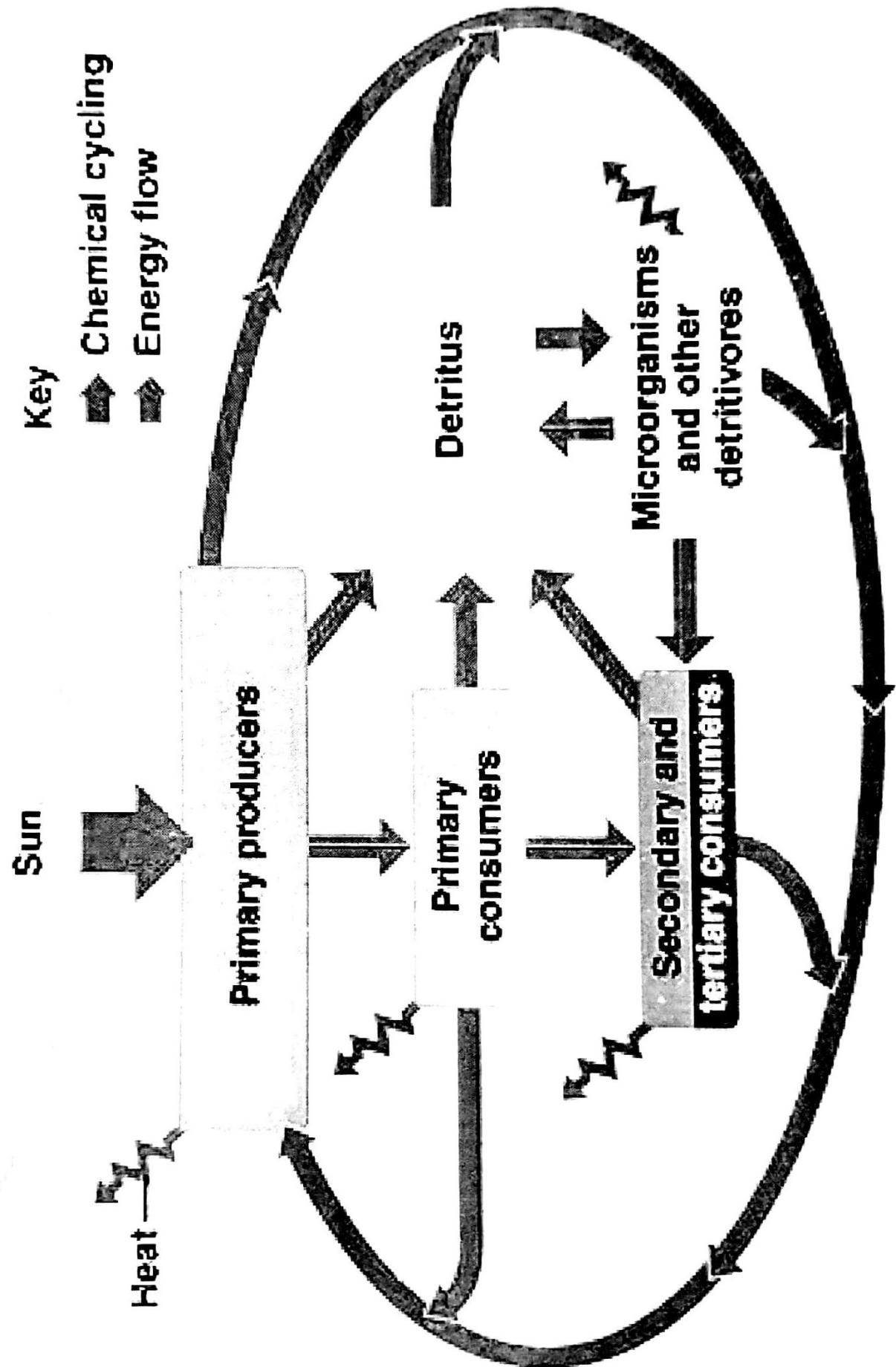
**First Law of Thermodynamics:** energy can neither be created nor destroyed but only is transformed from one form to another.

**Second Law of Thermodynamics:** the second law of thermodynamics states that no energy transformations are 100% efficient.

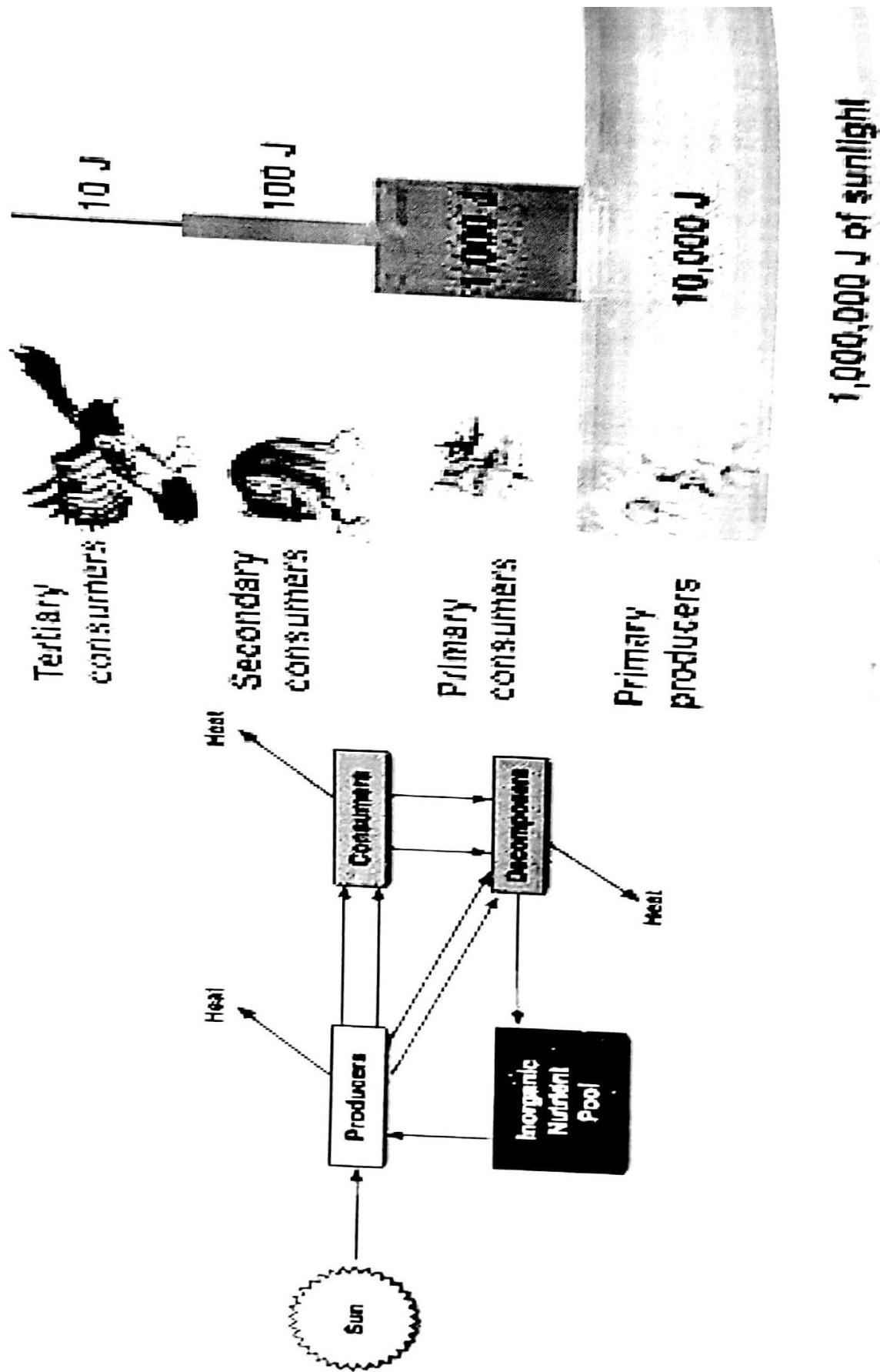
## 10 Percent Rule of Energy

As a rule of thumb, 90 percent of the energy involved is degraded at each trophic transfer and only 10 percent of the energy is **conserved in the organism's tissue.**

# Energy Flow in Ecosystems



# Energy flow in ecosystem and 10% Rule



# **Ecological Pyramid**

The graphical representations of different trophic levels in an ecosystem where producers occupy the base and the top consumer occupy the apex of the pyramid, is known as *ecological pyramid*.

They are used to illustrate the feeding relationships between organisms.

## **Types of Ecological Pyramids**

- **Pyramid of number**
- **Pyramid of biomass**
- **Pyramid of energy**

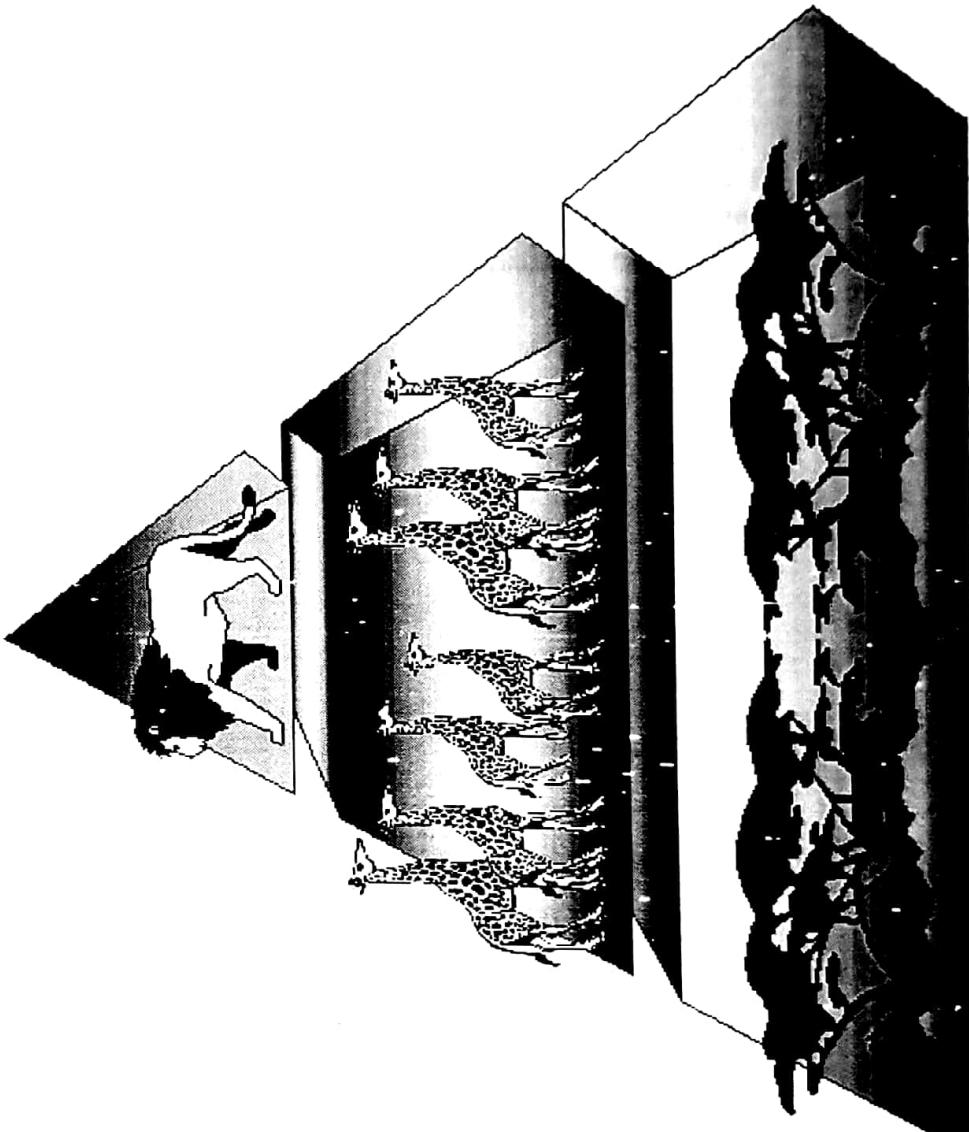
# ECOLOGICAL PYRAMIDS

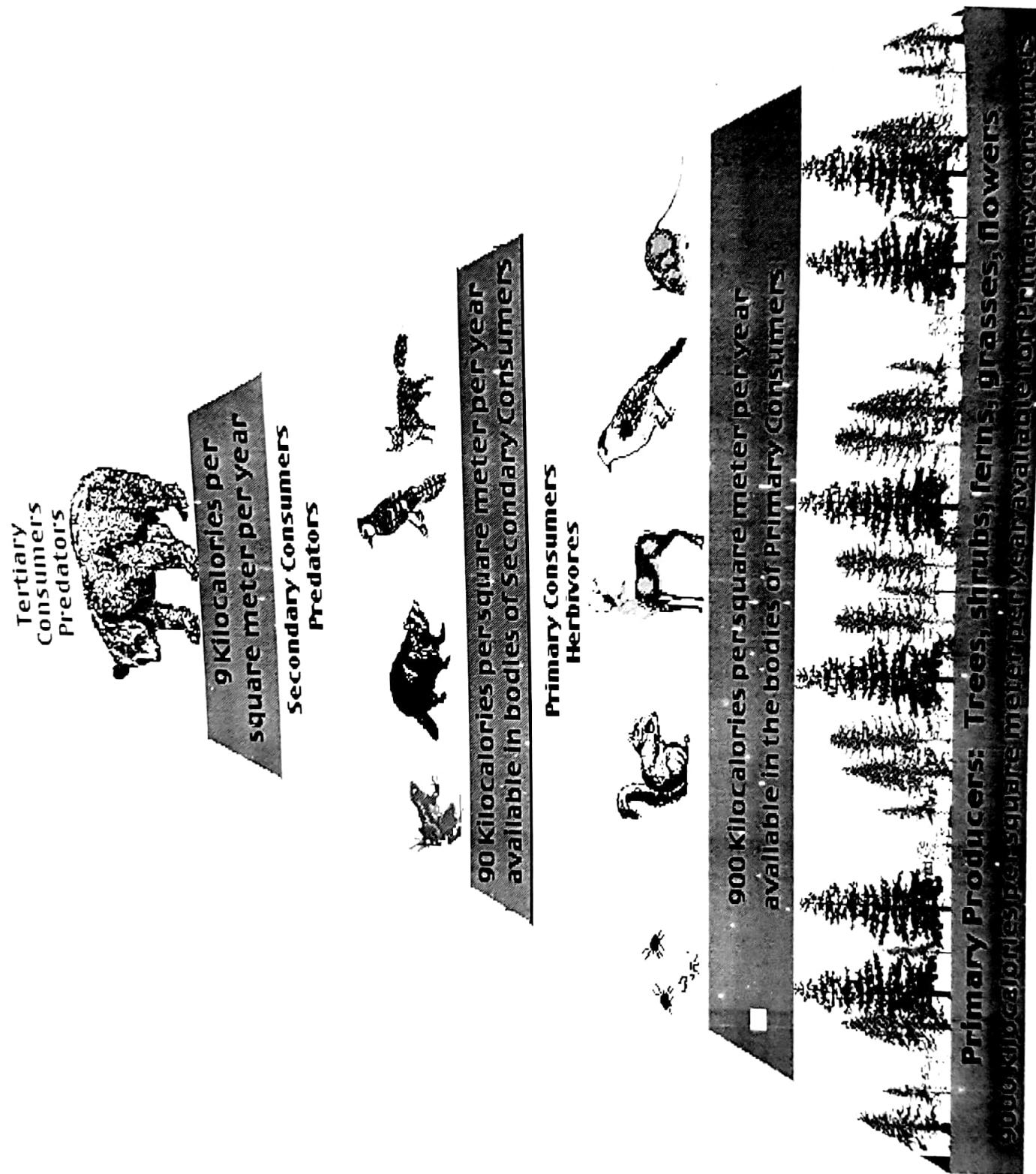
- Food chains and food webs do not give any information about the numbers of organisms involved.
- This information can be shown through ecological pyramids.

## **Pyramid of Number**

Pyramid of number is used to show the number of individuals in each trophic level.

It is upright in case of grassland and pond ecosystems.





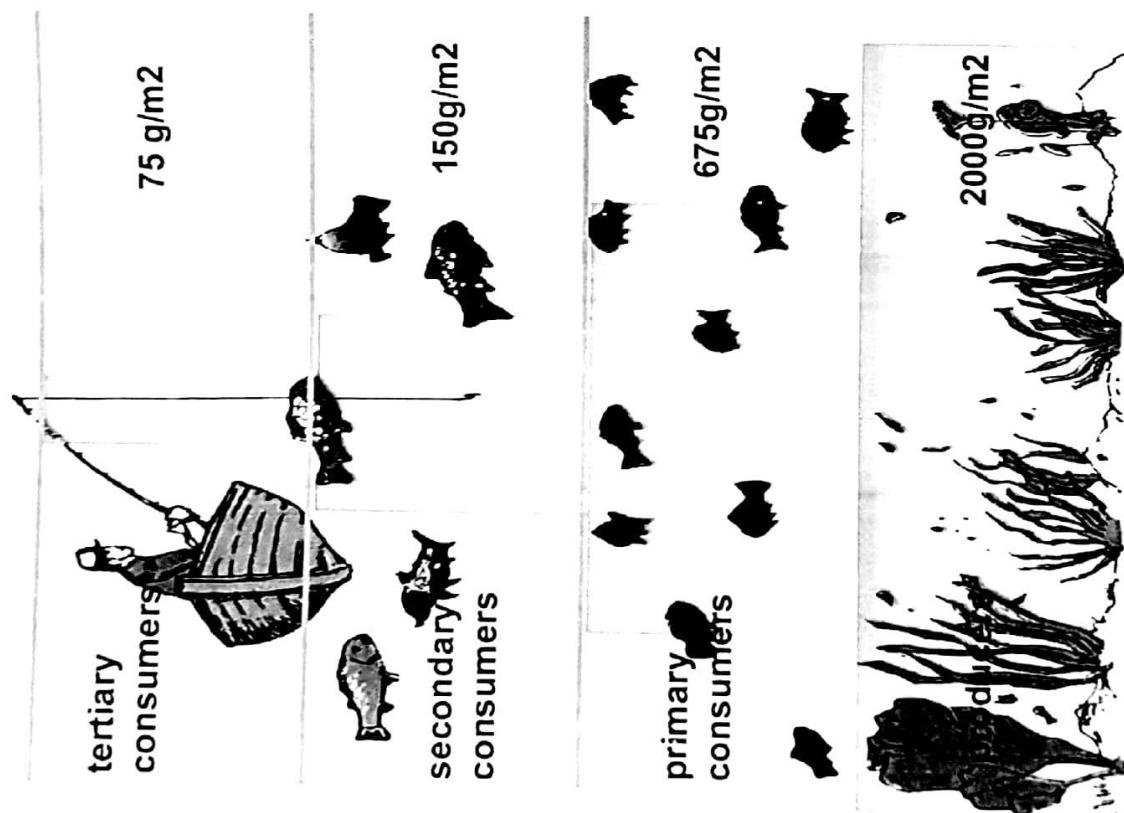
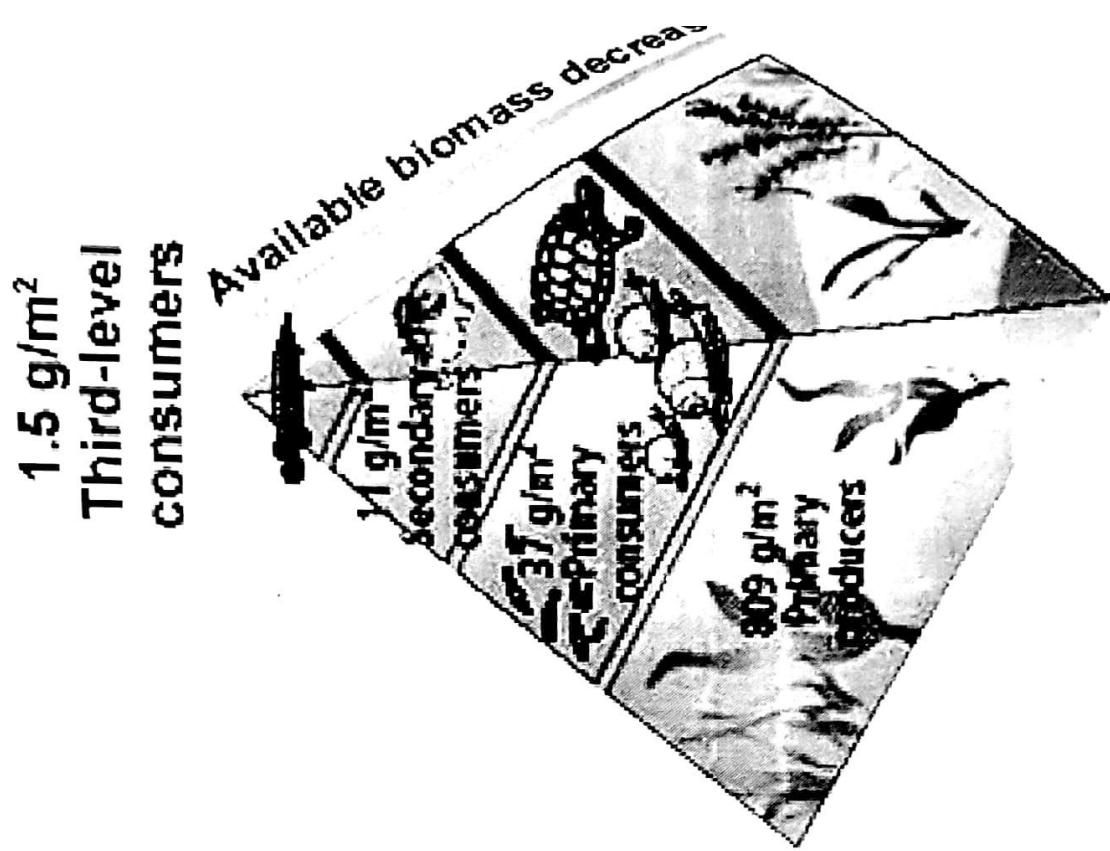
# Pyramid of Biomass

**Pyramid of biomass records the total dry organic matter of organisms at each trophic level in a given area of an ecosystem.**

**The pyramid of biomass is used to show the total biomass of individuals at each trophic level.**

**It is better than the pyramid of number for showing the relationships between organisms.**

# Ecological Pyramids

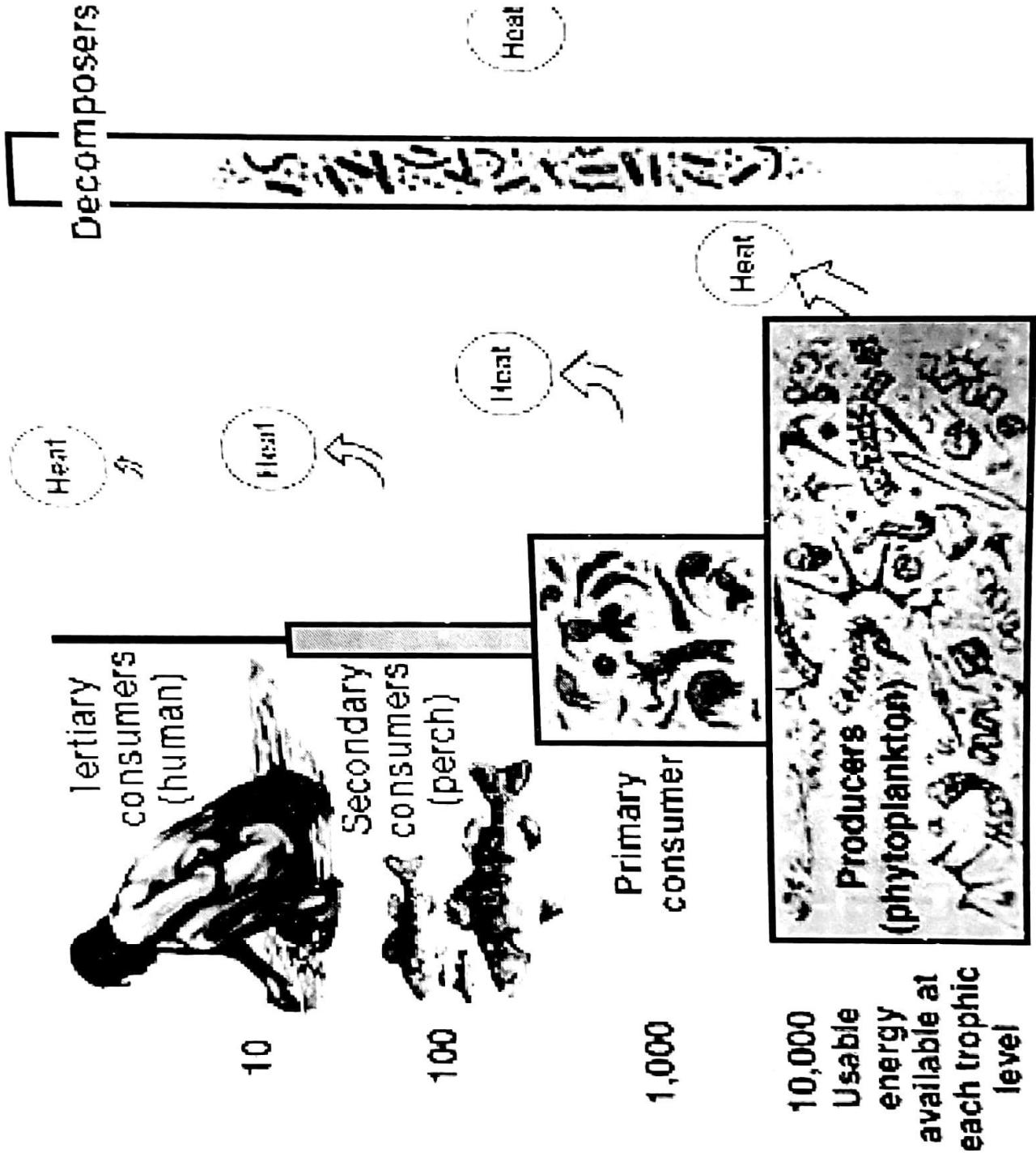


# Pyramid of Biomass

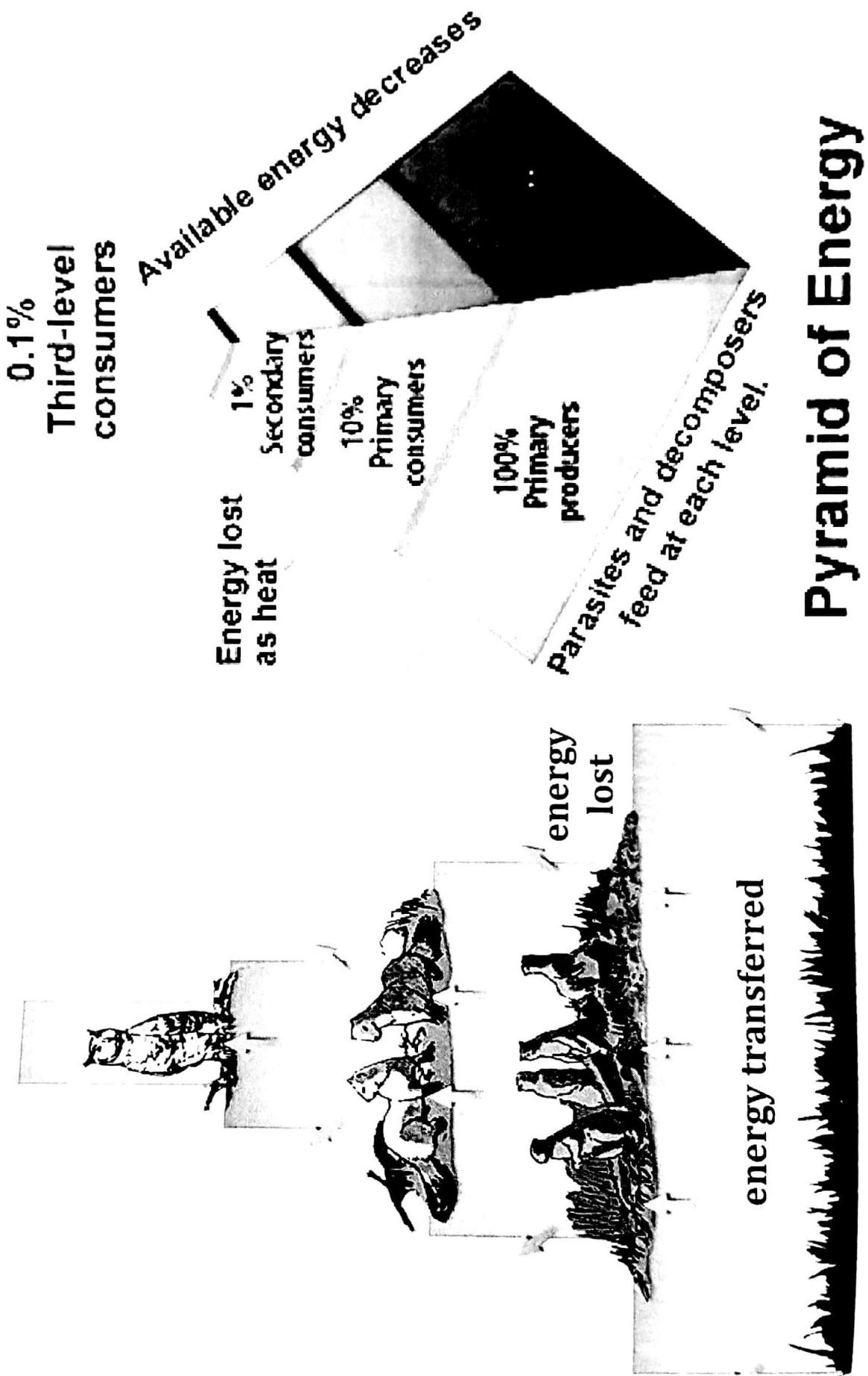
# **Pyramid of energy**

- Pyramid of energy is used to show the amount of energy transferred between trophic levels. It provides the best representation of the overall nature of an ecosystem.
- The pyramid of energy flow is always upright because there is always loss of energy while moving from lower trophic level to higher trophic level.
- The energy reaching the next trophic level is always less compared to that in the previous trophic level.

# Energy Pyramid



# Ecological Pyramids



# Ecological Succession

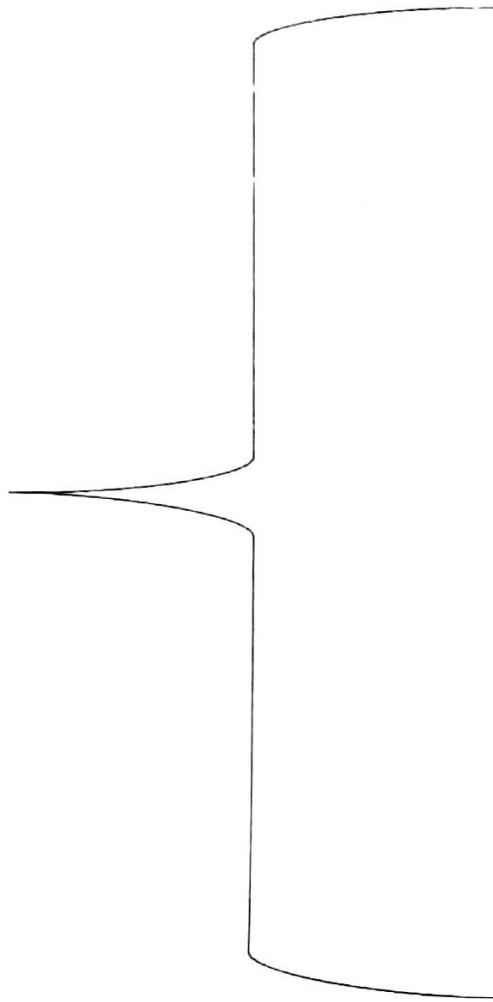
*Ecological succession* is the gradual process by which ecosystems change and develop over time. It is therefore a series of predictable temporary communities or stages leading up to a climax community. Each stage/temporary community is called a successional stage. Each step prepares the land for the next successional stage. All habitats are in the state of constant ecological succession.

Environment is always kept on changing over a period of time due to...

- variations in climatic and physiographic factors, and
- activities of the species of the communities themselves.

Ecological Succession is an orderly sequence of different communities over a period of time.

# Types of ecological succession



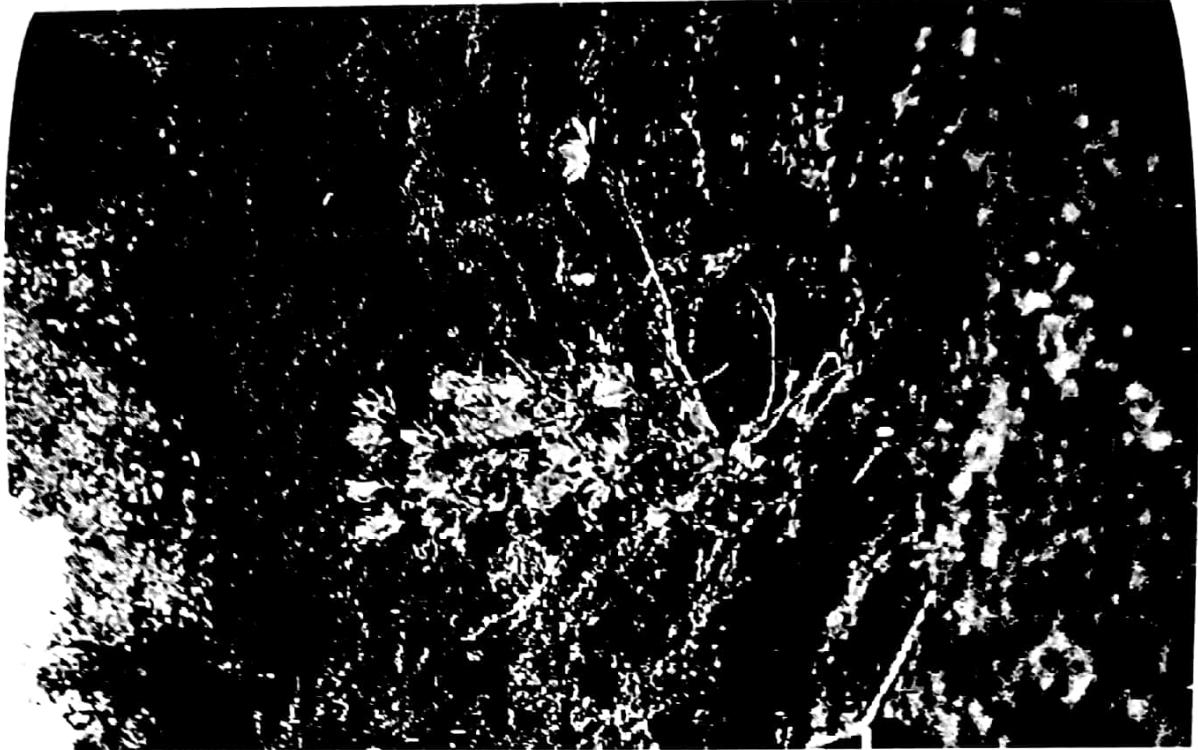
## Primary Succession

## Secondary Succession

Primary succession is the process by which an area first changes from bare rock into a functioning ecosystem.

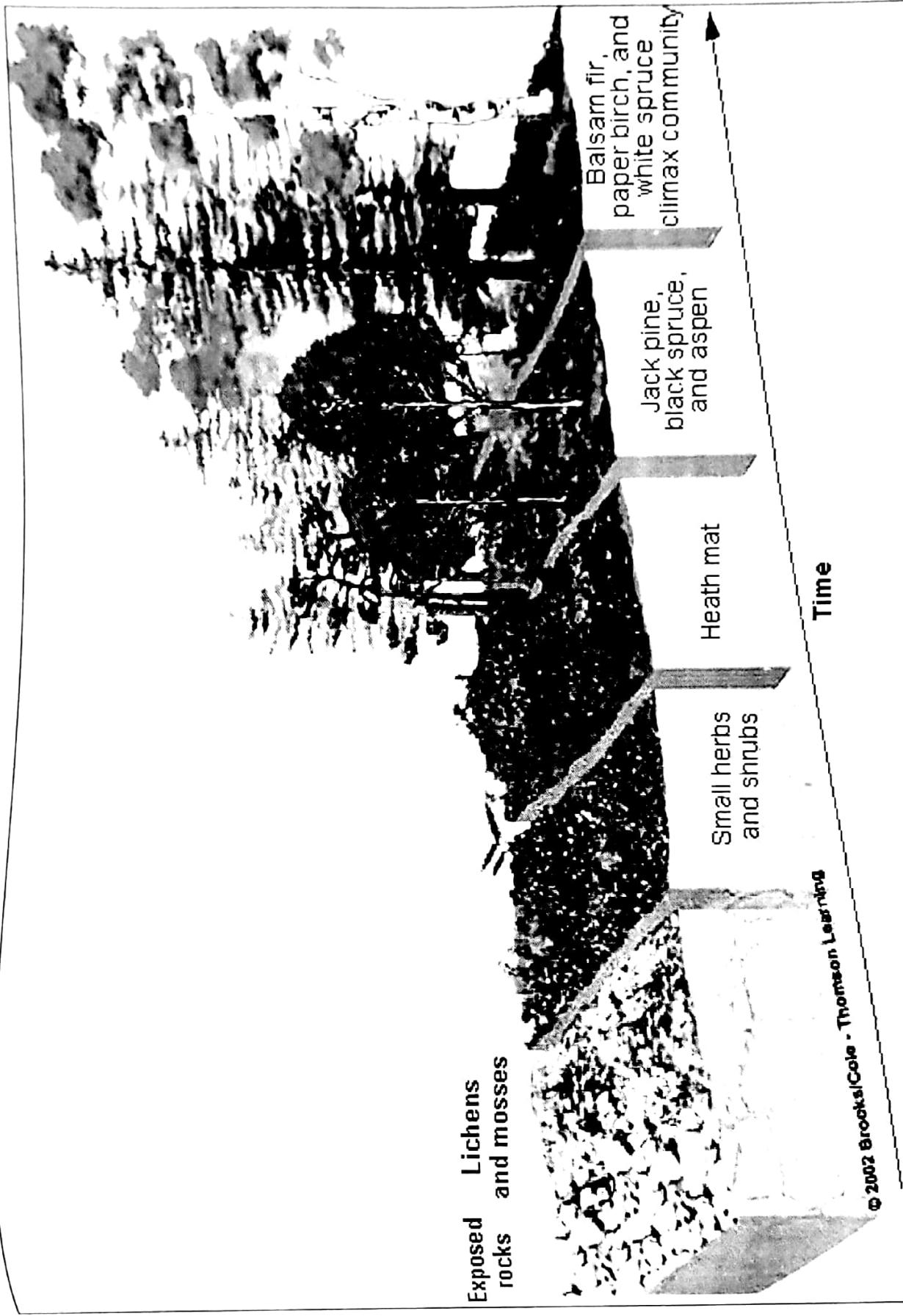
Secondary succession is the process by which an already existing plant community is replaced by another plant community.

# Primary Succession



- The development of an ecosystem in an area that has never had a community living within it occurs by a process called PRIMARY SUCCESSION.
- An example of an area in which a community has never lived before, would be a new lava or rock from a volcano that makes a new island.

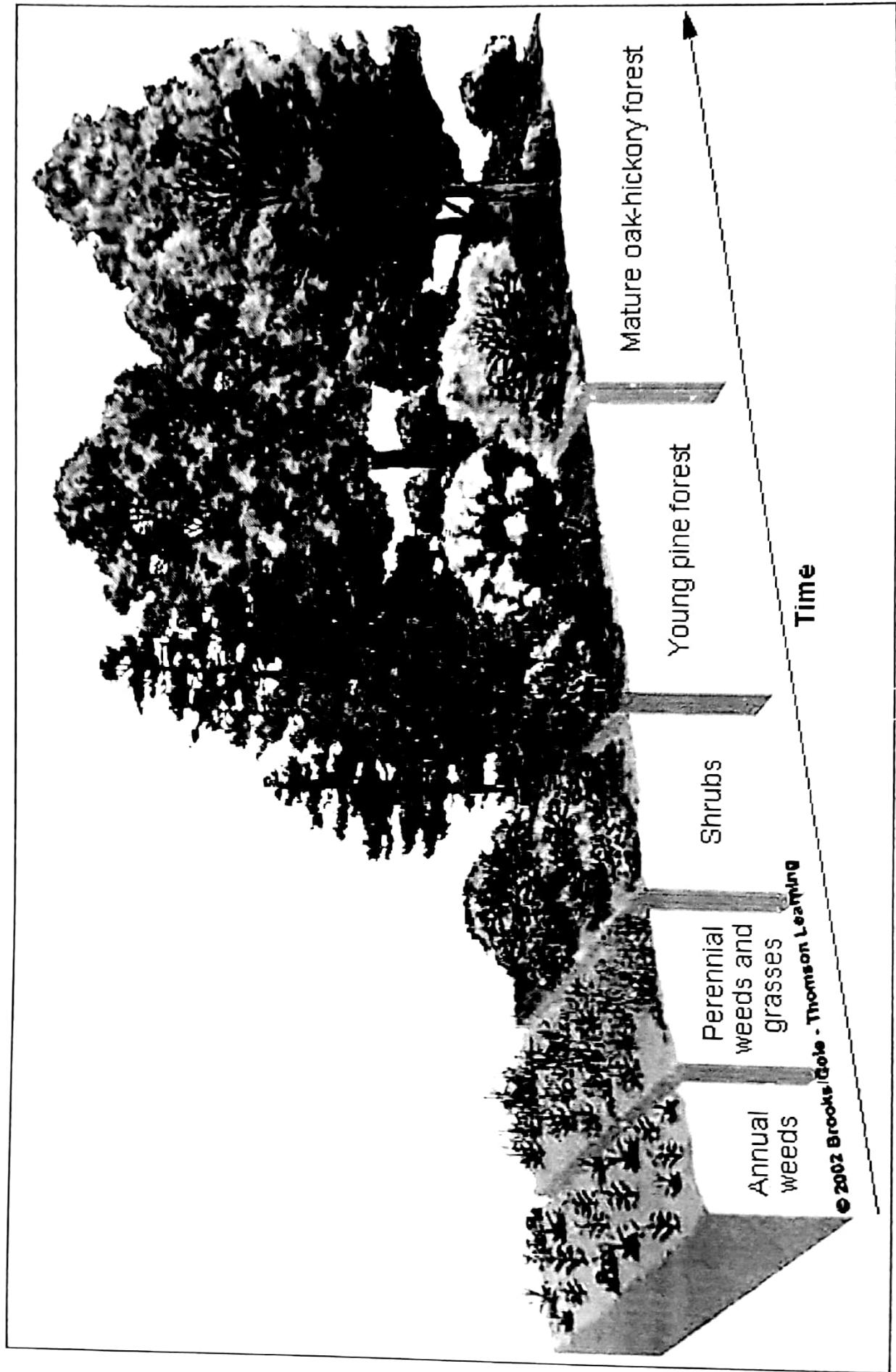
Primary succession is the process by which an area first changes from bare rock into a functioning ecosystem.



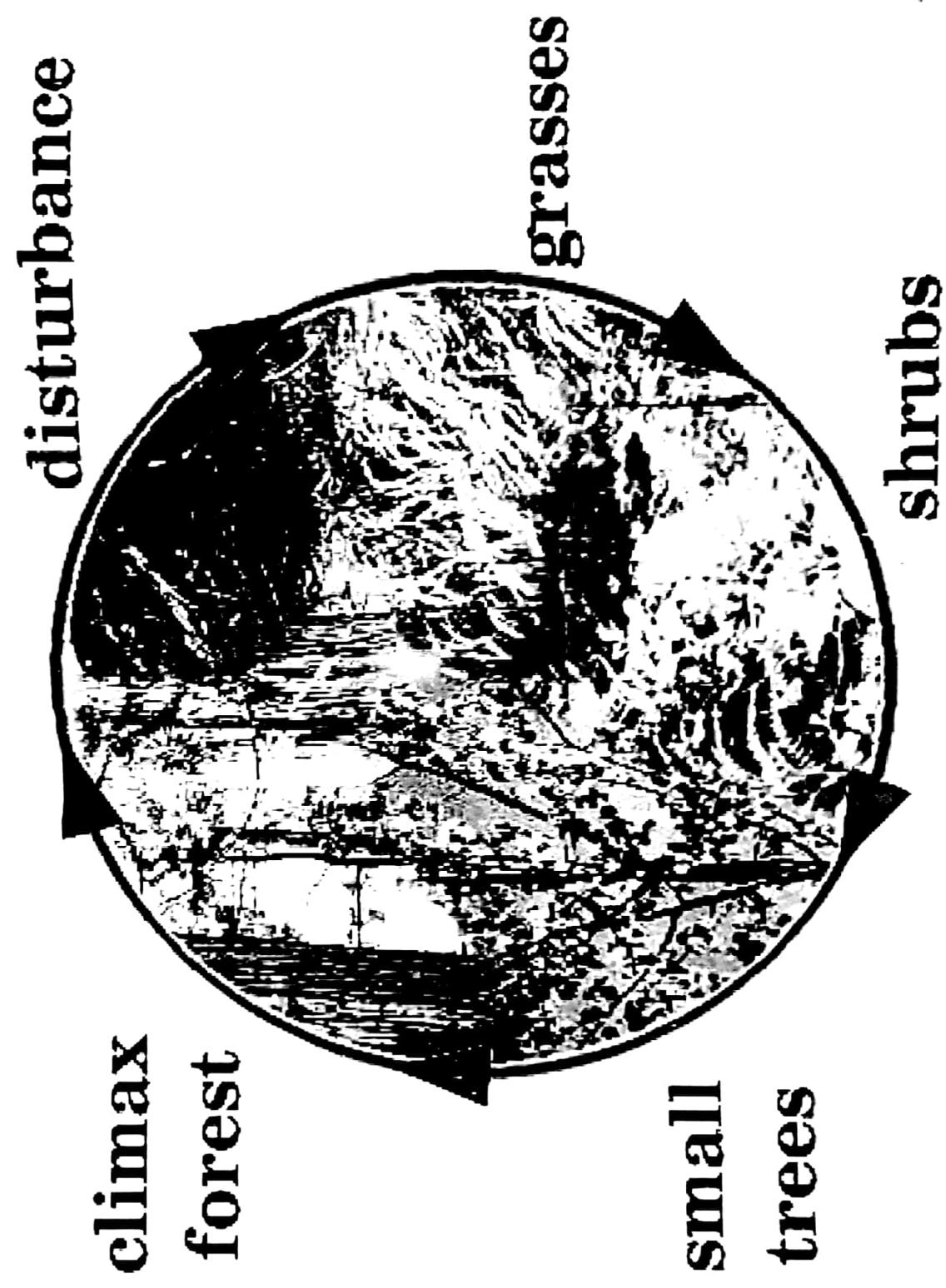
# Secondary Succession

- SECONDARY SUCCESSION begins in habitats where communities were entirely or partially destroyed by some kind of damaging event.
- When an existing community has been cleared by a disturbance such as a fire, tornado, etc...and the soil remains intact, the area begins to return to its natural community. Because these habitats previously supported life, secondary succession, unlike primary succession, begins on substrates that already bear soil. In addition, the soil contains a native seed bank.
- Since the soil is already in place, secondary succession can take place five to ten times faster than primary succession.

Secondary succession is the process by which an ecosystem that has been destroyed gradually returns to its previous state.



# The Circle of Life in Secondary Succession



# The Climax Community

- A climax community is a mature, stable community that is the final stage of ecological succession. In an ecosystem with a climax community, the conditions continue to be suitable for all the members of the community.
- Any particular region has its own set of climax species, which are the plants that are best adapted for the area and will persist after succession has finished, until another disturbance clears the area.

These are Climax Communities



# Process / Stages of Ecological Succession

Nudation- Succession begins with the development of a bare site, called Nudation (disturbance).

## Invasion

- Migration- It refers to arrival of propagates (seeds), dispersion.
- Ecesis- It involves establishment and initial growth of vegetation.
- Aggregation- It involves increase in number of species.

Competition- As vegetation became well established, grew, and spread, various species began to compete for space, light and nutrients. This phase is called competition.

Stabilization- Reaction phase leads to development of a climax community.

# **Study of some common ecosystems**

**Terrestrial ecosystem**

- Grassland ecosystem
- Desert ecosystem
- Forest ecosystem

**Aquatic ecosystem**

- Pond ecosystem
- Ocean ecosystem

# **Forest Ecosystem**

## **Abiotic Components**

Inorganic and organic substances found in the soil, climatic factors, e.g., temperature, humidity, rainfall, and light.



## **Biotic Components**

### **Producers**

Different kinds of trees depending upon the climate

### **Consumers**

Different kinds of primary, secondary, and tertiary consumers, e.g., deer, elephant, moles, snakes, lizards, lion, and tiger

### **Decomposers**

These are various kinds of bacteria and fungi

# Grassland ecosystem

All grasslands in the world are categorized into the following two types:

- Tropical grasslands- closest to equator and are hot throughout the year.
- Temperate grasslands- farther from the equator and have both hot summers and harsh winters.

# Grassland Ecosystem

## Abiotic Components

Inorganic elements (C, H, O, N, P, S), climatic components, temperature, rainfall, light, etc.



## Biotic Components

### Producers

Mainly grasses with a few scattered trees

### Consumers

Deer, rabbit, giraffe, etc., are herbivores, while wolf, leopard, etc., are carnivores

### Decomposers

Mainly bacteria and fungi

# Desert Ecosystem



## Abiotic Components

Low rainfall, high temperature, and sandy soil

## Biotic Components

### Producers

Predominantly thorny shrubs, cactus, etc.

### Consumers

Different insects, lizards, reptiles, nocturnal rodents, birds, etc.

### Decomposers

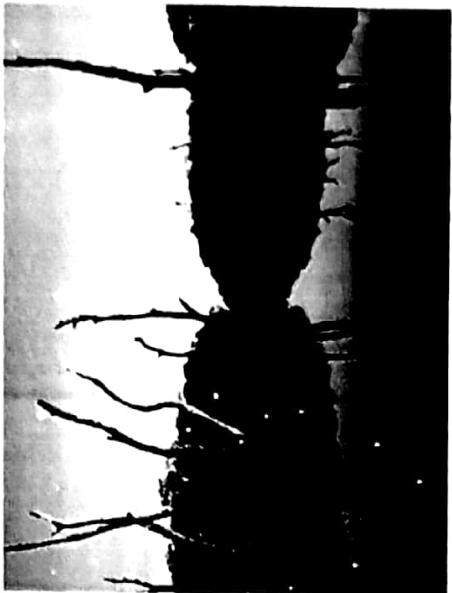
Various bacteria and fungi

# Pond and Ocean Ecosystem

## Abiotic Components



It includes organic and inorganic substances, atmospheric gases dissolved in water, minerals found in dissolved state, etc.



## Biotic Components

### Producers

Submerged floating and emergent aquatic plants For example, nelumbo, hydrilla, chara, etc.

### Consumers

May be primary, secondary, or tertiary, e.g., small fishes, beetles, mollusca, crustaceans, etc.

### Decomposers

Chiefly bacteria, actinomycetes, fungi, etc.