

# Chapter - 3

## ECOSYSTEMS







**Organism**



**Community**



**Population**



**Ecosystem**

# 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.

# Ecology

Ecology is the study of how living and non-living factors affect each other in an environment. An ecosystem is the basic and functional unit of ecology.

# Kinds of Ecosystems

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graph TD; A[Kinds of Ecosystems] --> B[Natural Ecosystems]; A --> C["Man-made Ecosystems (aquaria, garden, dams & cropland of maize, wheat, rice)."]; B --> D[Terrestrial Ecosystems]; B --> E[Aquatic Ecosystems]; D --> F[Forest Ecosystems]; D --> G[Grass land Ecosystems]; D --> H[Desert Ecosystems]; E --> I[Fresh water Ecosystems]; E --> J[Marine Ecosystems]; I --> K["Running water Ecosystems (lotic)"]; I --> L["Standing water Ecosystems (lentic)"];
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**Natural Ecosystems**

**Man-made Ecosystems (aquaria, garden, dams & cropland of maize, wheat, rice).**

**Terrestrial Ecosystems**

**Aquatic Ecosystems**

**Forest Ecosystems**

**Grass land Ecosystems**

**Desert Ecosystems**

**Fresh water Ecosystems**

**Marine Ecosystems**

**Running water Ecosystems (lotic)**

**Standing water Ecosystems (lentic)**



# Natural Ecosystems



# Man-made Ecosystems



What is the different  
between natural and man  
Made ecosystem?

# Structure of an Ecosystem

## Living (Biotic) Components

- Producers
- Consumers ( primary, secondary and tertiary)
- Decomposers

(Maintains biological cycle)

## Non-living (Abiotic) Components

- Organic
- Inorganic
- Physical

# Biotic Components of Ecosystems

- **Producers (or autotrophs)**

Green plants and some bacteria which manufacture their own food.

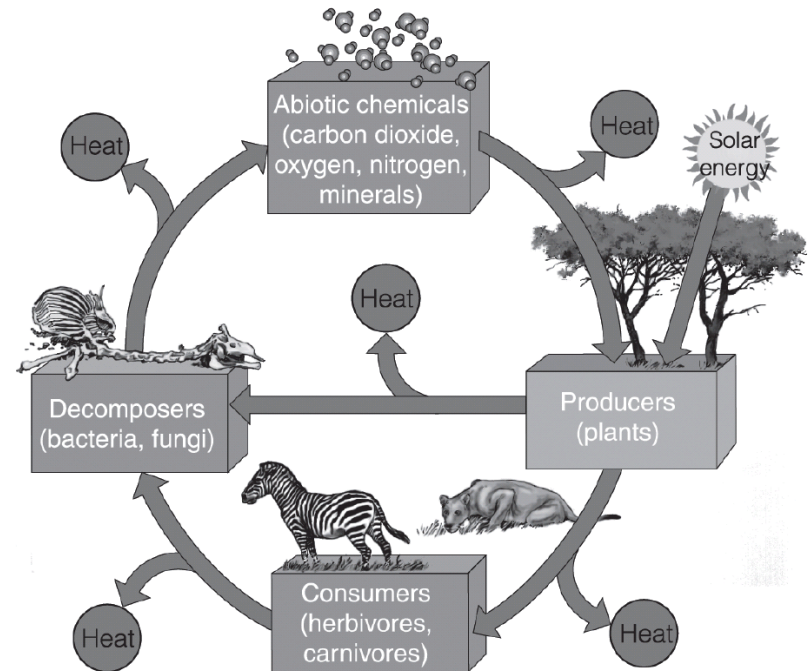
- **Consumers (or heterotrophs)**

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

## Organic

Carbohydrates

Lipids

Proteins

## Inorganic

Water

Ammonia

Gases

## Climatic

Rainfall

Humidity

Temperature



# Limiting factor

Factors which restrict the further growth of population

Availability of food

Water

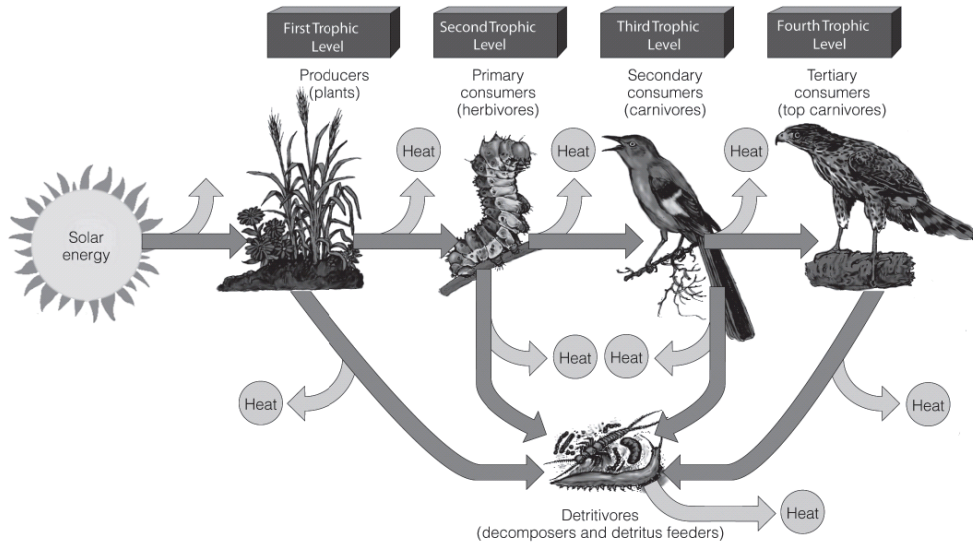
Shelter

Space

# Functions of an Ecosystem

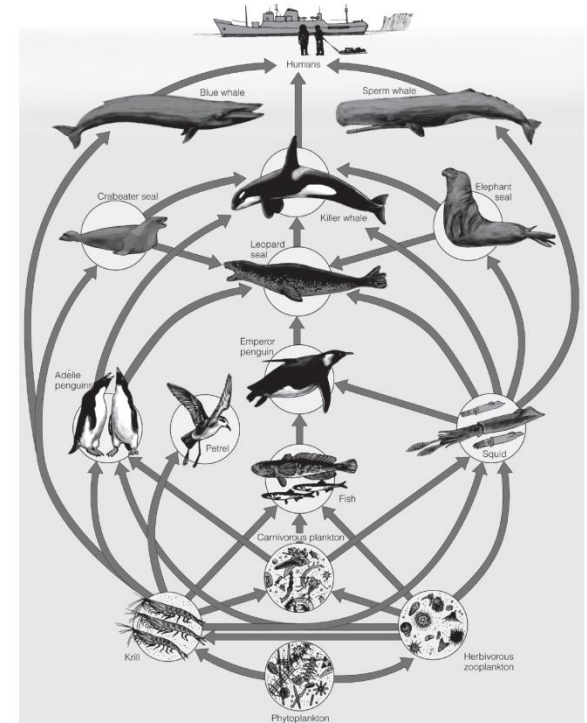
- Food chain and food web
- Energy flow
- Cycling of matter (chemicals)

# 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 as *food chain*.

# Food Web



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

# Significance of food chain

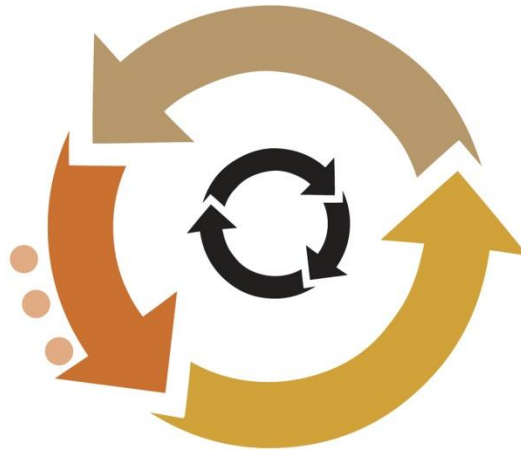
- Food chains are important for maintaining and regulating the population size
- Ecological balance
- biomagnification



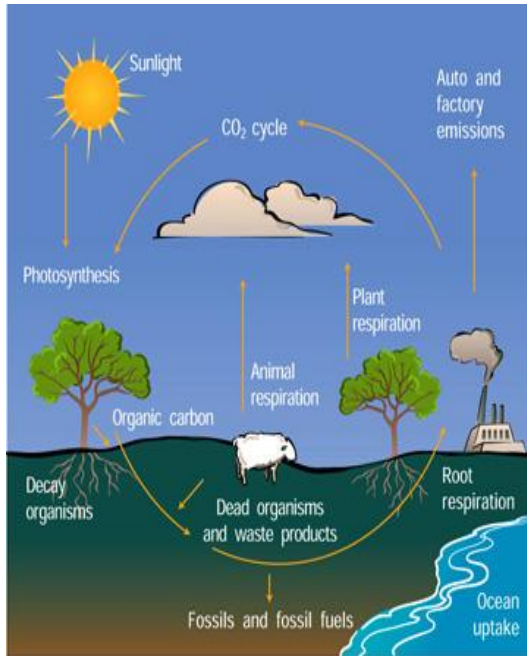


# Biogeochemical Cycling

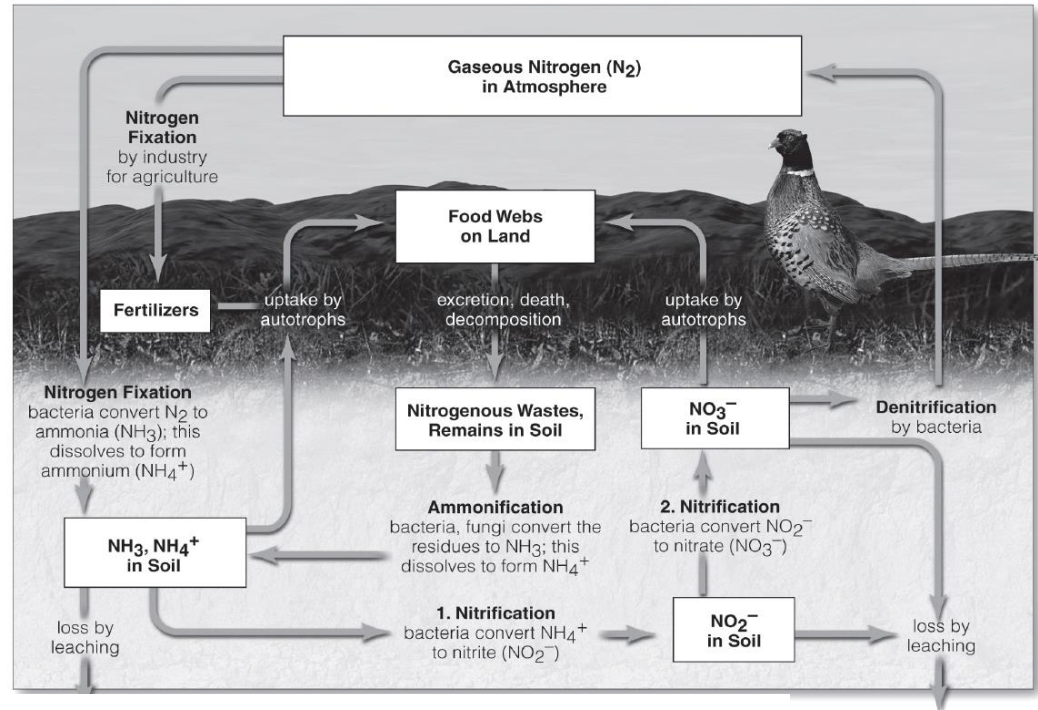
The cyclic movement of minerals from their reservoirs (air, water, and soil) to the living components and back to the reservoirs is called *nutrient cycling* or *biogeochemical cycles*.



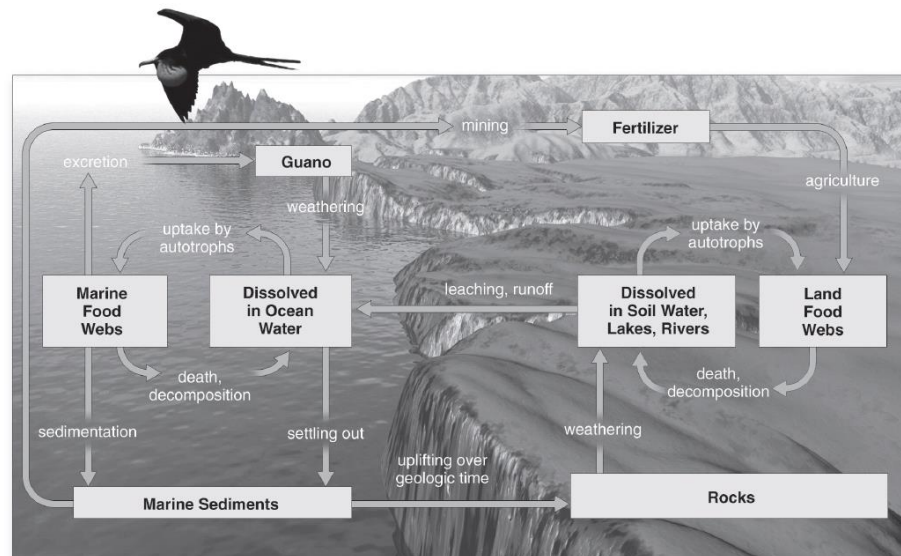
# Carbon Cycle



# Nitrogen cycle



# Phosphorus Cycle



# Ecological Pyramid

The graphical representations of different trophic levels in an ecosystem 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



# 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.

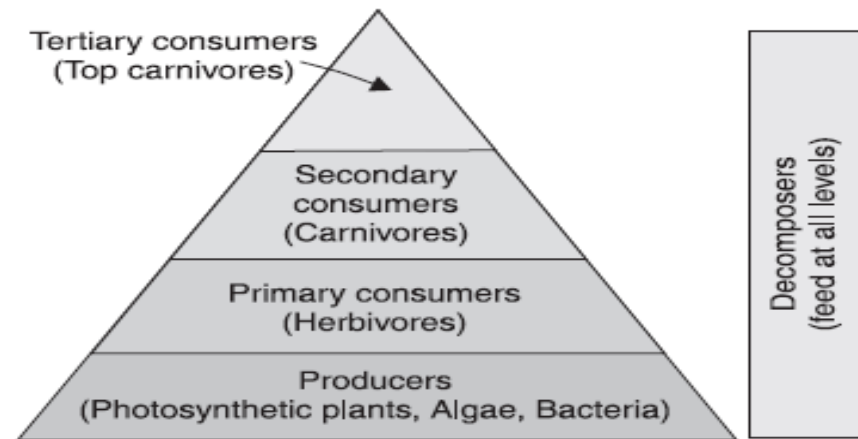
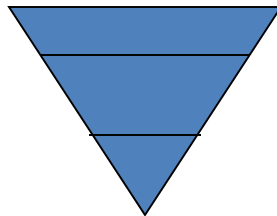


Figure 2.3 Trophic levels

In some cases, the pyramid of number is inverted.

For example, in case of forest ecosystem.



Hyperparasite

Parasites

Herbivores

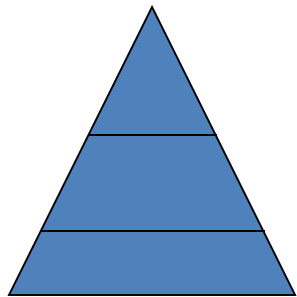
Producer

# Pyramid of Biomass

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.

Pyramid of biomass is upright in case of grassland and forest ecosystems

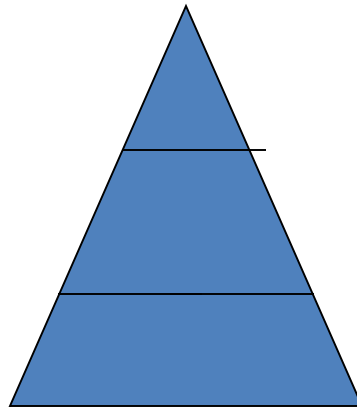


# Pyramid of energy

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.

Therefore, the energy reaching the next trophic level is always less compared to that in the previous trophic level.



# 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 or seral stage. Each step prepares the land for the next successional stage. All habitats are in the state of constant ecological succession.

## Types of Succession

### Primary succession

Primary succession refers to a series of community changes which occur on an entirely new habitat which has never been colonized before. For example, a newly quarried rock face or sand dunes.

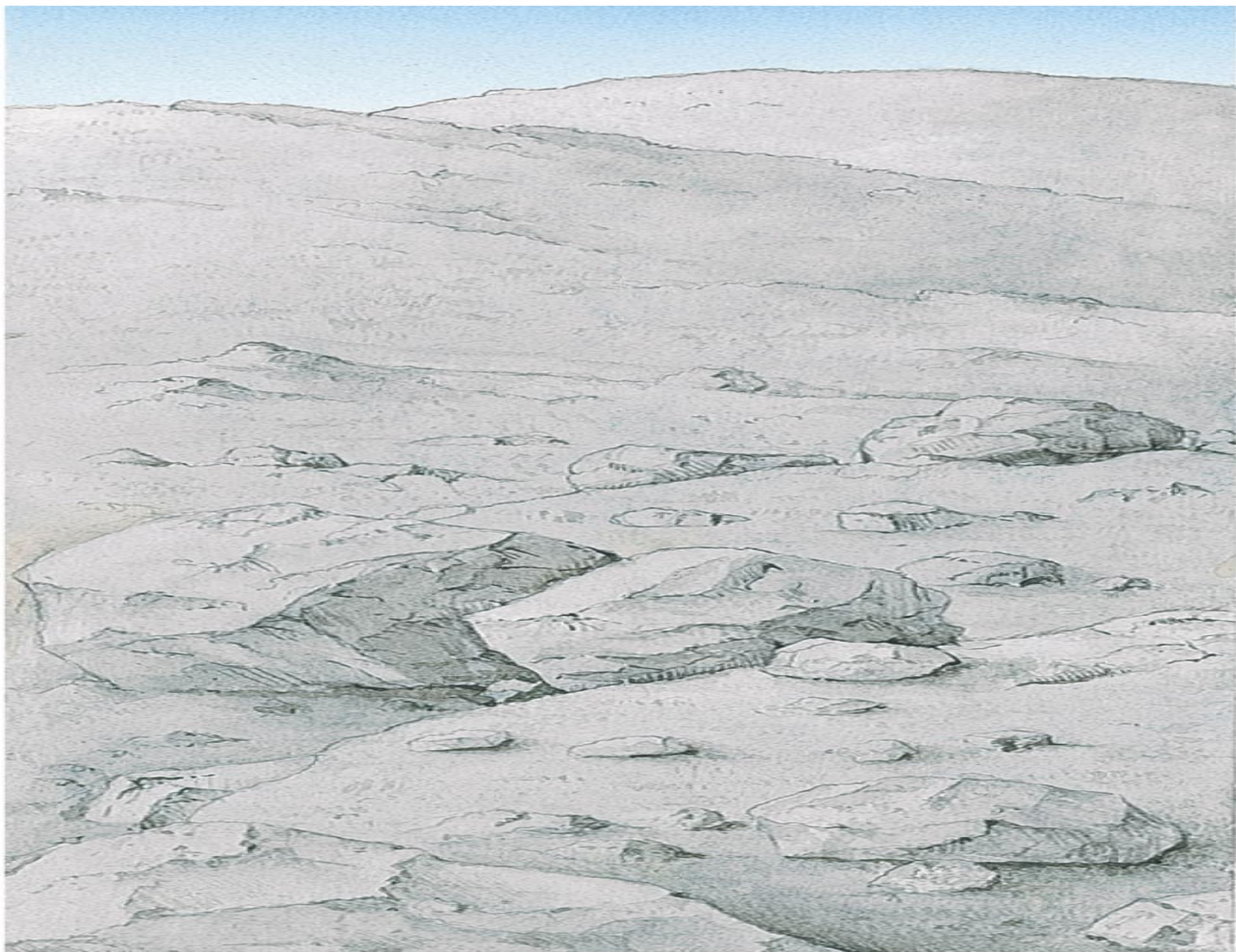
### Secondary succession

Secondary succession refers to a series of community changes which take place on a previously colonized, but disturbed or damaged habitat. For example, land obtained after felling trees in a woodland, land clearance, or fire.



# Primary Succession

- Soil starts to form as lichens and the forces of weather and erosion help break down rocks into smaller pieces
- When lichens die, they decompose, adding small amounts of organic matter to the rock to make soil



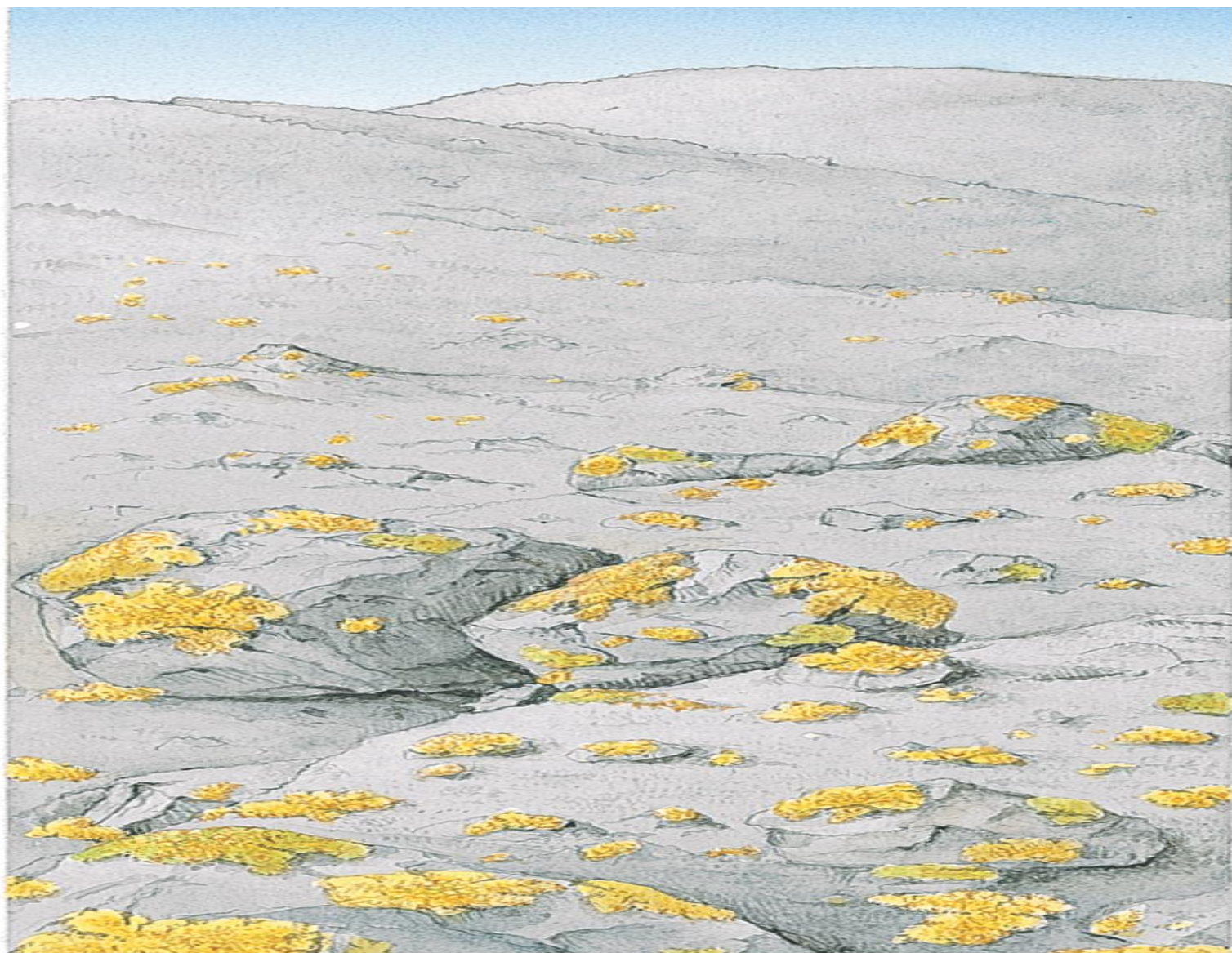








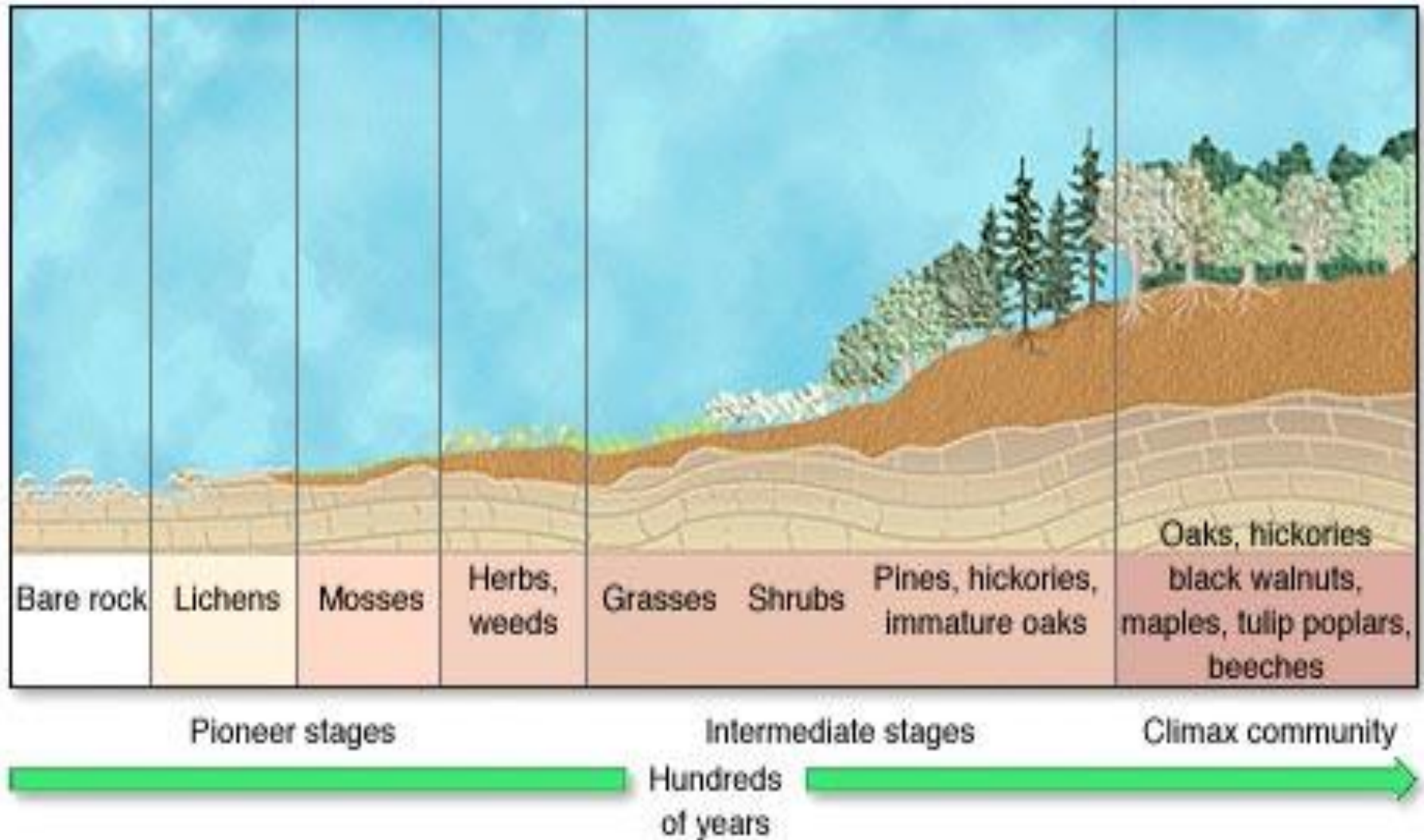


Figure 53.20 Spruce coming into the alder and cottonwood forest





# Primary Succession



# Secondary Succession

- Secondary Succession: The process of re-stabilization that follows a disturbance in an area where life has formed an ecosystem.
- Begins in a place that already has soil and was once the home of living organisms
- Occurs faster and has different pioneer species than primary succession
- Example: after forest fires

## Forest fire

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Benjamin  
Cummings

# Ecosystem characteristic that changes during Succession

<b>Characteristics</b>		<b>Stage</b>	
		<b>Initial</b>	<b>Climax</b>
<b>1.</b>	<b>Size of individual</b>	<b>Small</b>	<b>Large</b>
<b>2.</b>	<b>Community organization</b>	<b>Simple</b>	<b>Complex</b>
<b>3.</b>	<b>Food Chain &amp; food Web</b>	<b>Simple</b>	<b>Complex</b>
<b>4.</b>	<b>Efficiency of energy use</b>	<b>Low</b>	<b>High</b>
<b>5.</b>	<b>Nutrient conversion</b>	<b>Low</b>	<b>High</b>

## Cause that initiate the ecological succession

- An established species and impact of external natural forces, which try to alter the environmental condition of that area
- Ex. Hardwood tree replacing red pine
- Ecosystem is continuously changing and reorganizing,
- ecological succession refers to orderly changes in composition or structure of ecosystem



# Process of ecological succession

- Nudation

- Invasion

Migration (dispersal)

Ecesis (establishment)

Aggregation

- Competition

- Stabilization

# TERRESTRIAL ECOSYSTEM:

## Grassland Ecosystems

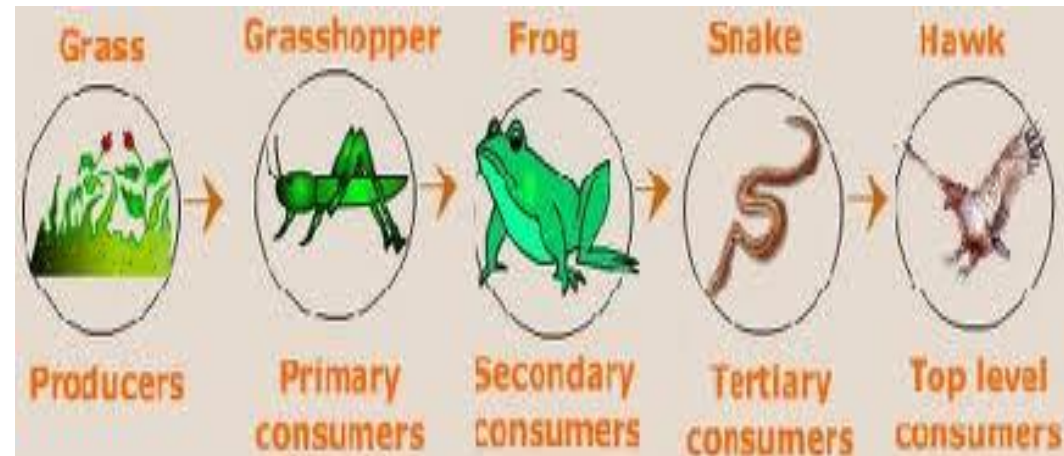
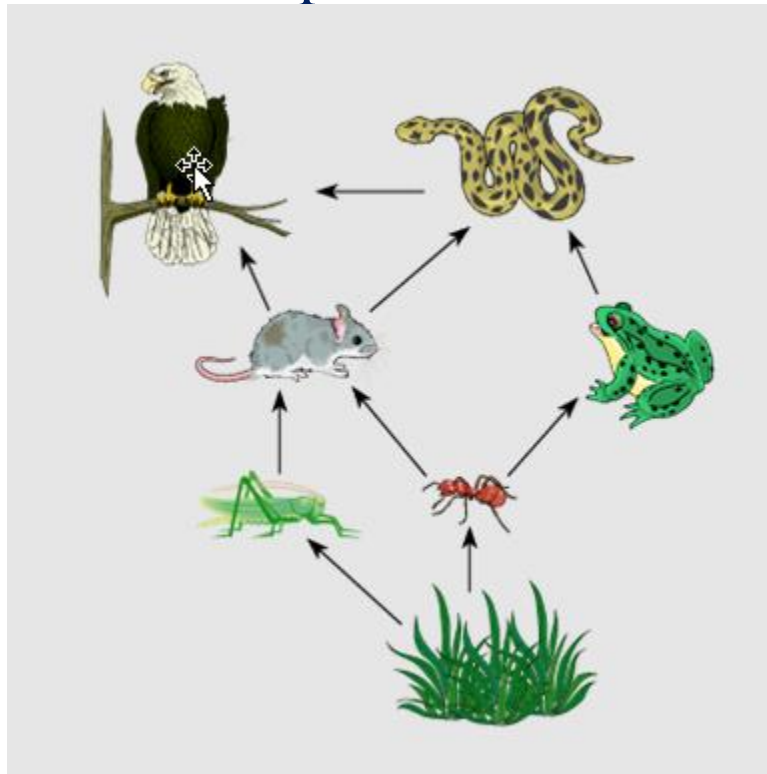
- In terrestrial ecosystems, grassland ecosystem form the majority. Grassland ecosystems are defined as big open spaces with dominant vegetation; not many bushes are found here and trees are found only along the banks of rivers and near streams.
- These ecosystems are found where the annual rainfall ranges between 500mm -900mm (20-35 inches)
- Grassland soils contain humus and tend to be deep and fertile.



# Categories of Grasslands

- **Tropical Grasslands:** These type of grasslands are closest to equator and are hot throughout the year.
- **Temperate Grasslands:** These are away from the equator and have both hot summers and harsh winters.
- **STRUCTURE OF GRASSLAND ECOSYSTEMS:**
- **Abiotic Components:** These include inorganic elements (C,H,N,P,S etc ), climatic components ,temperature , rainfall etc.
- **Biotic Components:**
  - **Producers:** Main producers are grasses and some scattered trees
  - **Primary Consumers:** Grazing animals,insects,termites are the primary consumers

- **Secondary Consumers:** Snakes, lizards, jackal ,fox etc are secondary consumers.
- **Tertiary Consumers:** Hawks and kites
- **Decomposers:** Various bacteria and fungi are found in the soils of grasslands which decompose the dead parts of plants and animals. They bring minerals to the soil e,g. Penicillium, Rhizopus etc.



**Deseret Ecosystem:** Six percent of the World's land surface is desert. Dissert receives less than 25cm of rainfall anually. There are three kinds of deserts: Hot, temerate and cold desert

## **Structure of Desert Ecosystem:**

**Abiotic Components:** Low rainfall, high temperature and sandy soil

### **Biotic Components:**

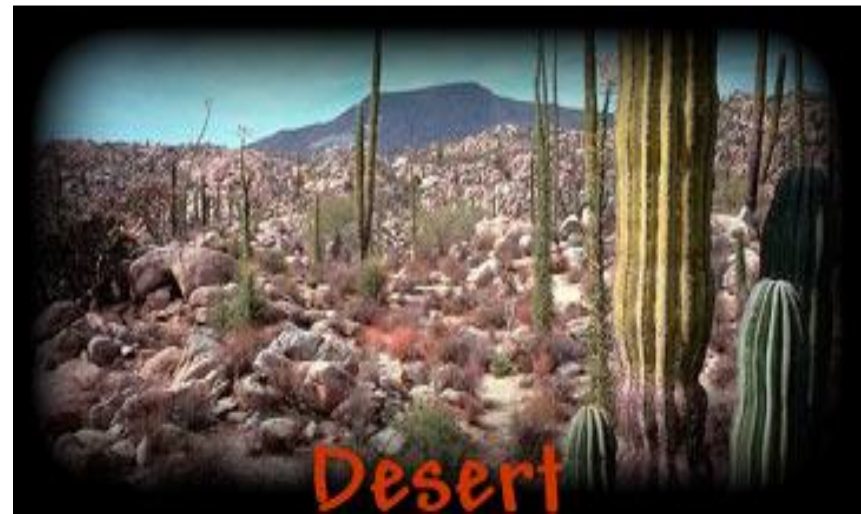
**Producers:** Thorny shurbs, cactus, opuntia etc are found in deserts.

**Consumers:** Lizards, reptiles, birds and camel

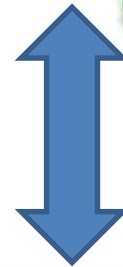
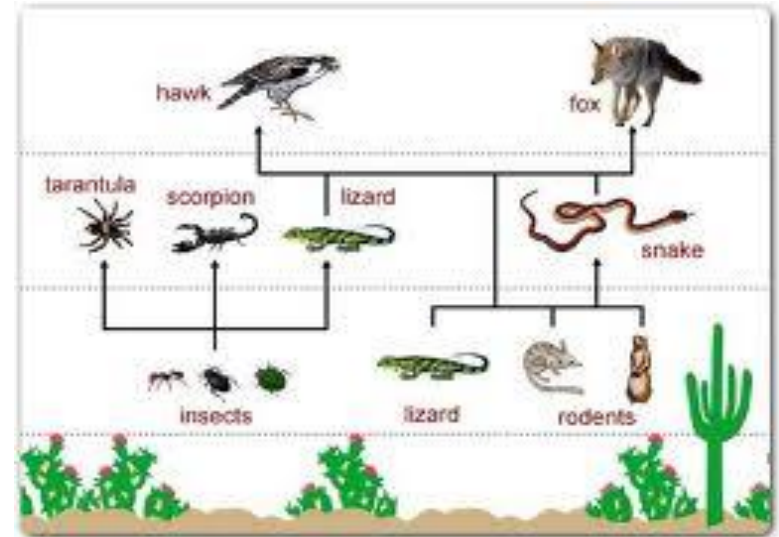
**Decomposers:** Various bacteria and fungi are found in desert soil. It is poor in organic matter and decomposition process is impeded by lack of moisture.

# Desert Plants

- **Deserts are very dry ecosystems.**
- **Desert plants and animals can survive with very little water.**
  - Desert plants, such as cactus, have thick stems that store water.
  - The roots of a cactus lie just below the soil and spread far from the plant.





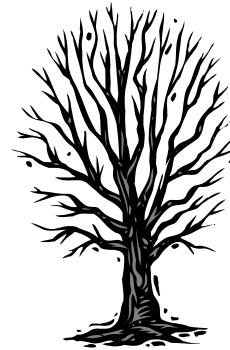
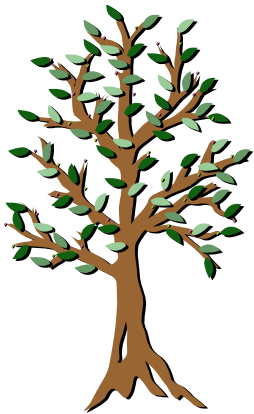


## DESERT ECOSYSTEM



# Forest Ecosystems

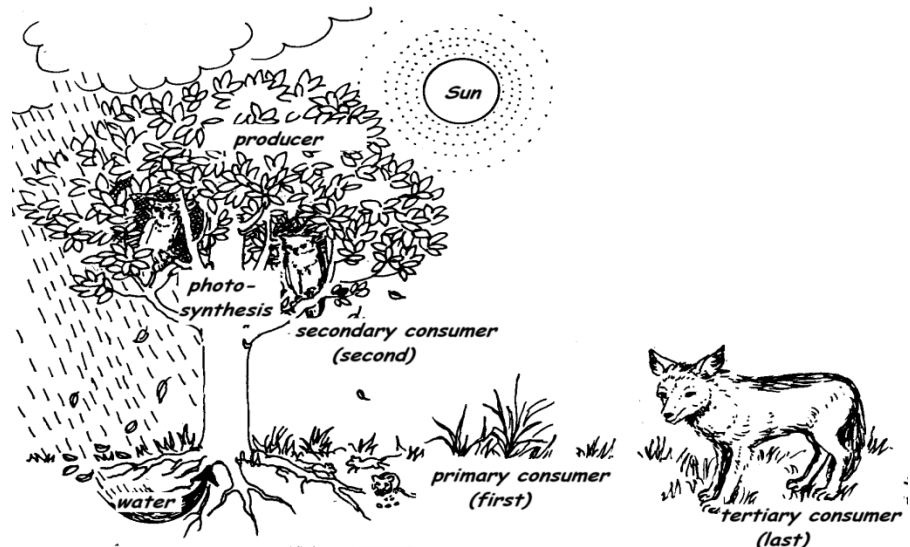
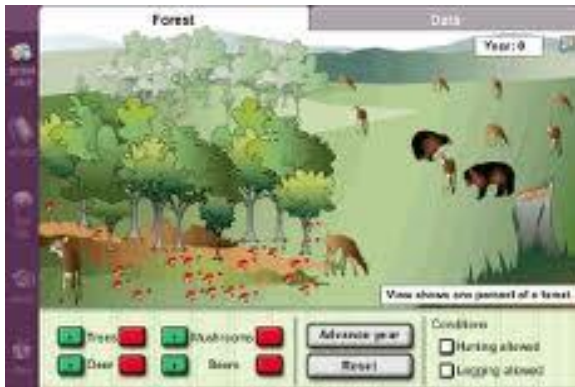
In these ecosystems natural plant communities are dominated by the presence of trees and other woody plants. Forest communities need an annual average rainfall of at least 50cm. The two environmental factors temperature and rainfall determine the particular type of forest ecosystem



# Structure of Forest Ecosystem

- **Abiotic Components:** Inorganic and organic substances found in the soil and the climatic factors e.g. Temperature, humidity, rainfall and light play an important role in the development of forest community.
- **Biotic Components:**
  - **Producers:** Different kinds of trees depending upon the climate. These varies depending upon forest types and habitats conditions of the specific area.
  - **Consumers:** The composition of consumers in forest ecosystem vary depending upon the forest types and climatic conditions.
  - **Primary Consumers:** These include plant eating animals and are also known as herbivores. Examples of primary consumers include deer, elephant, moles etc.

- **Secondary Consumers:** These include the carnivores that feed on herbivores. These include snakes, lizards.
- **Tertiary Consumers:** They depend on secondary consumers for obtaining their food e.g. Lion, tiger etc.
- **Decomposers:** These include various kinds of bacteria and fungi. They decompose or degrade the dead organism and liberate mineral elements into the soil.



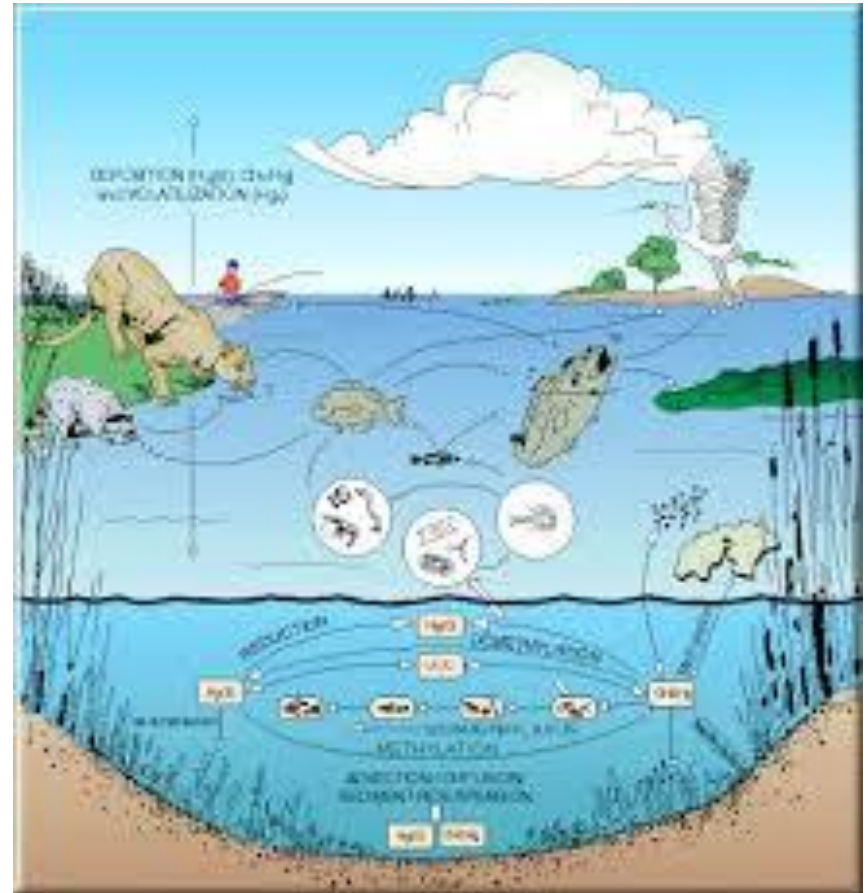
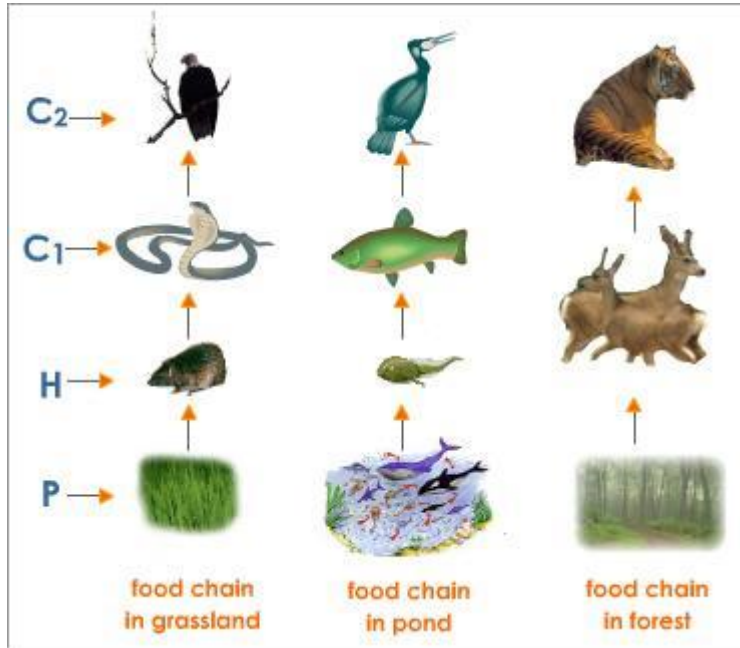
# AQUATIC ECOSYSTEM

- An ecosystem located inside a water body is called an aquatic ecosystem. There are two types of aquatic ecosystems.
- **Pond Ecosystem:** A shallow water body is called a pond. It is a good example of a small ,self sufficient and self regulating freshwater ecosystem.
- **Structure of Pond Ecosystem:**
- **Abiotic Components:** It includes organic and inorganic substances. The atmospheric gasses are also dissolved in water. Different minerals are found in dissolved state in the physical environment. Temperature, light ,pH of water and several basic organic and inorganic substances such as  $\text{CO}_2$ ,  $\text{O}_2$ ,  $\text{N}_2$ , Ca, S and carbohydrates constitute the abiotic components.

- **Biotic Components:** The biotic components of pond system are as follow:
- **Producers:** The producers in a pond ecosystem are the submerged, floating and emergent aquatic plants e.g. Nelumbo, Hydrilla, Chara. These also include small, microscopic floating or suspended plants majority of which are algae.
- **Consumers:** These may be primary, secondary or tertiary depending upon their trophic positions e.g. Small fishes, beetles, mollusca, crustaceans.
- **Decomposers:** Decomposers chiefly include bacteria, actinomycetes, fungi etc. They play an important role in the return of minerals again to the medium of pond. They decompose the dead organic material in the aquatic medium.



# POND ECOSYSTEM



# OCEAN ECOSYSTEM

- Oceans cover approximately 70% of the earth's surface, therefore they form the largest of all the ecosystems. They are the large water bodies characterised by the high salinity of water (3.5%). The major ocean ecosystems are Atlantic, Pacific, Indian, Arctic and Antarctic oceans.
- **STRUCTURE OF OCEAN ECOSYSTEM:**
- **Abiotic Components:** In the marine environment most important abiotic factors which influence marine life are light, temperature, pressure, salinity, tides and currents.
- **Biotic Components:**
- **Producers:** Phytoplankton e.g. Diatoms, microscopic algae, seaweeds, red algae and brown algae etc constitute producers.
- **Consumers:** The consumers in an ocean ecosystem are mainly crustaceans, molluscs and small and big fishes
- **Decomposers:** Bacteria and fungi.

