

Introduction to Ecology

- The meaning of the word ecology was given by German Biologist Hackle in 1869.
- The word ecology is derived from Greek words 'Oikos' meaning *house, habitat* or *place of living* and 'Logos' meaning *to study*.
- *Ecology* is defined as the study of interrelationship of different organisms with each other and with their environment. It is concerned with the general principles that apply to both animals and plants.



Objectives of Ecological Studies

- It is important for humanity to understand its environment because we have the ability to modify the environment through the use of technology, and through overexploitation of natural resources as a result of greed or sheer pressure of numbers. Therefore, ecology is more than just the understanding of the interrelationships between organisms and their environment; it also has social, political, economic and technological dimensions.
- It also is a study of evolutionary development of organisms, the biological productivity and energy flow in the natural system.
- To develop mathematical models to relate interaction of parameters and to predict the effects

Classification of Ecology

- **Based on study area :**

1. Autecology : It deals with the study of an individual species of organisms and it's population. The ecologists study the behavior and adaptations of particular species to the environmental condition at every stage of that individual's life cycle. It is also called the Species ecology.
2. Synecology : It deals with the study of communities, their composition, their behavior and relation with the environment. It is also called as Ecology of communities. It is further divided into 3 types :
 - 1) Population Ecology
 - 2) Community Ecology
 - 3) Ecosystem Ecology

Classification of Ecology

2. Based on Environment or habitat

1) **Aquatic ecology** : The study of interaction of organisms in the water

1) Marine water ecology

- i) Ocean
- ii) Deep Sea
- iii) Estuary

2) Freshwater Ecology

- i) Lentic (Running water)
 - a) River
 - b) Stream
 - c) Spring
- ii) Lentic (Standing Water)
 - a) Pond
 - b) Lake



Fresh water river



Coral reefs

Classification of Ecology

2) **Terrestrial Ecology** : The study of interaction of organisms on land :

- a. Grassland Ecology
- b. Forest Ecology
- c. Desert Ecology

3. **Based on Advancement in the field of ecology**

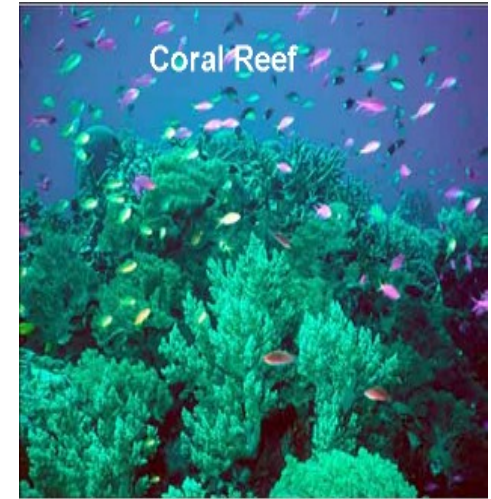
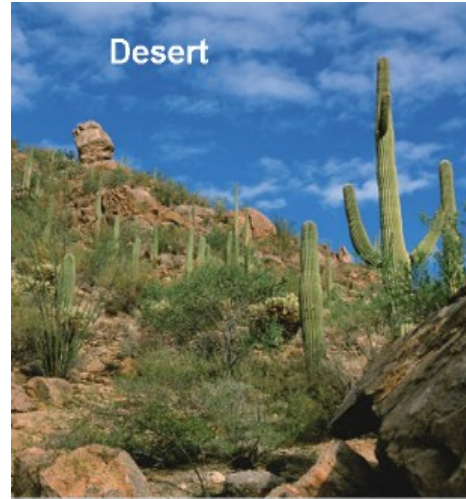
- a. Productive ecology
- b. Population ecology
- c. Community ecology
- d. Ecosystem ecology
- e. Microbial ecology
- f. Radiation ecology
- g. Pollution ecology
- h. Space ecology



Forest Ecology

Ecosystem

- The term Ecosystem was first proposed by A.G. Tansley in 1935. he defined it as “the system resulting from the interaction of all the living and non living factors of the Environment.
- An ecosystem consists of the biological community that occurs in some locale, and the physical and chemical factors that make up its non-living or abiotic environment. There are many examples of ecosystems - a pond, a forest, an estuary, a grassland.



Various types of Ecosystem

Types of Ecosystem

1. **Natural Ecosystems** : These operate under natural conditions without any major interference by man.
 - i. **Terrestrial Ecosystem** :
Forest, grassland, desert, etc.
 - ii. **Aquatic Ecosystem** :
 - a. **Fresh water** : Lotic (running water like spring, stream, or rivers) or Lentic (standing water as lake, pond, pools, etc.)
 - b. **Marine water** : Such as deep bodies as ocean or shallow ones as Sea or an estuary.



Lentic (standing water)
lake ecosystem



Lotic (flowing water) river ecosystem

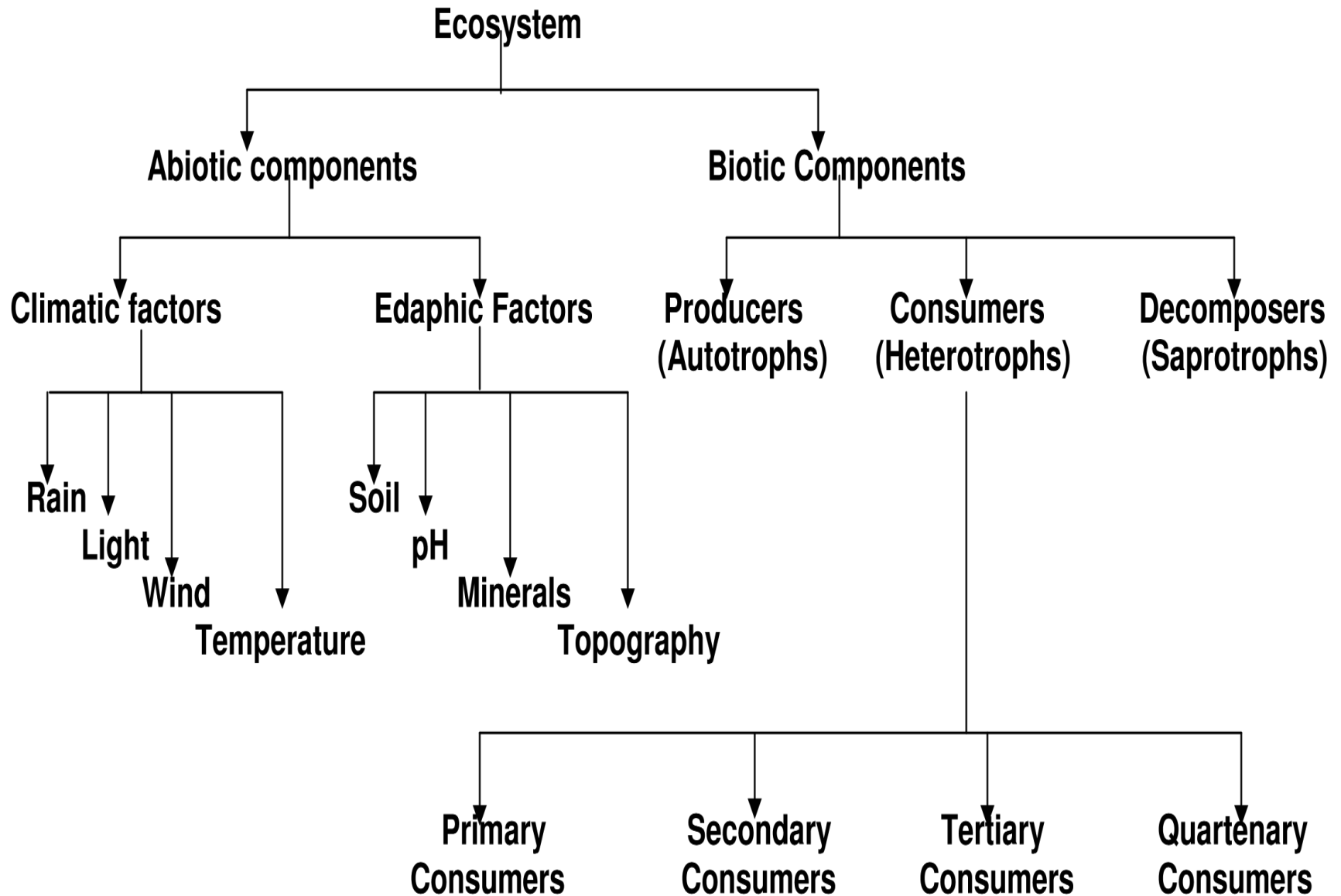
Types of Ecosystem

2. **Artificial (Man Engineered) Ecosystems** : These are maintained artificially by man where by addition of energy and planned manipulation, natural balance is disturbed regularly e.g., crop land ecosystem.



Crop land ecosystem

Components of Ecosystem



Components of Ecosystem

1. Abiotic

- Consists of Non-living chemical & physical components such as water, air, nutrients in the soil or water & Solar Energy.
- Physical & chemical factors that influence living organisms in land (terrestrial) ecosystem & aquatic life zones.
- Abiotic factors can act as LIMITING FACTORS that keep a population at a certain level.

Abiotic Components are mainly of two types:

1) Climatic Factors:

which include rain, temperature, light, wind, etc.

2) Edaphic Factors:

which include soil, pH, Topography, Minerals, etc.

Components of Ecosystem

2. Biotic factors

- All the living things that directly or indirectly affect the ecosystem biotic factors interact with other living organisms and the physical environment can also be *Limiting Factors* ex. disease (bacteria), predators, food resources.
- Made up of biological components consisting of living and dead plants, animals and microorganisms.
- The Major Biological Components of Ecosystem :
 - a. Producers (Autotrophs)(self-feeders)**
 - Make their own food from compounds that are obtained from their environment.
 - Are the source of all food in an ecosystem.
 - On land most producers are green plants.
 - In freshwater and marine ecosystems, algae and plants are the major producers near shorelines.
 - In open water, the dominant producers are **phytoplankton** (most of them microscopic) that float or drift in the water.
 - Most producers capture sunlight to make carbohydrates (such as glucose) by **photosynthesis** .

Components of Ecosystem

b. **Consumers (Heterotrophs)** (“other feeders”)

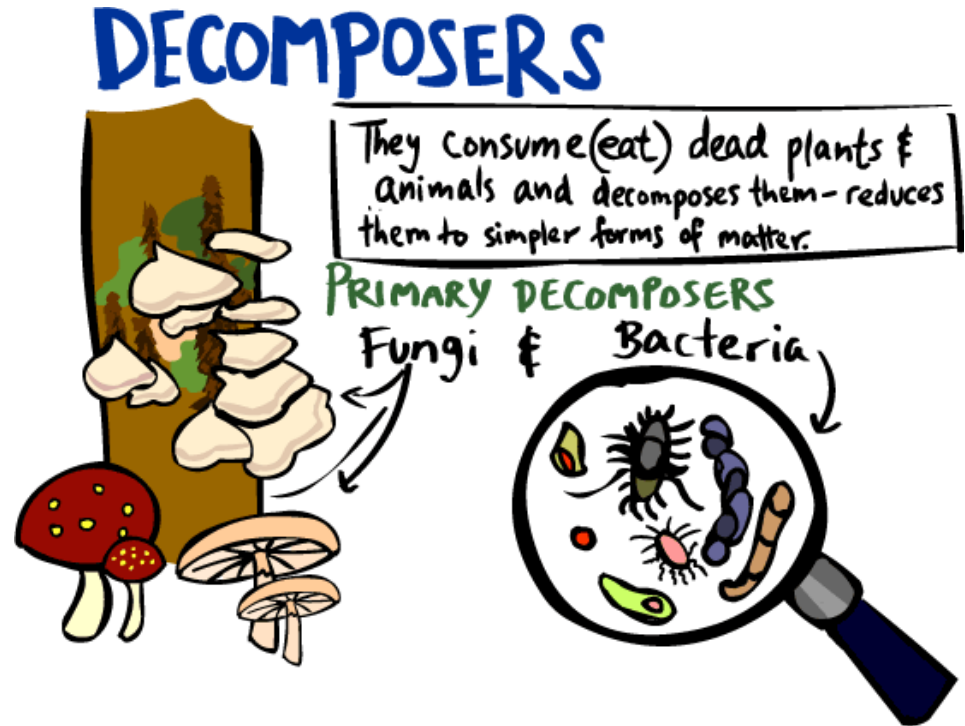
Get their energy and nutrients by feeding on other organisms or their remains.

- i. **Primary consumers** : Are those that eat producers (plants) as a source of food. They are also known as **herbivores**.
- ii. **Secondary consumers or carnivores** : Eat other animals.
- iii. **Tertiary Consumers** : Large Carnivores which feed on **secondary consumers**.
- iv. **Quaternary Consumers** : Largest Carnivores that feed on tertiary consumers. They are not eaten by any animals.
- v. **Omnivores** : Have mixed diet that include both plants and animals.

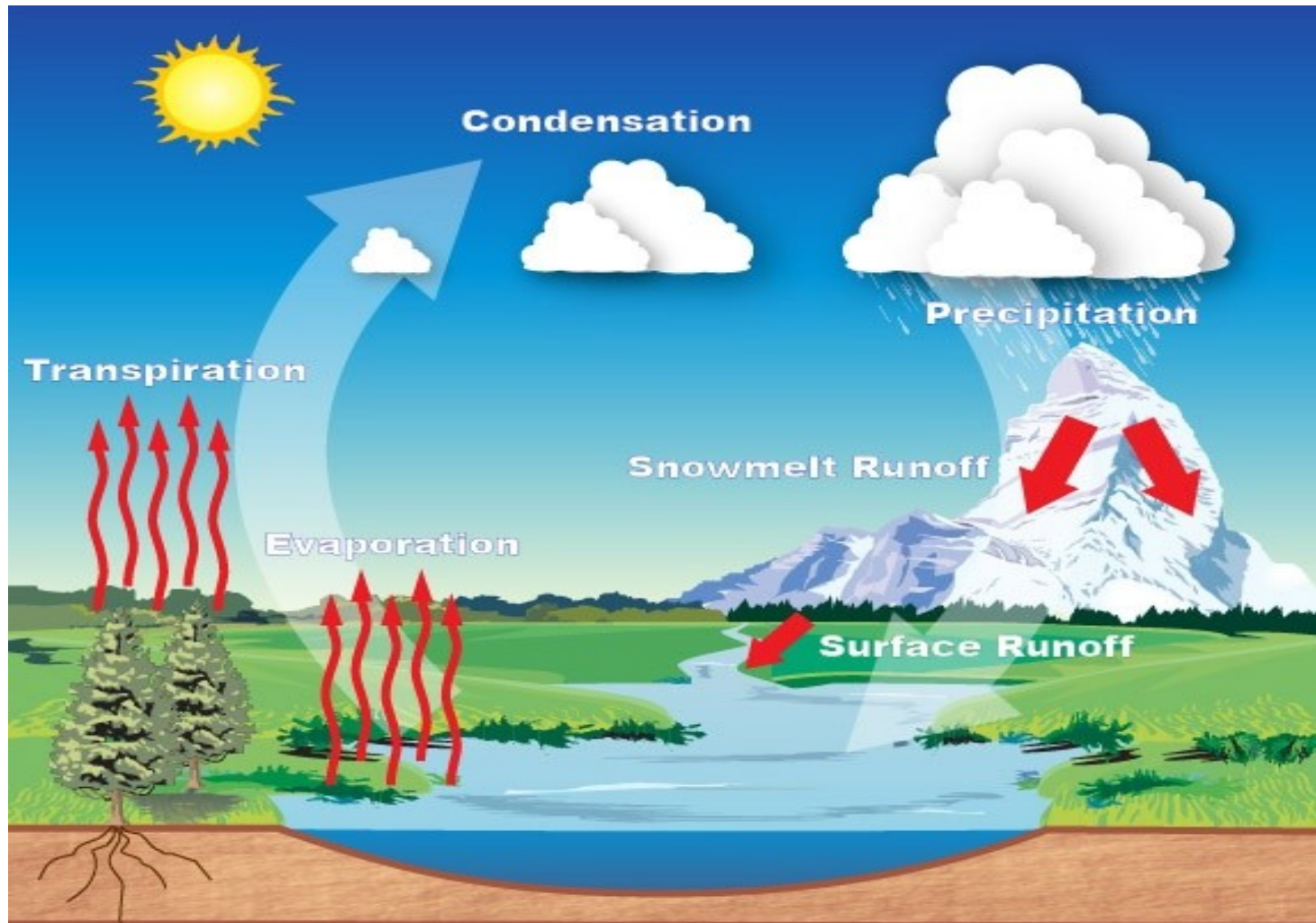
Components of Ecosystem

3. Decomposer :

- Mostly certain types of bacteria and fungi are specialized consumers that recycle organic matter in ecosystems.
- They do this by breaking down (biodegrading) dead organic material to get nutrients and releasing the resulting simpler inorganic compounds into the soil and water, where they can be taken up as nutrients by producers.



HYDROLOGICAL CYCLE

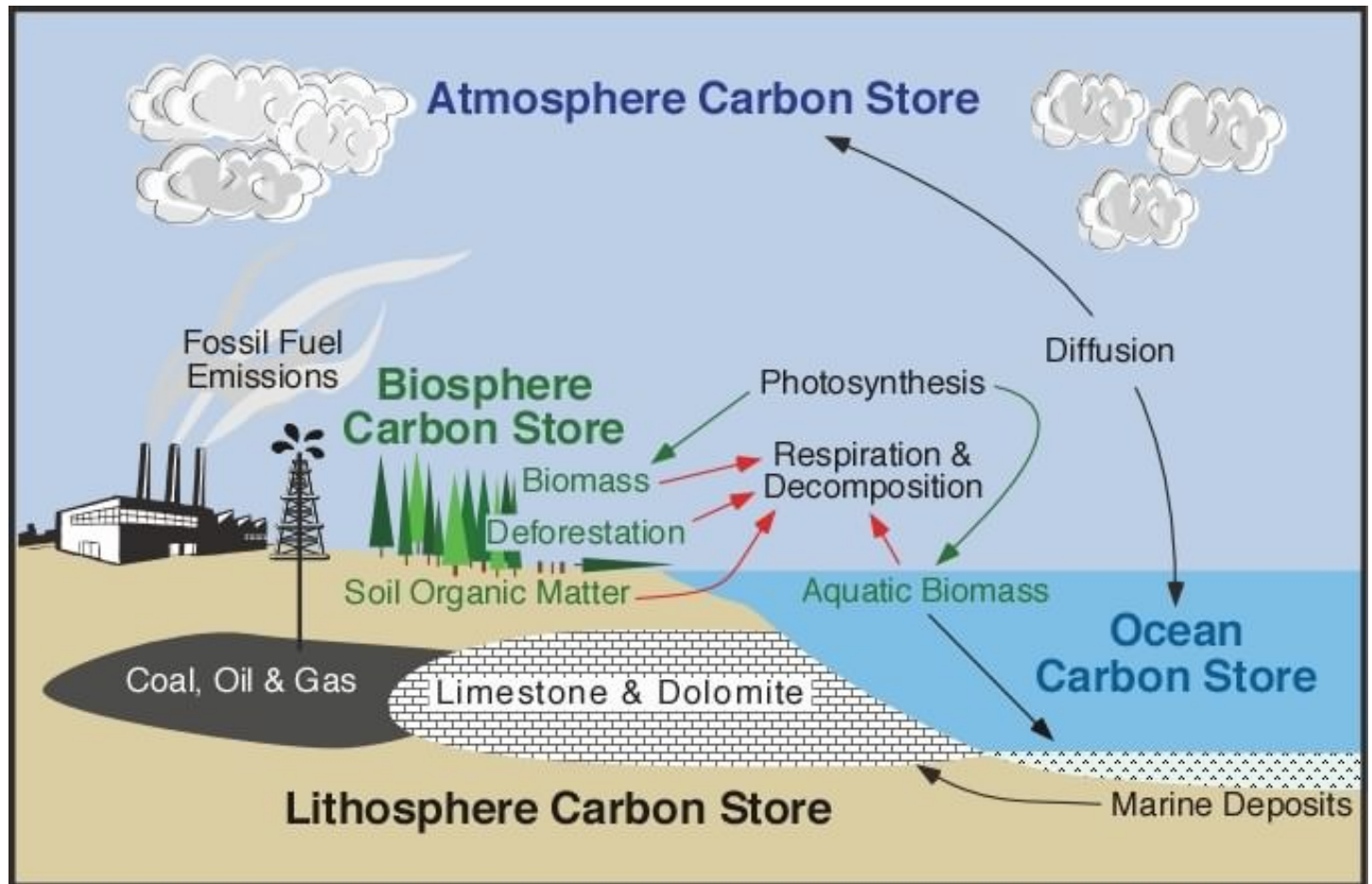


Definition & Description

- Definition : The water from various moist surface evaporates and falls again on the earth in the form of rains and snow and passes through living organisms and ultimately returns to the ocean or water bodies. This cycle is called as hydrological cycle.
- Description : The hydrologic cycle involves the continuous circulation of water in the Earth-Atmosphere system. At its core, the water cycle is the motion of the water from the ground to the atmosphere and back again. Of the many processes involved in the hydrologic cycle, the most important are...
- Evaporation
- Transpiration
- Condensation
- Precipitation
- Infiltration
- Run-off

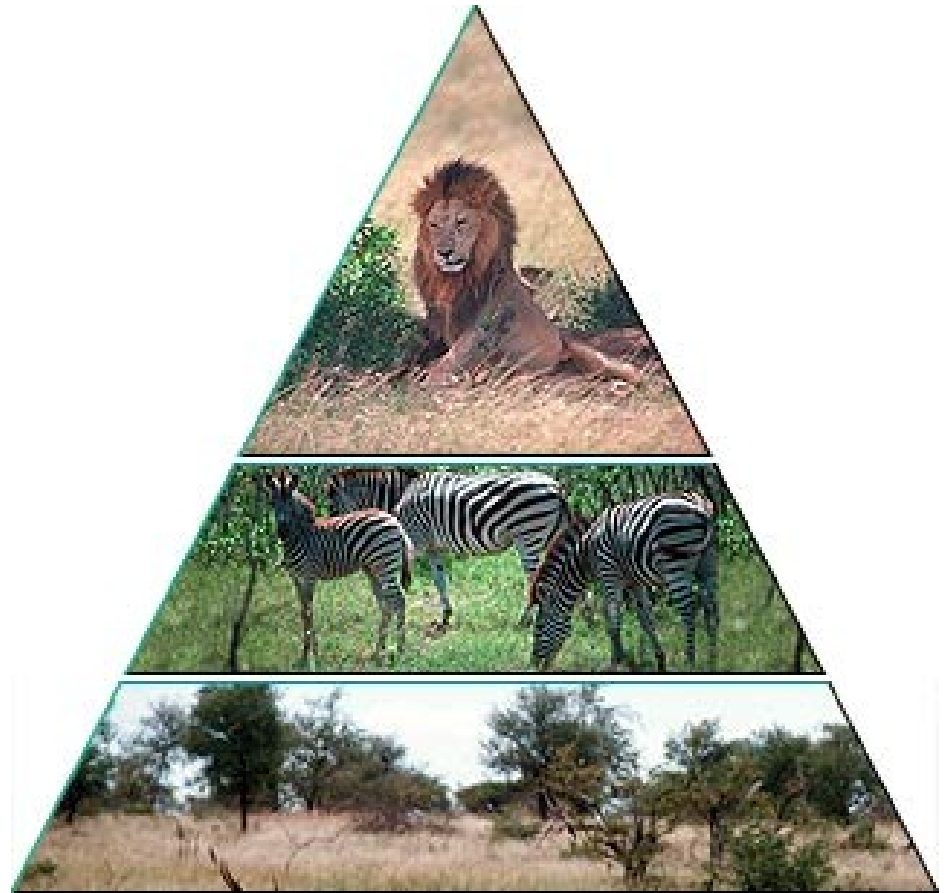
Carbon Cycle

- The **carbon cycle** is the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth.



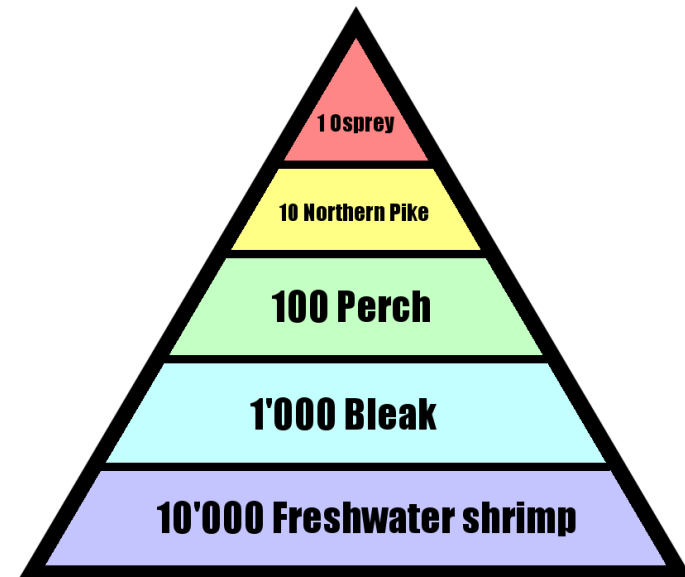
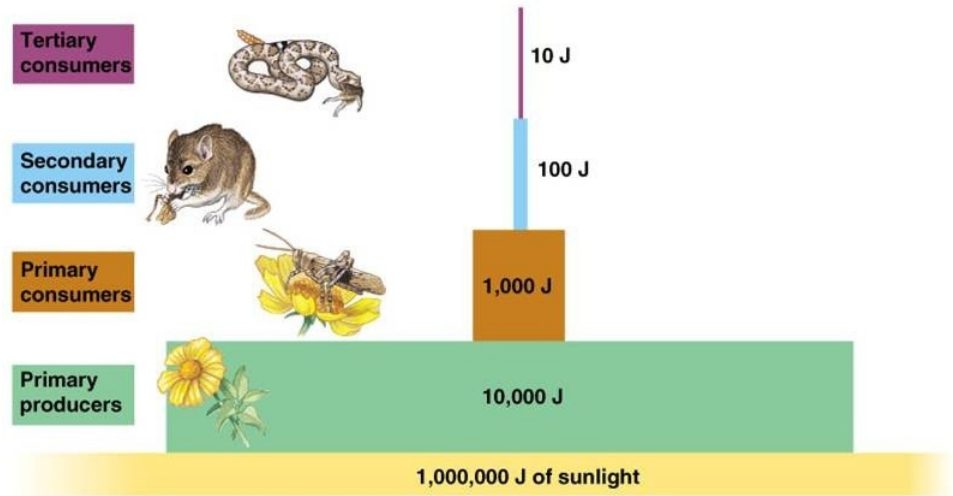
Ecological Pyramids

- Graphic representation of trophic structure & functioning of ecosystem starting with producers at the base & successive trophic levels forming the apex



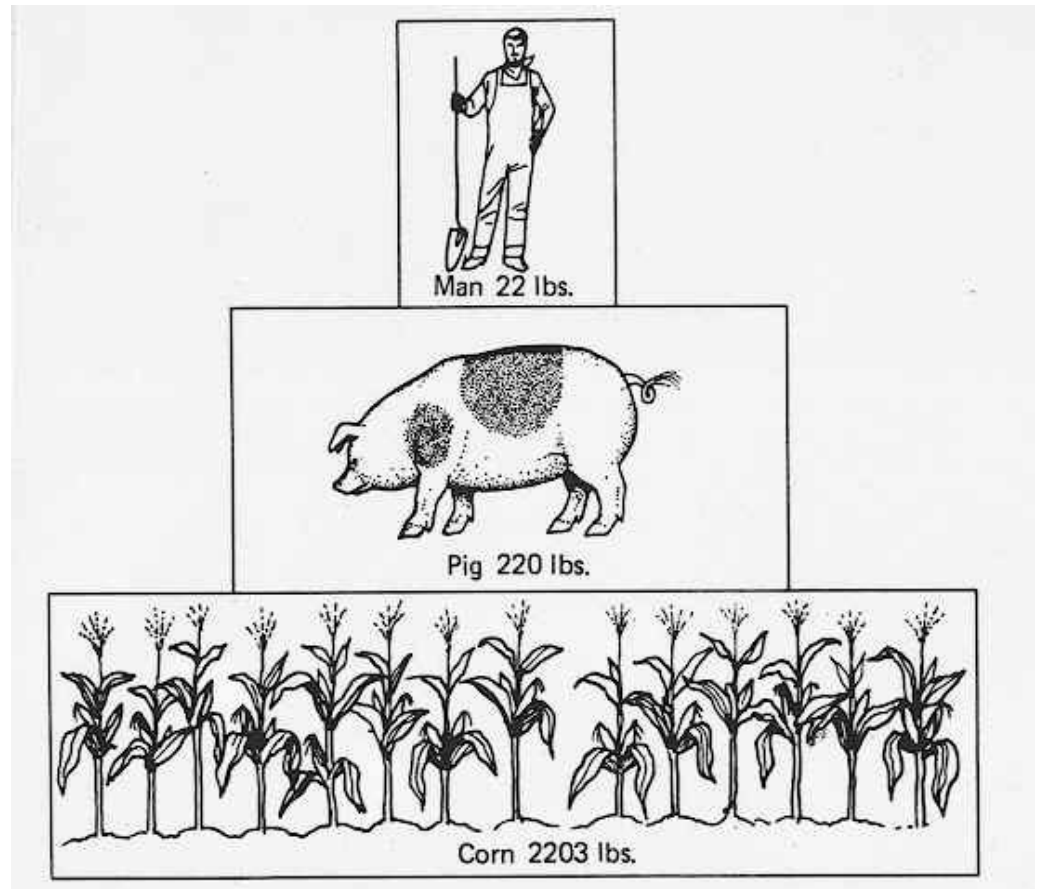
Pyramid Of Numbers:

- A pyramid of numbers is a graphical representation of the numbers of individuals in each population in a food chain. Often it is drawn from the autotrophic level up. A pyramid of numbers can be used to examine how the population of a certain species affects another. Often, the autotrophic level in a pyramid of numbers is much larger than any of the higher trophic levels, and the numbers decreases upon ascending the pyramid. There are exceptions, however. For example, in a tree community, a single tree could support many different populations of larger numbers.



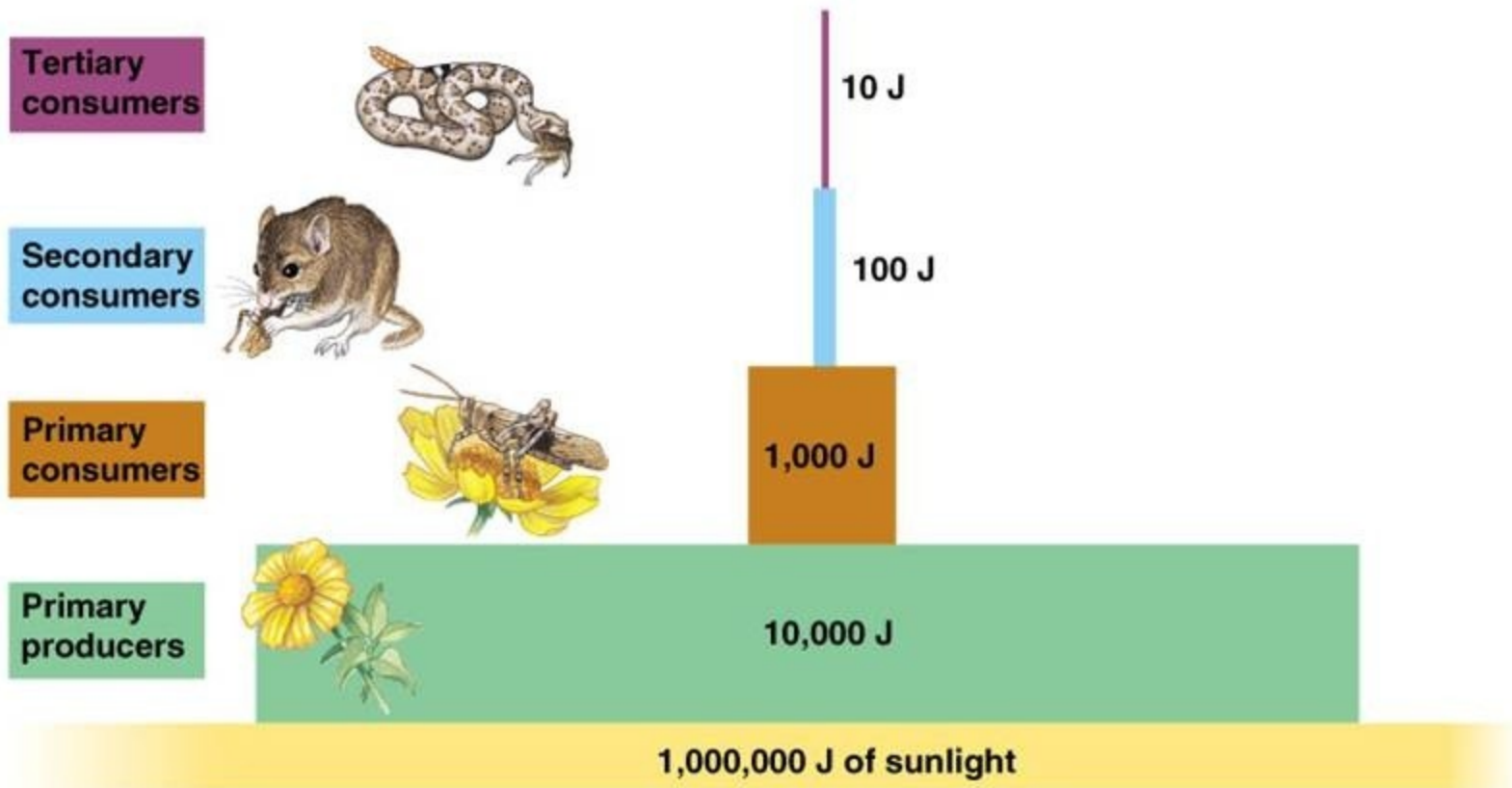
Pyramid of Biomass:

- Illustrates the amount of biomass in each trophic level
 - Biomass weight is determined after dehydration
- Shows the amount of matter lost between trophic levels.
- Measured in Kg, grams or pounds



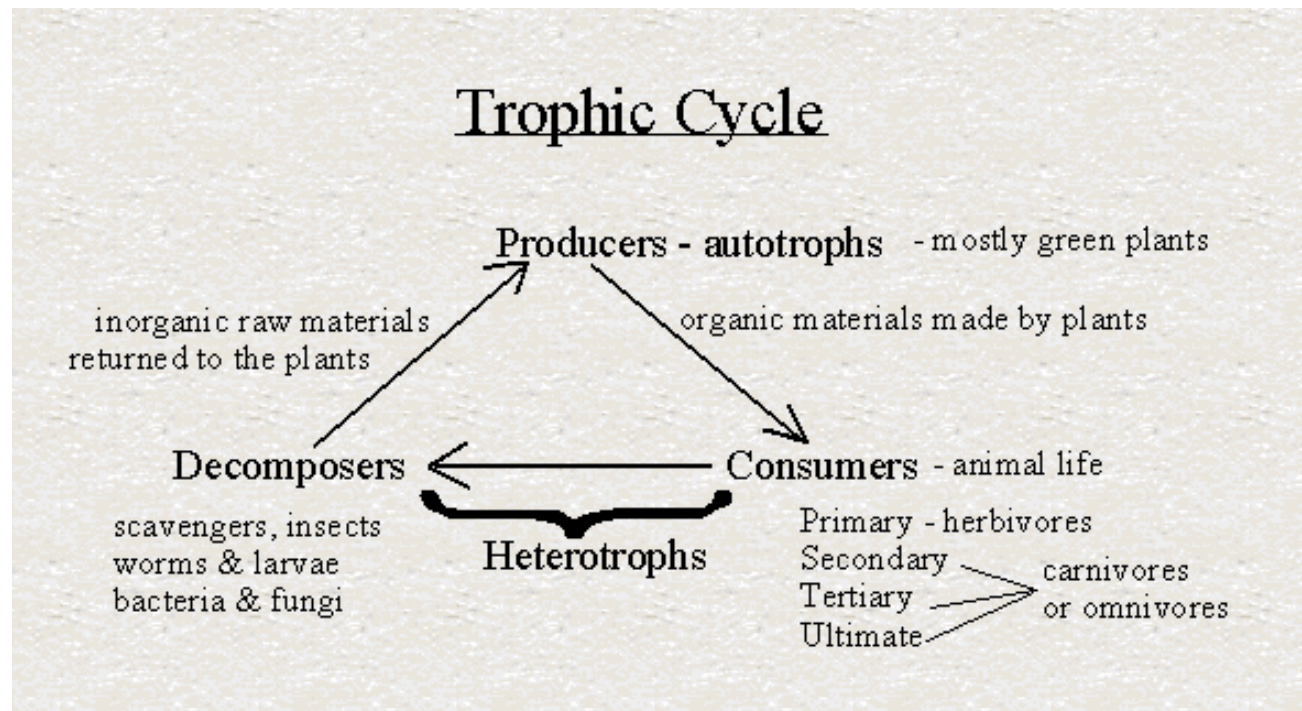
Pyramid of Energy:

- Shows the energy available at each trophic level.
 - The size of the blocks represents the proportion of productivity
 - Measured in Joules or Calories



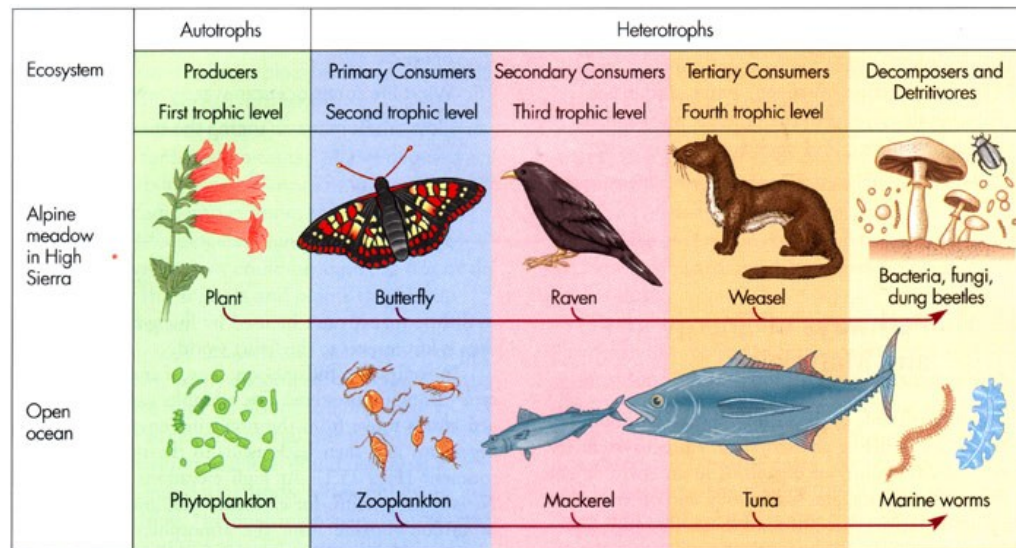
Trophic Structure

- All organisms in an ecosystem can be placed in trophic levels depending on what energy source they rely upon and how they provide energy for other organisms in the food web. With the exception of life near hydrothermal vents in the deep ocean, life is always dependent directly or indirectly on the energy from the sun. In every ecosystem, there is an organism at the lowest level that converts energy from the sun into useable energy for other organisms.



Food Chain

- Every organism needs to obtain energy in order to live. For example, plants get energy from the sun, some animals eat plants, and some animals eat other animals.
- A food chain is the sequence of who eats whom in a biological community (an ecosystem) to obtain nutrition

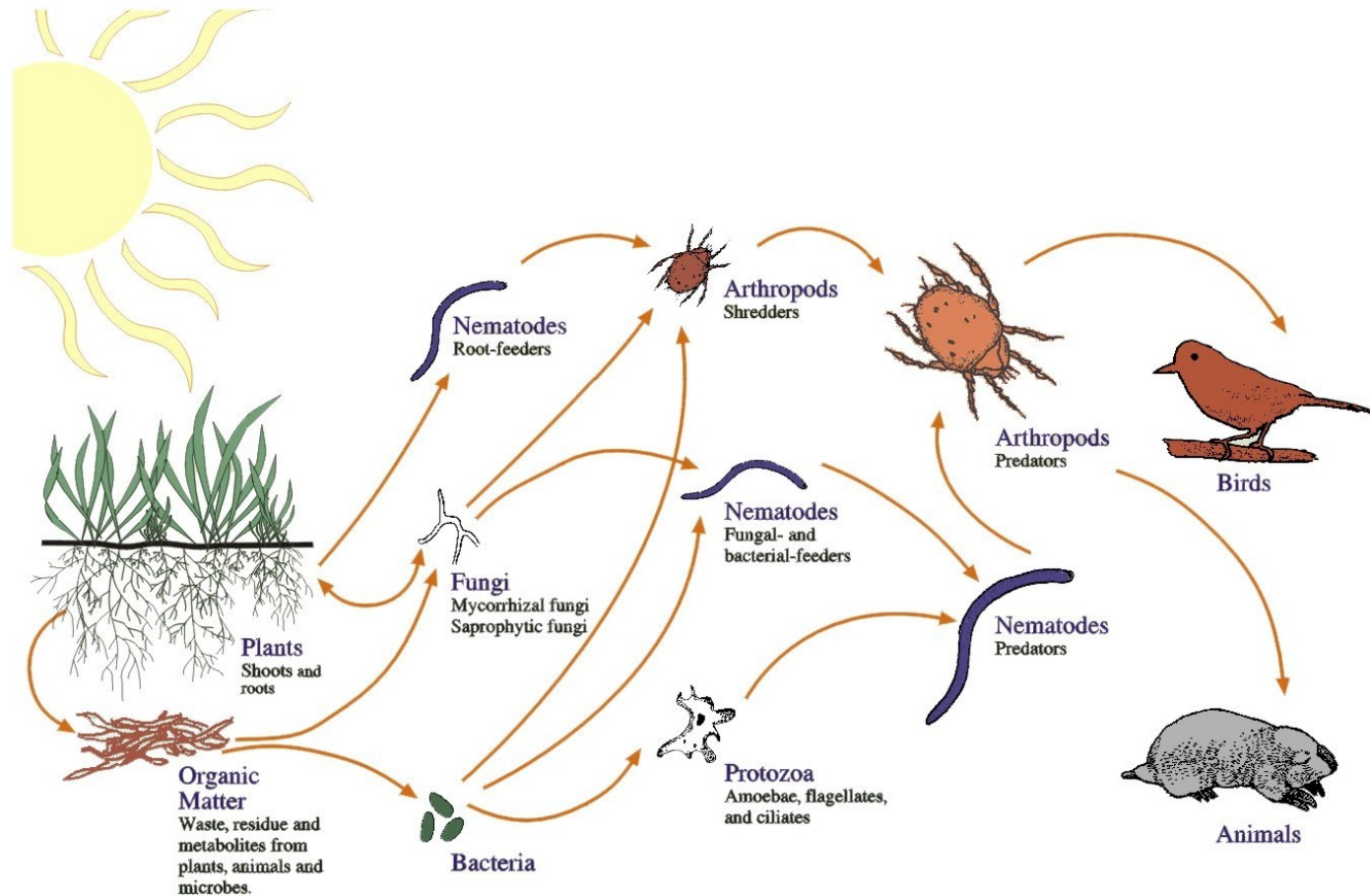


Food Web

- A **food web** (or **food cycle**) depicts feeding connections (what-eats-what) in an ecological community and hence is also referred to as a consumer-resource system.
- The food web is a simplified illustration of the various methods of feeding that links an ecosystem into a unified system of exchange.
- Various food chains are often interlinked at different trophic levels to form a complex interaction between different species from the point of view of food.
- Food Web provides more than one alternatives of food to most of the organisms in an ecosystem and thus increases their chances of survival.

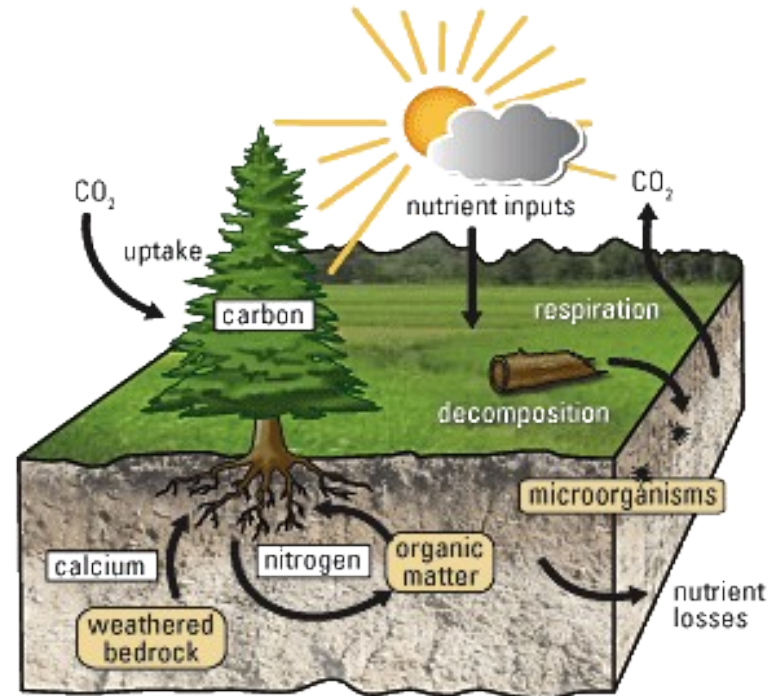
Food Web

- Example : Food Web of organisms residing in the soil (Soil Ecosystem)



Forest Ecosystem

- They have a predominance of trees that are interspersed with large number of species of herbs, shrubs, climbers, lichens algae & a variety of wild animals & birds.
- Depending upon the climatic conditions forests can be of different types :
 1. Tropical Rain Forest
 2. Tropical Deciduous forests
 3. Tropical Scrub Forests
 4. Temperate Rain Forests
 5. Temperate Deciduous Forests
 6. Evergreen Coniferous Forests



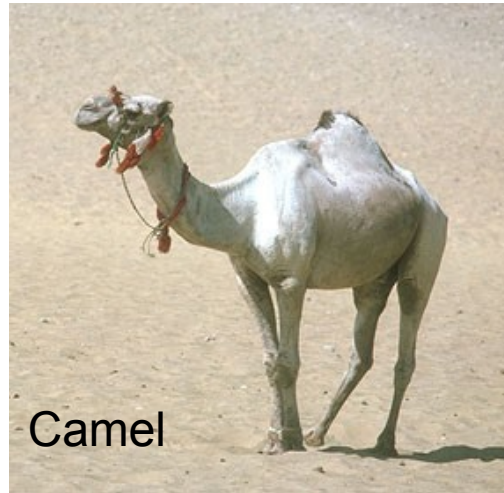
Desert – an ecosystem found where there is very little rainfall.

- They occur in regions where evaporation exceeds precipitation (rainfall, snow, etc.)
- Mainly two kinds of deserts:
 - Hot deserts
 - Cold deserts
- Hot deserts
 - Temperatures are very warm all year round
 - The summers are very hot
- Cold deserts
 - Short, warm summers
 - Long, cold winters
 - Found in places near the north and south poles

Desert Plants

Main Components :

1. Desert Plants
2. Desert Animals



Camel

Gila monster (lizard)

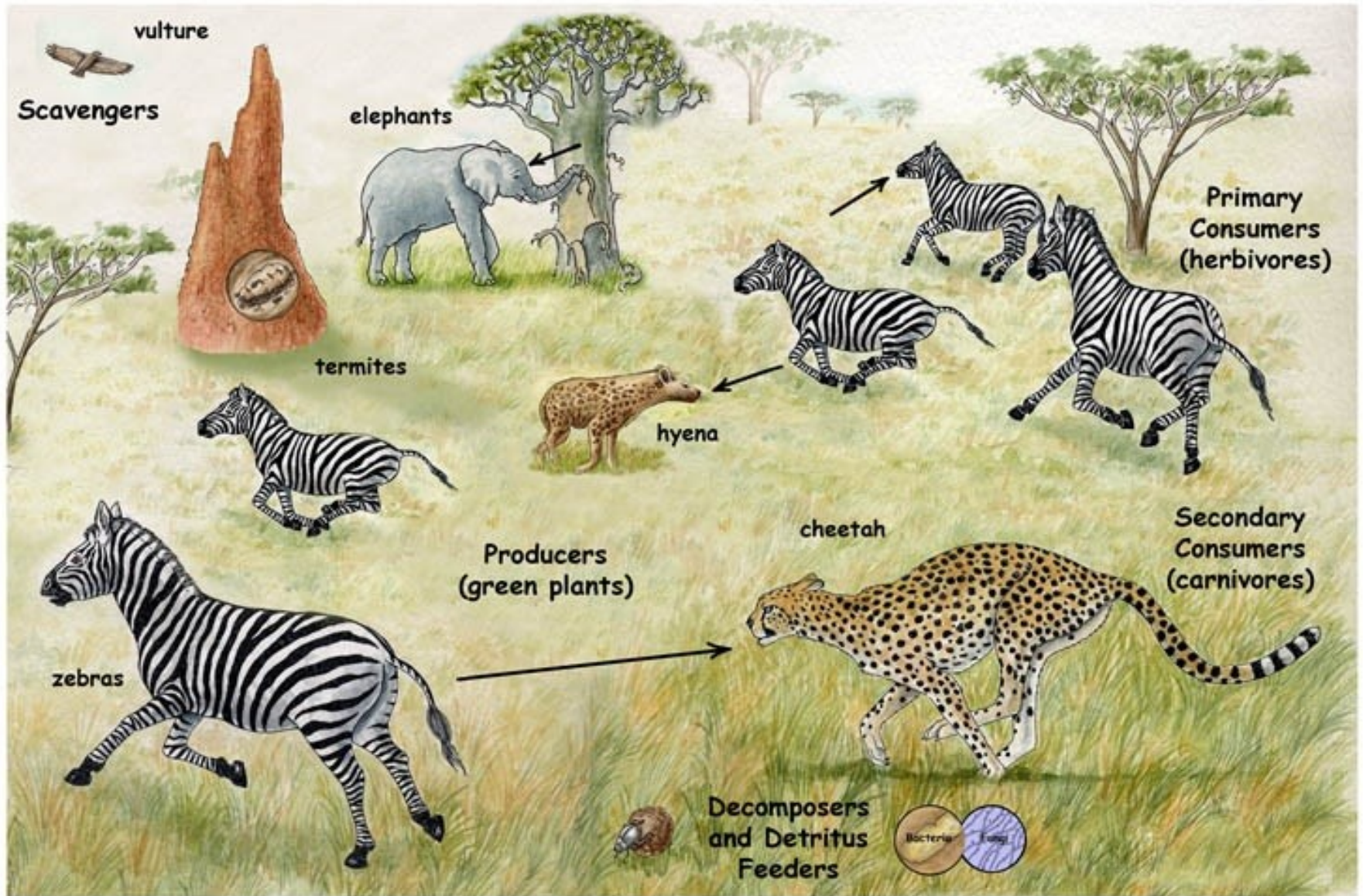


Roadrunner

Grass Land Ecosystem

- A grassland ecosystem is an ecological unit that has physical factors like water, soil and air, which help to establish that animals live there. The plants, animals, microbes along with the water, soil and air they live in help to create the ecosystem.
- About 1.2×10^8 mi² (4.6×10^7 km²) of the Earth's surface is covered with grasslands, which make up about 32% of the plant cover of the world.
- Grasslands occur in regions that are too dry for forests but that have sufficient soil water to support a closed herbaceous plant canopy that is lacking in deserts.
- Different kinds of grasslands develop within continents, and their classification is based on similarity of dominant vegetation, presence or absence of specific dominant species, or prevailing climate conditions.
 1. Temperate grasslands
 2. Tropical grasslands
 3. Polar grasslands
- Grassland Soils are highly fertile & contain large amount of exchangeable bases & organic matter.

Grassland Food Web



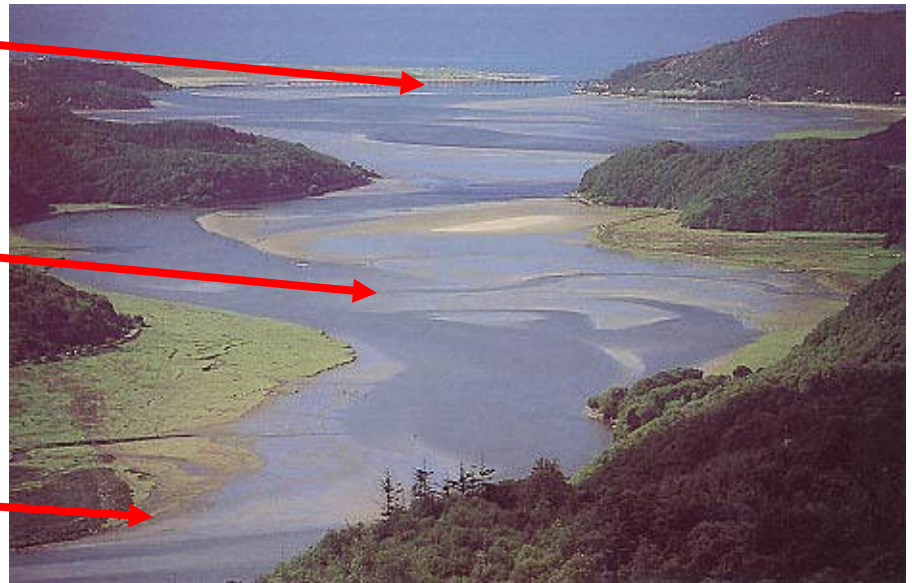
Estuaries

- An estuary is a semi closed coastal body of water that has free connection with sea.
- An area in which fresh water from a river mixes with salt water from the ocean; a transition area from the land to the ocean. Other names: bay, sound, lagoon, harbor, or bayou

The Ocean

Area where
fresh and salt
water mix

River bringing
freshwater to
the sea



Characteristics of Estuaries

- Very nutrient rich ecosystems → leads to high productivity and high biodiversity.
- There is a gradual increase in salinity as you go from the river (0-5ppt) to the middle of the estuary (5-25ppt), to the ocean (>25 ppt) .
ppt = parts per thousand
- Sediment settles out in the estuary when the water slows down.
- Nutrients accumulates on the bottom (benthic zone).
- Pollutants are absorbed in estuaries.

Aquatic Ecosystem

- An **aquatic ecosystem** is an ecosystem in a body of water. Communities of organisms that are dependent on each other and on their environment live in aquatic ecosystems
- Aquatic Ecosystem can be further classified into :
 1. Fresh water Ecosystem
 - Pond Ecosystem : small bodies of freshwater with shallow and still water, marsh, and aquatic plants
 - Lake Ecosystem : slow moving water like pools, ponds, and lakes.
 - River Ecosystem : large streams flowing downwards from the mountain highlands into the sea
 2. Marine Ecosystem : cover approximately 71% of the Earth's surface and contain approximately 97% of the planet's water

Aquatic Ecosystem

- Detailed information about aquatic system

