

ECOSYSTEM



Concept of Ecosystem



- ❧ There are many supporting systems like Forests, oceans, grasslands, deserts which have structural components and functions.
- ❧ They all have living organisms interacting with their surroundings exchanging matter and energy.
- ❧ The word Ecology was coined by Earnest Haeckel in 1869 from Greek Words:
Oikos (Home) + Logos(study)
- ❧ So ecology is study of organisms in their natural home interacting with the biotic and abiotic components (Surroundings)

What is Ecosystem???



- ❧ An Ecosystem is a self regulating group of biotic communities of species interacting with one another with their non-living environment exchanging energy and matter.
- ❧ Therefore Ecology can be termed as---
“Study Of Ecosystems”

Continue.....



- ❧ Ecosystem is a unit or a system which is composed of no. of sub-units
- ❧ They may exchange energy & matter from outside – is an Open Ecosystem; or isolated from outside in a closed one.
- ❧ The Closed ones are generally artificial. Eg. Biosphere2, in Oracle, Arizona
- ❧ Life on earth is sustained by the flow of energy from sun & cycling of nutrients

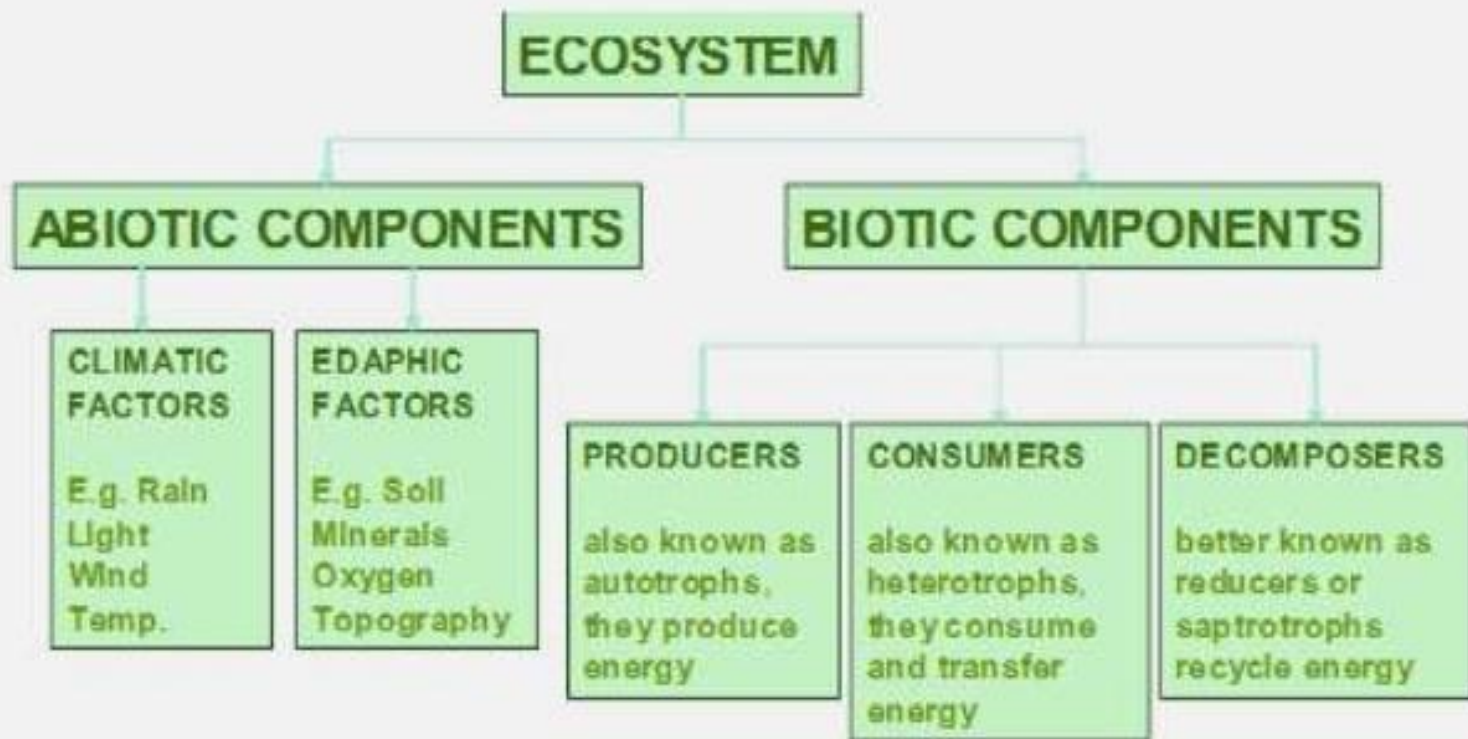
Characteristics of an Ecosystem



- ❧ Structure of ecosystem
 - ❧ Biotic Structure
 - ❧ Abiotic Structure
- ❧ Types of Ecosystems
- ❧ Functions of Ecosystem
 - ❧ Trophic Structure
 - ❧ Food Chains
 - ❧ Food Web
 - ❧ Ecological Pyramids
 - ❧ Energy Flow
 - ❧ Nutrient Flow
- ❧ Ecological Succession

Structure of Ecosystems

STRUCTURE OF AN ECOSYSTEM



Biotic Components



- A) Producers- they produce their own food either by process of Photosynthesis or by Chemical Process
 - ❧ Plants produce food by Photosynthesis(using sun, CO₂ and water) in presence of Chlorophyll. Thus they are also called as **Autotrophs**
 - ❧ There are some micro-organisms which produce organic matter to some extent by oxidation of certain chemicals in absence of sunlight. They are called as Chemosynthetic or **Chemotrophs**

Biotic Components



B) Consumers :All organisms which get their food by feeding on other organisms are called as Consumers

- ❧ Herbivores- Feed on producers (plant eaters)also called as Primary Consumers
- ❧ Carnivores- Feed on other consumers
 - ❧ If they feed on Herbivores- Secondary Consumers – eg frog
 - ❧ If they feed on Carnivores – tertiary Carnivores/ Consumers- eg. Snake, Big Fish
- ❧ Omnivores- They feed on plants and animals- Man, many birds, fox
- ❧ Detrivores- They feed on parts of dead organisms, wastes of living organisms. Also known as Saprotrophs or Detritus feeders

Biotic Components



C) Decomposers

They derive energy by breaking down complex organic matter to simpler once.

E.g. Bacteria & Fungi



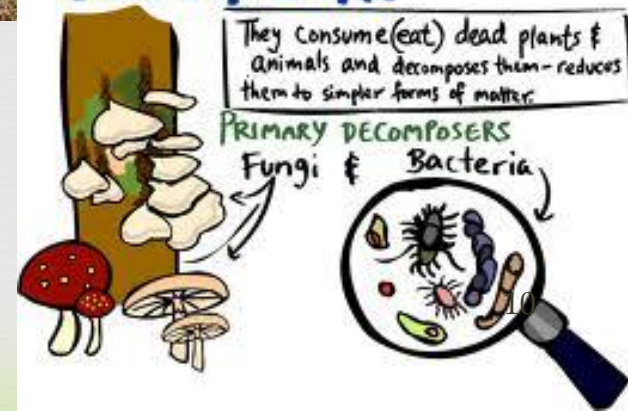


DECOMPOSERS

They consume (eat) dead plants & animals and decomposes them - reduces them to simpler forms of matter.

PRIMARY DECOMPOSERS

Fungi & Bacteria



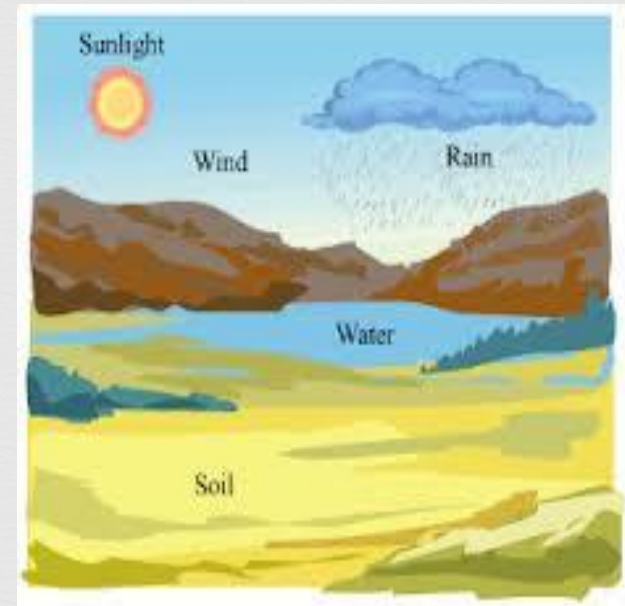
Abiotic Components



They include various physical, chemical & Geographical factors;

Physical Factors:

- ✧ The sunlight & shade
- ✧ Intensity of Solar flux
- ✧ Average Temperature
- ✧ Annual Rainfall
- ✧ Wind
- ✧ Soil type, availability of water,



We can clearly see the difference in solar flux, temp., rainfall pattern in desert , tropical & Tundra Ecosystem. While in grassland and forest they also vary as per geographical location

Abiotic Components



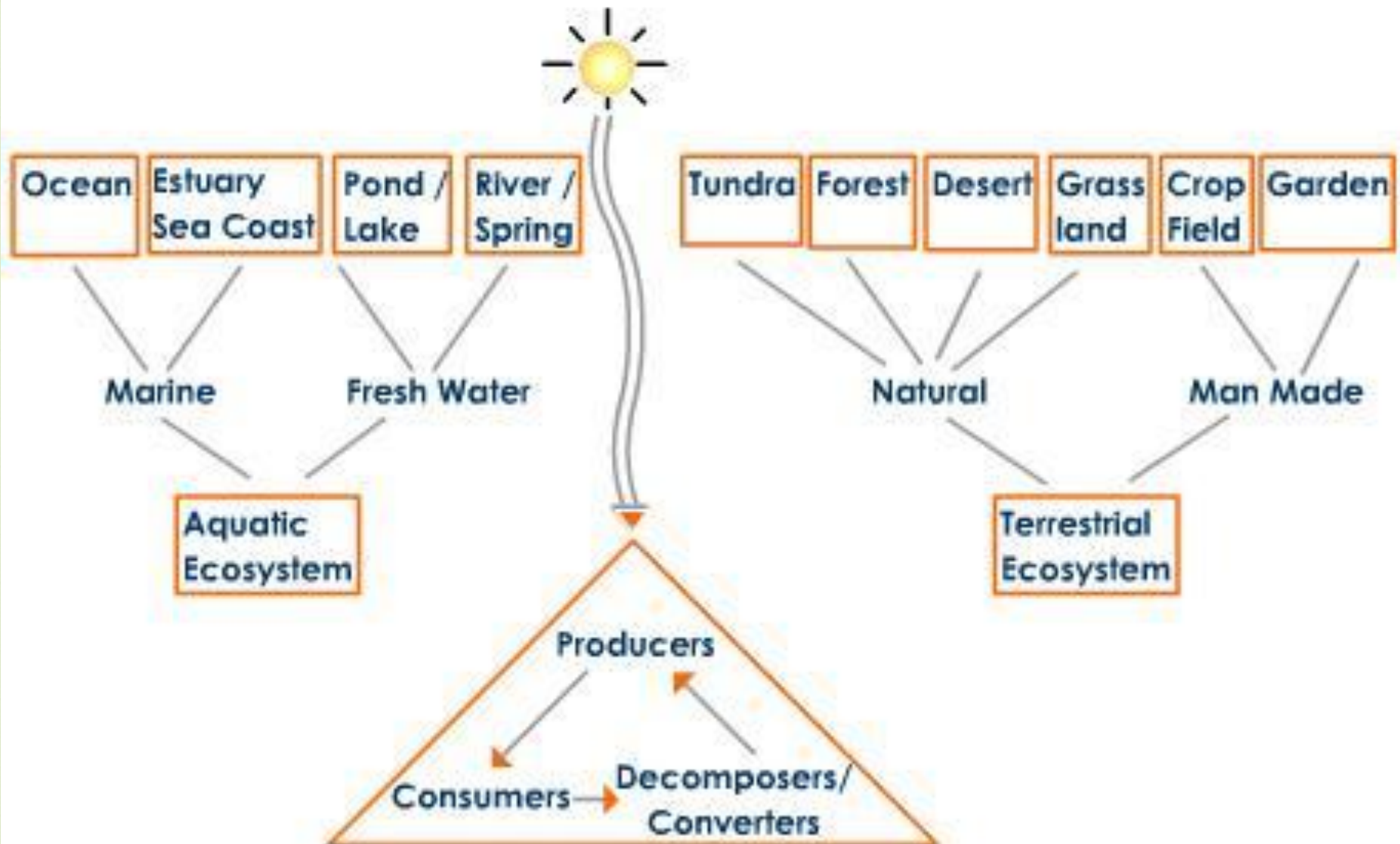
❧ Chemical Factors

- ❧ They include availability of nutrients like Nitrogen, Phosphorus, Carbon, Hydrogen, potassium, Oxygen, sulphur, levels of toxic substances, salts causing salinity influence the function of ecosystem.

❧ Geographical Factors

- ❧ Latitude, Longitude and altitude

Types of Ecosystem



Major Ecosystems



- ∞ Forest ecosystems
- ∞ Desert Ecosystems
- ∞ Grassland Ecosystems
- ∞ Aquatic Ecosystems

Forest Ecosystems



Forest Occupy roughly 40 % of the land.

The different components of forest ecosystem are as follows:



∞ Abiotic Components: These are organic & inorganic substances present in the soil and atmosphere. In addition to minerals present in forest we find the dead organic debris, moreover light condition are different due to complex stratification in the plants.

∞ Biotic Components:

∞ Producers: These are mainly trees that show much species and greater degree of stratification. Besides trees there are also present shrubs, and ground vegetation.

∞ Consumers: Primary Consumers: These are herbivores that include animals feeding on tree leaves, ants, beetles, grass hoppers, etc., and large elephants, deers, squirrels, etc.

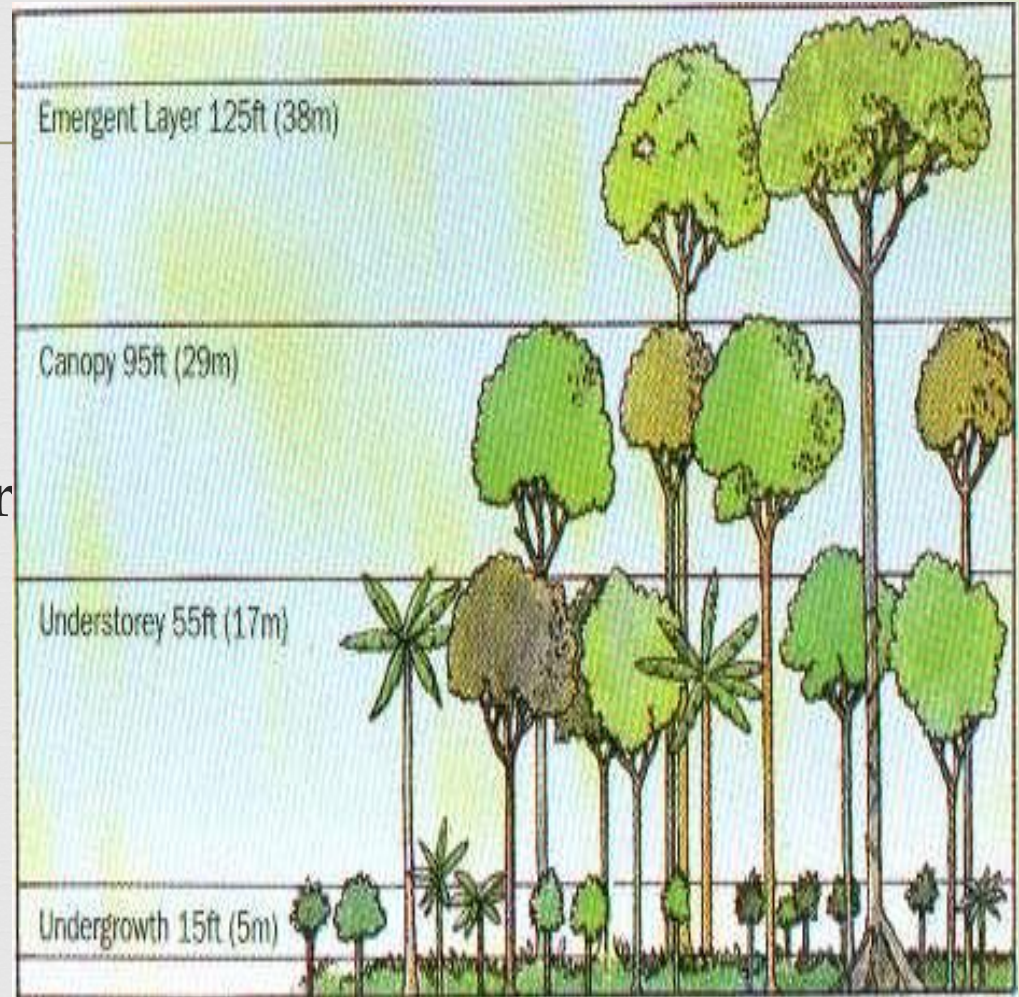
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- ❧ Secondary Consumers: These are carnivores, like snakes, birds, lizards, fox, etc. feeding on herbivores.
- ❧ Tertiary consumers: These are top carnivores like lion tiger, etc. that eat carnivores of secondary level.
- ❧ Decomposers: These are wide variety of micro organisms including, fungi, bacteria.
- ❧ Also present are epiphytes, lianas
- ❧ Extremely diverse and productive

Layered structure

- ❧ Emergent layer
- ❧ Canopy layer
- ❧ Under storey
- ❧ Shrub layer
- ❧ Ground layer or for floor



Desert Ecosystem



Desert occupy 17 % of land.

❧ Abiotic components include, light, temperature, minerals.



❧ Biotic Components:

❧ Producers : These are shrubs, especially bushes, some grasses, and few trees.

E.g. Cacti, Xerophytes, mosses

❧ Consumers: The most common animals are reptiles, and insects, there are some rodents, and birds, and above all ship of desert camels, feed on tender plants.

❧ Decomposers: These are very few as due to poor vegetation the amount of dead organic matter is less. They are some fungi and bacteria.

Types



☞ Tropical deserts: high heat, very dry

Eg : Sahara, Thar desert

☞ Temperate desert: day temperatures very hot in summer and nights very cool in winter

Eg: Mojave in Southern California

☞ Cold deserts: Cold winters and warm summers

Eg : Gobi desert in China

Grassland Ecosystem



Grassland occupy comparatively fewer area roughly 19 % of the earth's surface.

❧ Abiotic Components: These are nutrients present in soil, and aerial environment, thus the elements like, phosphates, sulphates, water, carbon dioxide, present in soil and in air. Moreover some trace elements are also present.

❧ Biotic Components:

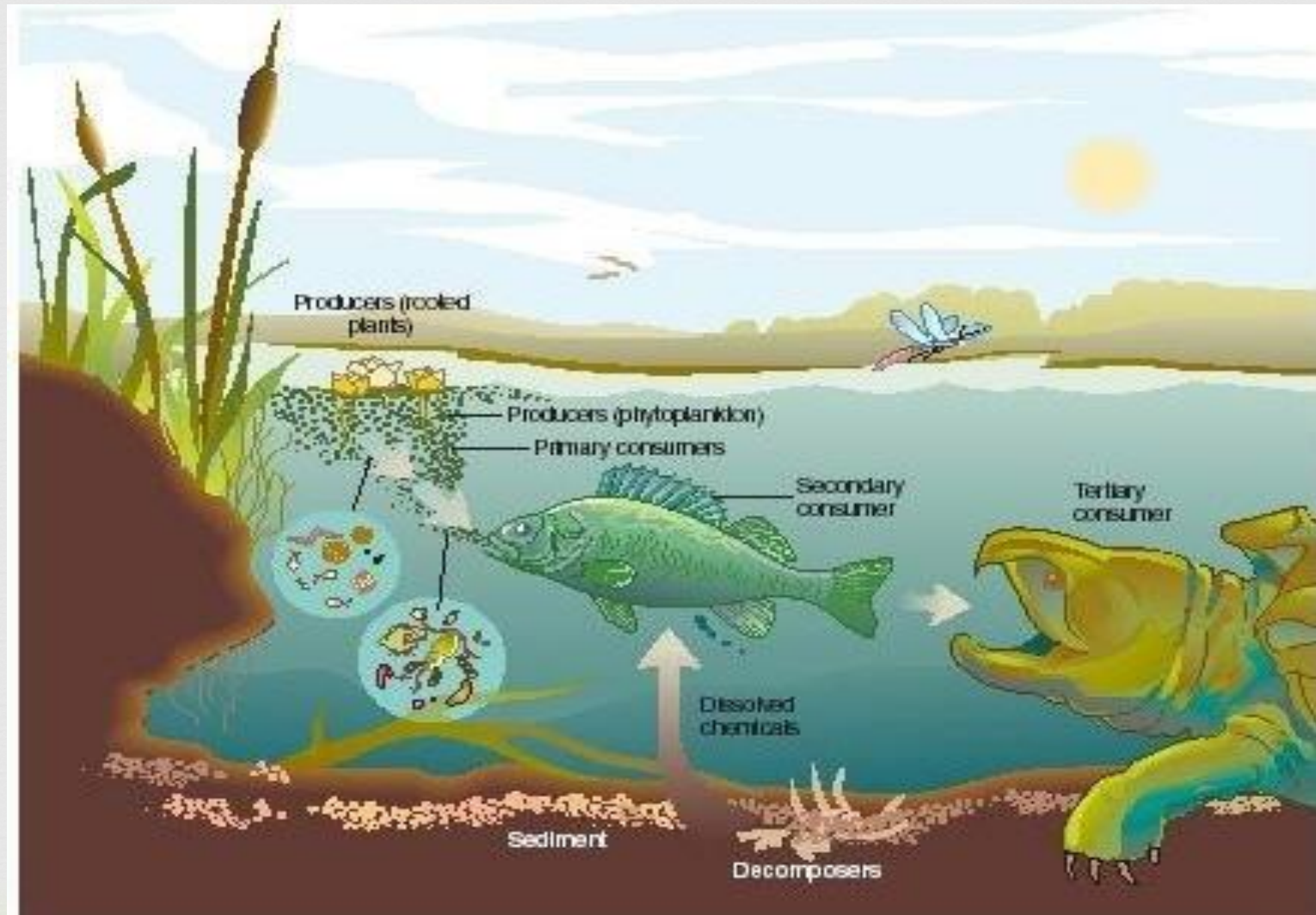
❧ Producers: They are mainly grasses as species of Cynadon, Desmodium, besides them a few shrubs also contribute some primary production.

❧ Consumers:



- ❧ Primary Consumers: The herbivores feeding on grasses are grazing animals, as cows, goats, rabbit, etc. besides them there are some insects as termites, millipedes that feed on grasses.
- ❧ Secondary Consumers: These are carnivores feeding on herbivores these include, animals like, fox, jackals, snakes, frogs, birds.
- ❧ Tertiary Consumers: Some times hawks, vultures, feeding on secondary consumer, thus occupy tertiary consumers.
- ❧ Decomposers: The microbes active in the decay of dead organic matter of different form are fungi and some bacteria

Aquatic ecosystems



Pond Ecosystem



Producers are of following type

- Macrophytes: these are large rooted plants, which include partly or completely submerged hydrophytes, e.g. : Hydrilla, Trapa, Typha.
- Phytoplankton: These are minute floating or submerged lower plants e.g.: algae.
- Consumers: They are heterotrophs which depends for their nutrition on the organic food manufactured by producers.

❧ Primary Consumers:

- ❧ Benthos: These are animals associated with living plants , detritivores and some other microorganisms
- ❧ Zooplanktons: These are chiefly rotifers, protozoans, they feed on phytoplankton

❧ Secondary Consumers: They are the Carnivores which feed on herbivores, these are chiefly insect and fish, most insects & water beetles, they feed on zooplanktons.

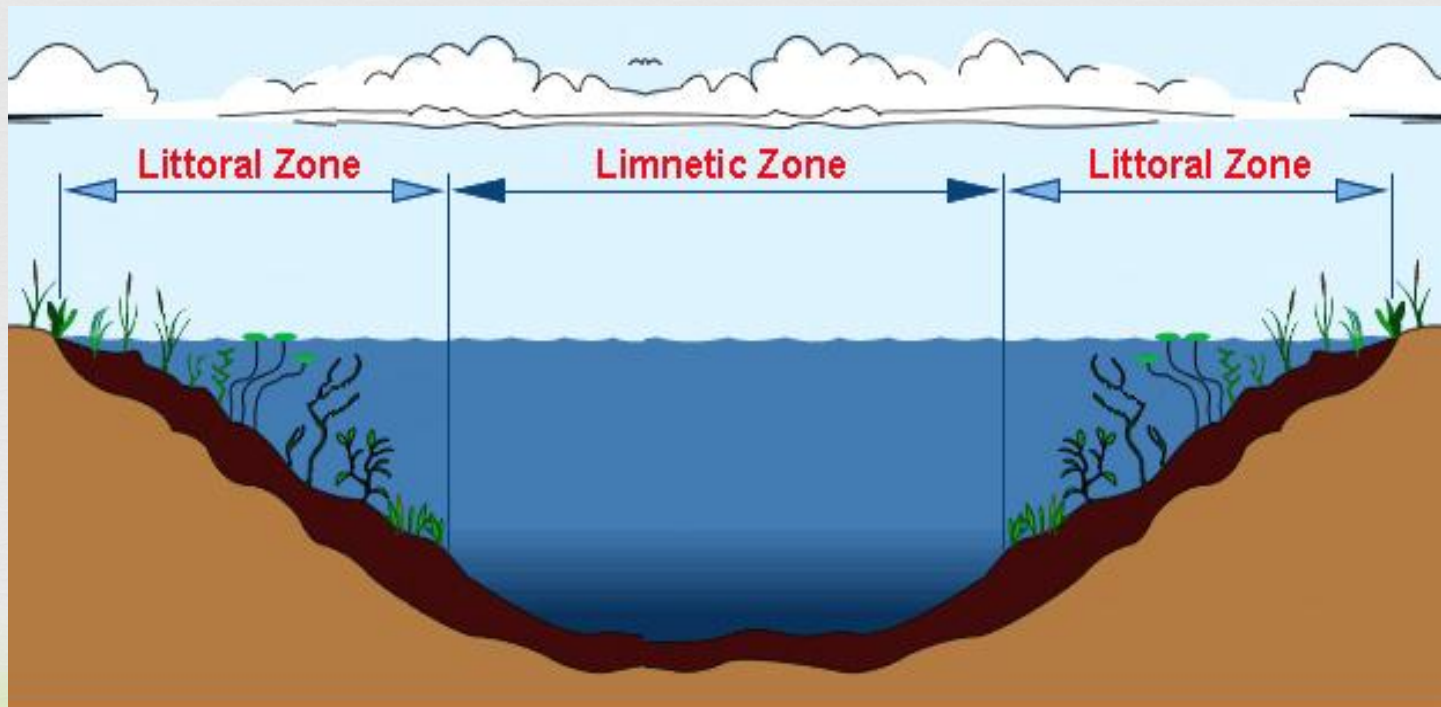
❧ Tertiary Consumers: These are some large fish as game fish, turtles, which feed on small fish and thus become tertiary consumers.

❧ Decomposers: They are also known as micro-consumers. They decompose dead organic matter of both producers and animal to simple form. Thus they play an important role in the return of minerals again to the pond ecosystem, they are chiefly bacteria, & fungi.

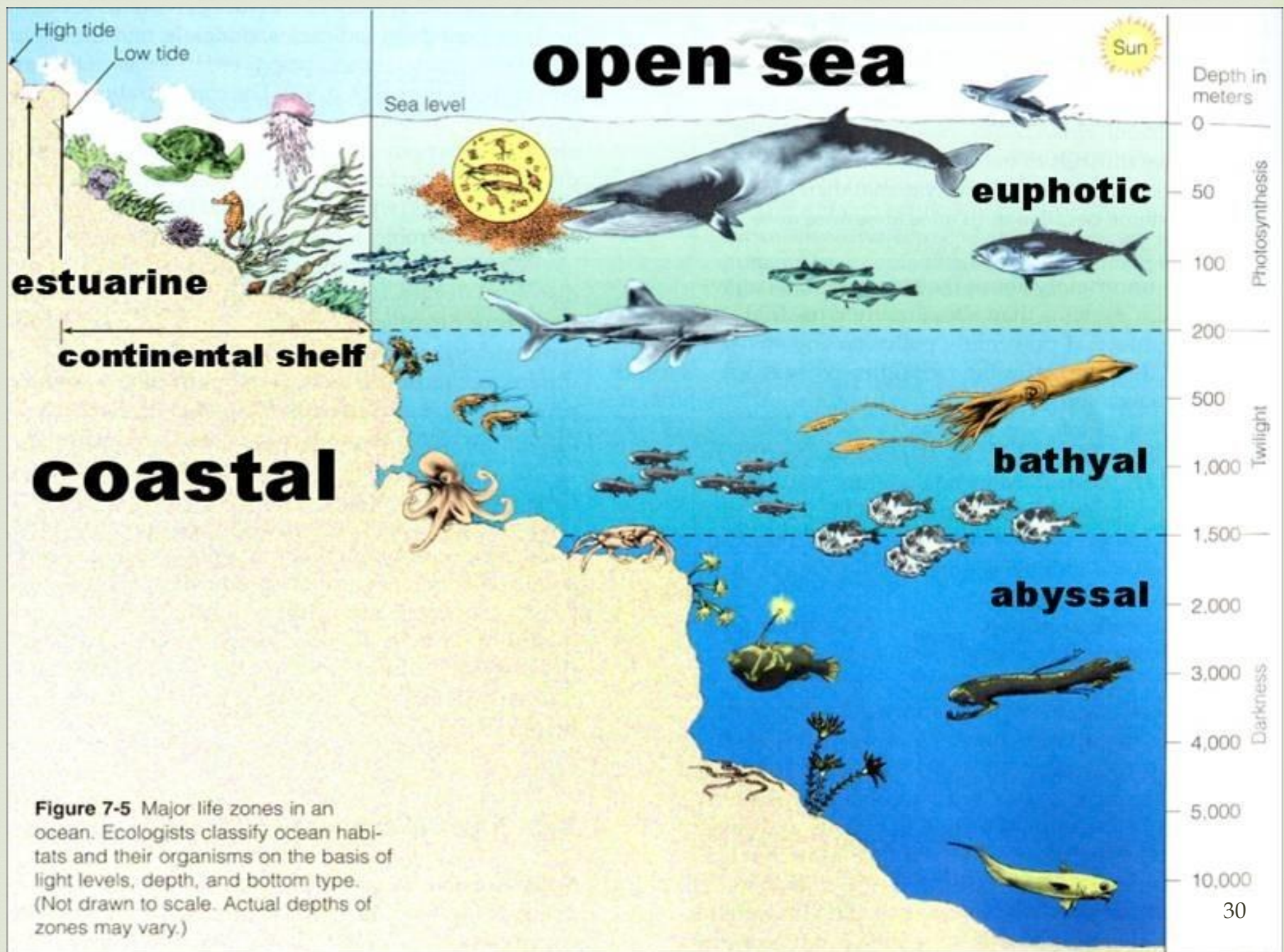
Lake Ecosystem



- ❧ Big freshwater bodies with standing water
- ❧ Planktons, Nektons, Neustons, Benthos, Periphytons
- ❧ Stratification based on temperature differences



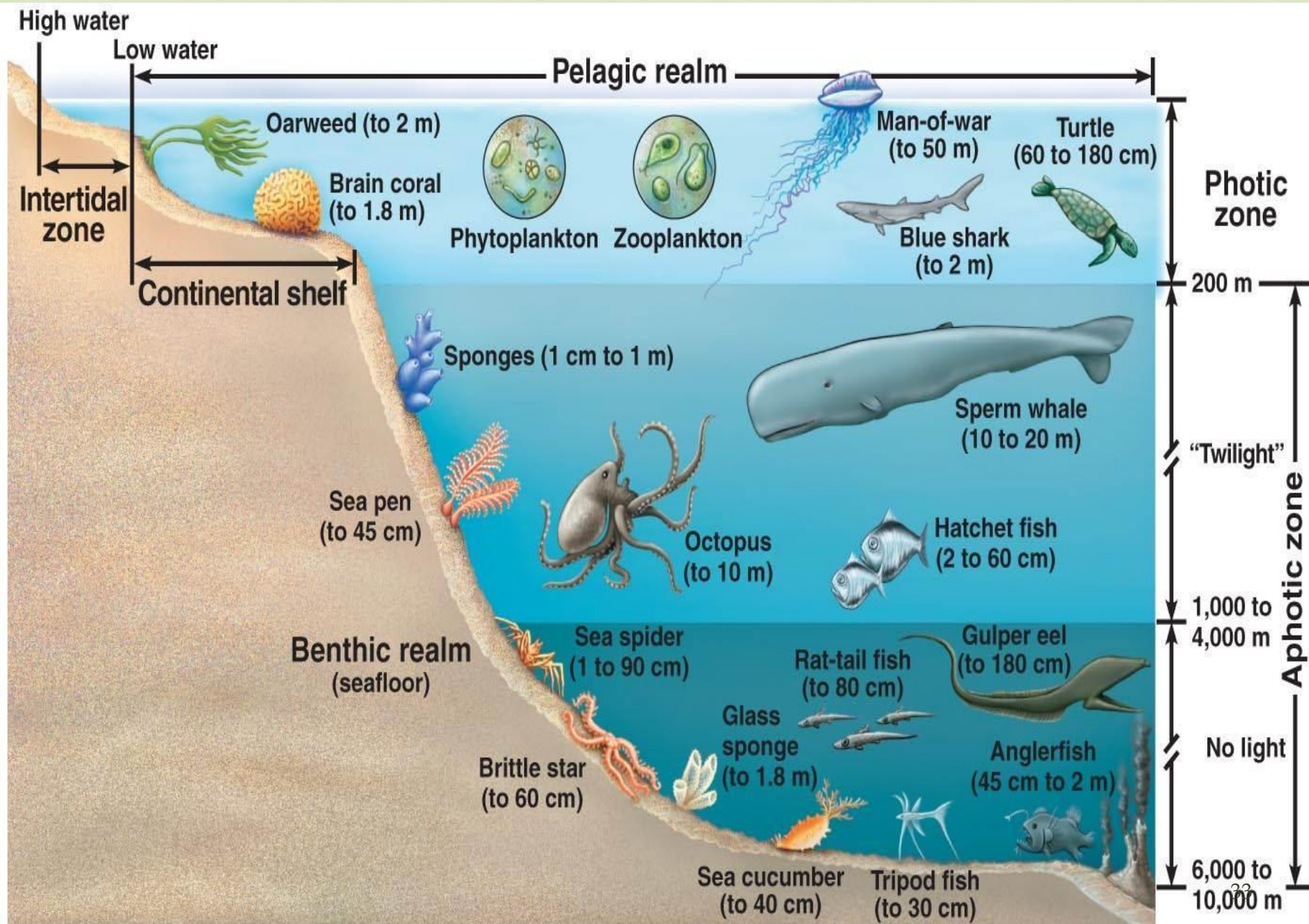




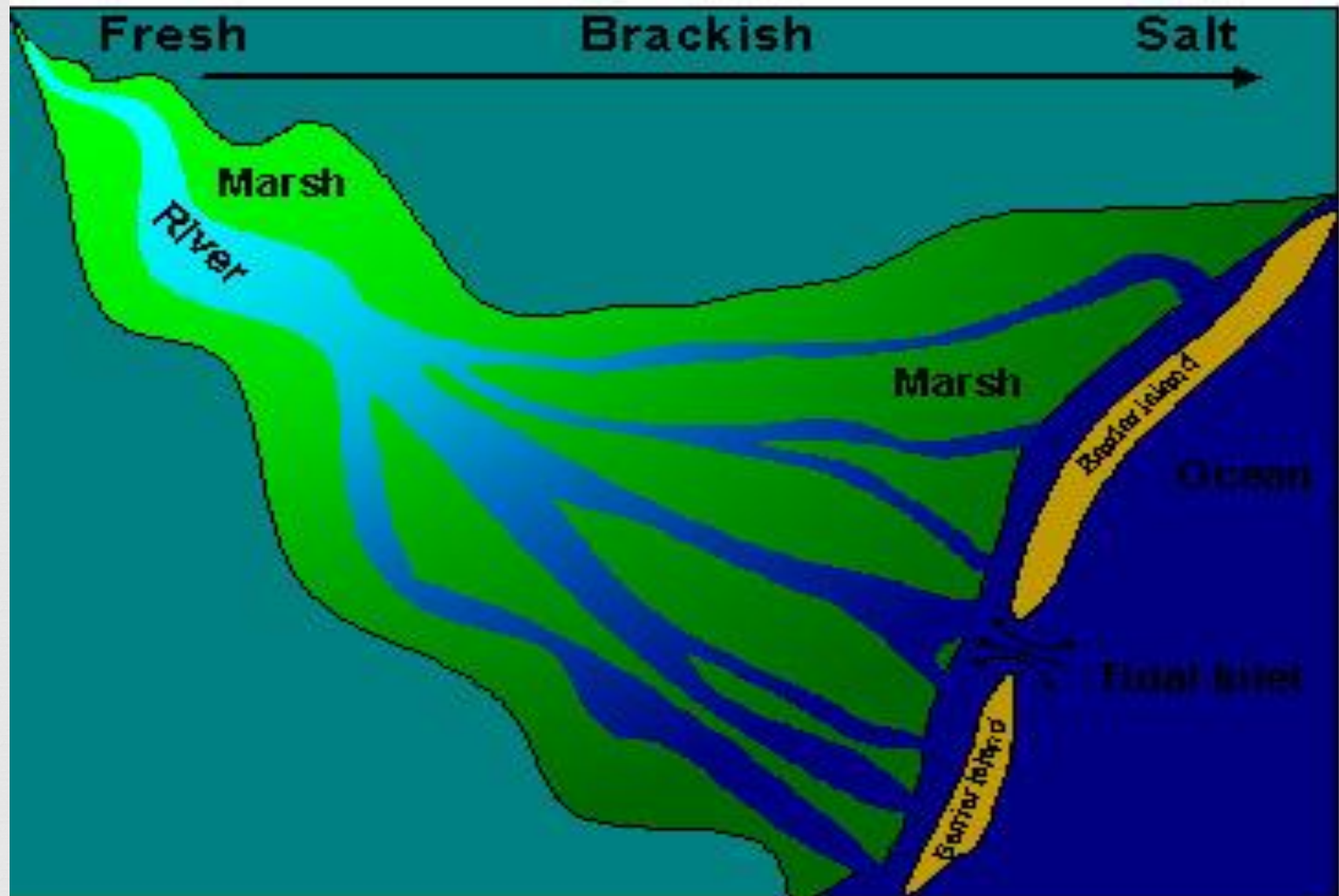
Ocean Ecosystems

- ❧ Ocean Ecosystem are more stable than pond ecosystem, they occupy 70 % of the earth surface.
- ❧ Abiotic Components: Dissolved oxygen, light, temperature, minerals.
- ❧ Biotic Components:
- ❧ Producers: These are autotrophs and are also known Primary producers. They are mainly, some microscopic algae (phyto- planktons) besides them there are mainly, seaweeds, as brown and red algae also contribute to primary production.

- ❧ Consumers: They are all heterotrophic macro consumers
- ❧ Primary Consumer: The herbivores, that feed on producers are shrimps, Molluscs, fish, etc.
- ❧ Secondary Consumers: These are carnivores fish as Herring, Shad, Mackerel, feeding on herbivores.
- ❧ Tertiary Consumers: These includes, other carnivores fishes like, Cod, Halibut, Sea Turtle, Sharks etc.
- ❧ Decomposers: The microbes active in the decay of dead organic matter of producers, and animals are chiefly, bacteria and some fungi.



The Estuary



Estuarine ecosystems

- ❧ An estuary is a partially enclosed body of water along the coast where fresh water from river and streams meet and mix with salt water from oceans. This Ecosystems are considered as most fertile ecosystem.
- ❧ Abiotic Components: Nutrients such as phosphorus and nitrogen, temperature, light, salinity, pH.
- ❧ This ecosystem experience wide daily and seasonal fluctuations in temperature and Salinity level because of variation in freshwater in flow.

❧ Biotic Components:

- ❧ Producers: Phytoplankton's - these micro-organisms manufacture food by photosynthesis and absorb nutrients such as phosphorous and nitrogen, besides them, mangroves, sea grass, weeds, and salt marshes.
- ❧ Consumers: Primary consumers, Zooplanktons that feed on Phytoplankton, besides them some small microorganisms that feed on producers.
- ❧ Secondary Consumer: Include worms, shellfish, small fish, feeding on Zooplanktons
- ❧ Tertiary Consumer : Fishes, turtles, crabs, starfishes feeding on secondary consumers.
- ❧ Decomposers: Fungi & Bacteria are the chief microbes active in decay of dead organic matter.



Tabular Format



Type of Ecosystem	Producers	Herbivores	Primary Carnivores	Secondary Carnivores	Tertiary Carnivores
A. Grassland Ecosystem	1. Grasses	Insects	Frogs	Snakes	Predatory Birds
	2. Grasses	Rats and Mice	Snakes	Predatory Birds	
	3. Grasses	Rabbit	Fox	Wolf	Lion
B. Pond Ecosystem	Phytoplank-ton	Zooplanktons	Small Fishes	Large Fishes	Predatory Birds
C. Forest Ecosystem	Trees	Phytophagous Insects, Herbivore Mammals	Lizards Birds Foxes	Lions Tigers Etc.	

Functions of Ecosystems:

Trophic structure



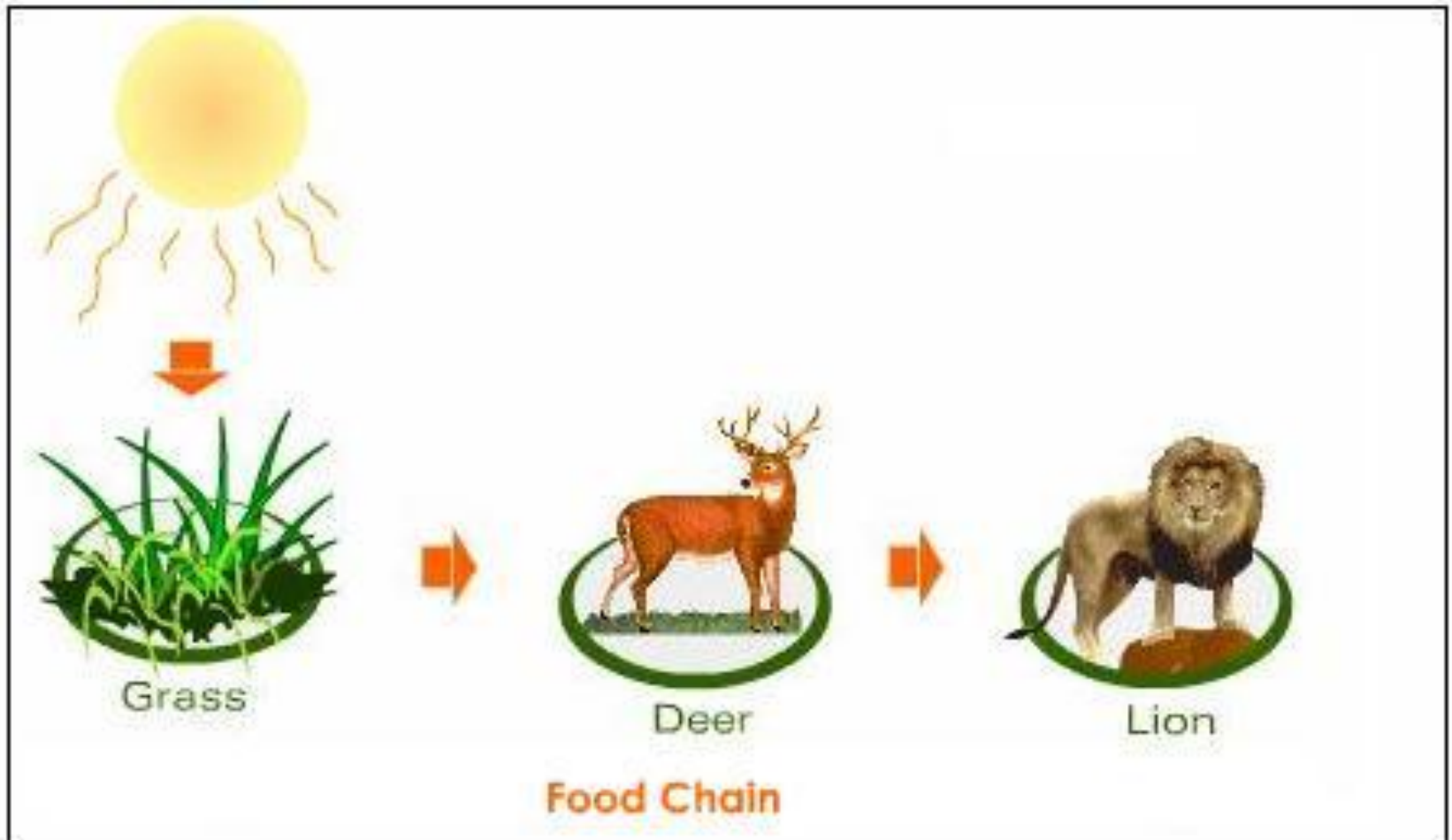
- ❧ In ecosystems energy and matter exchange occurs in a definite pattern.
- ❧ Nutrients and energy move along food chain
- ❧ Producers, consumers are arranged in a specific manner and their interaction along with population size is called as Trophic structure and the level as Trophic Level.
- ❧ And the amount of living matter at each level is called Standing Crop or Standing Biomass

Food chain

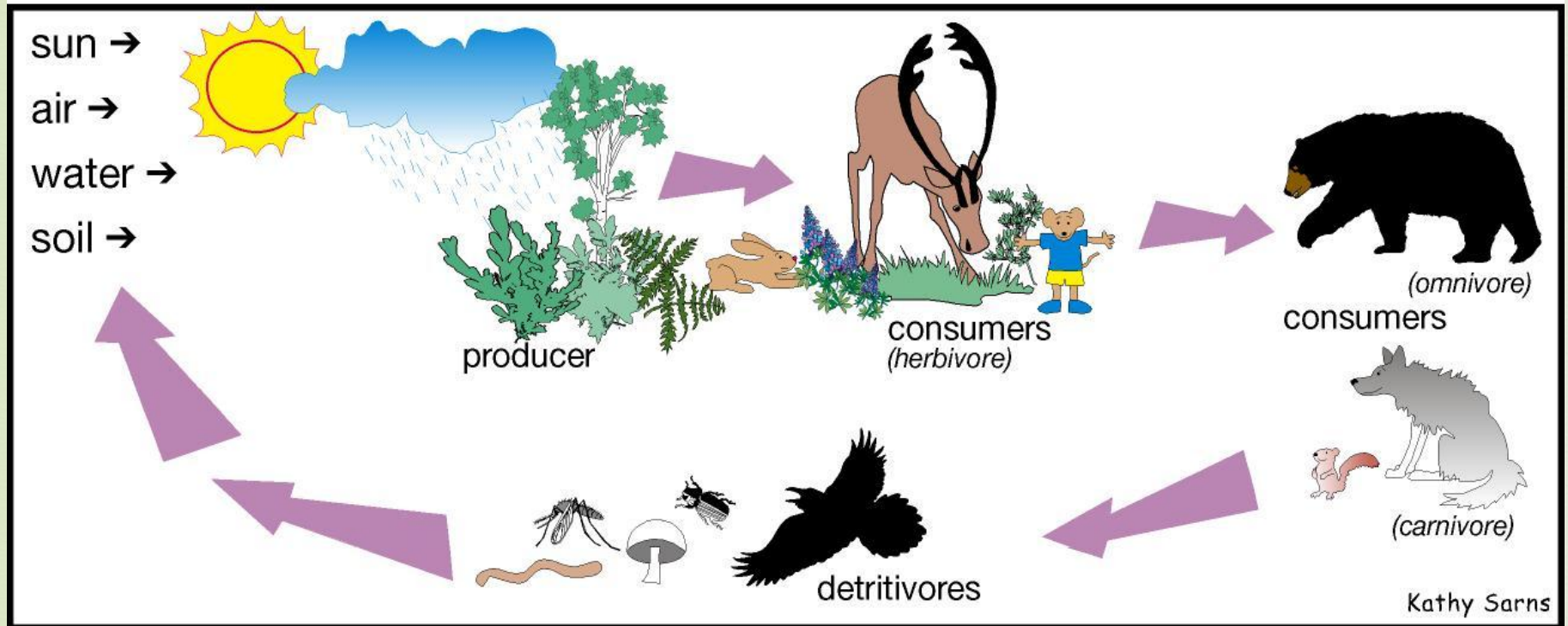


- ❧ The sequence of eating and being eaten is known as food chain.
- ❧ Someone is the food of other.
- ❧ Three types of food chains
 - ❧ Grazing- Starts from producers that is green plants – terrestrial, marine, pond ecosystem
 - ❧ Detritus- Starts with dead organic matter- Mangrove Ecosystem
 - ❧ Parasitic –Starts with big host(Living organism)

Simple Grazing Food Chain

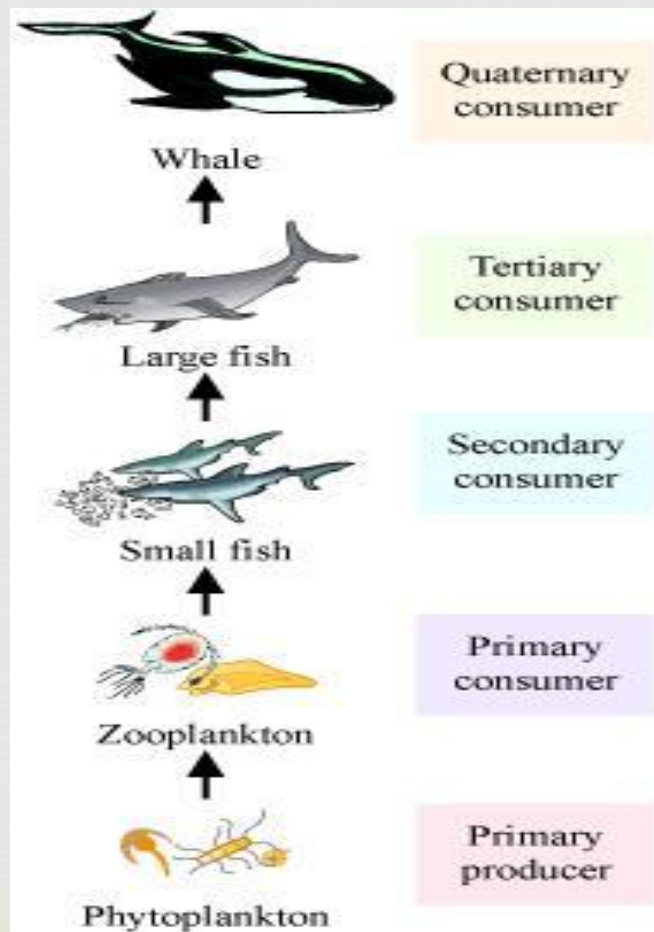


Grazing food chain



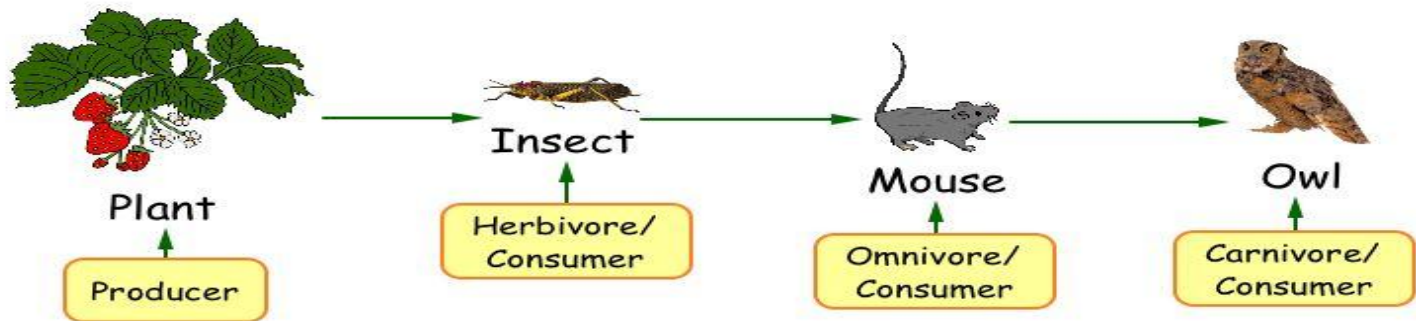
Terrestrial Food Chain

Grazing food chain (Marine Eco System)



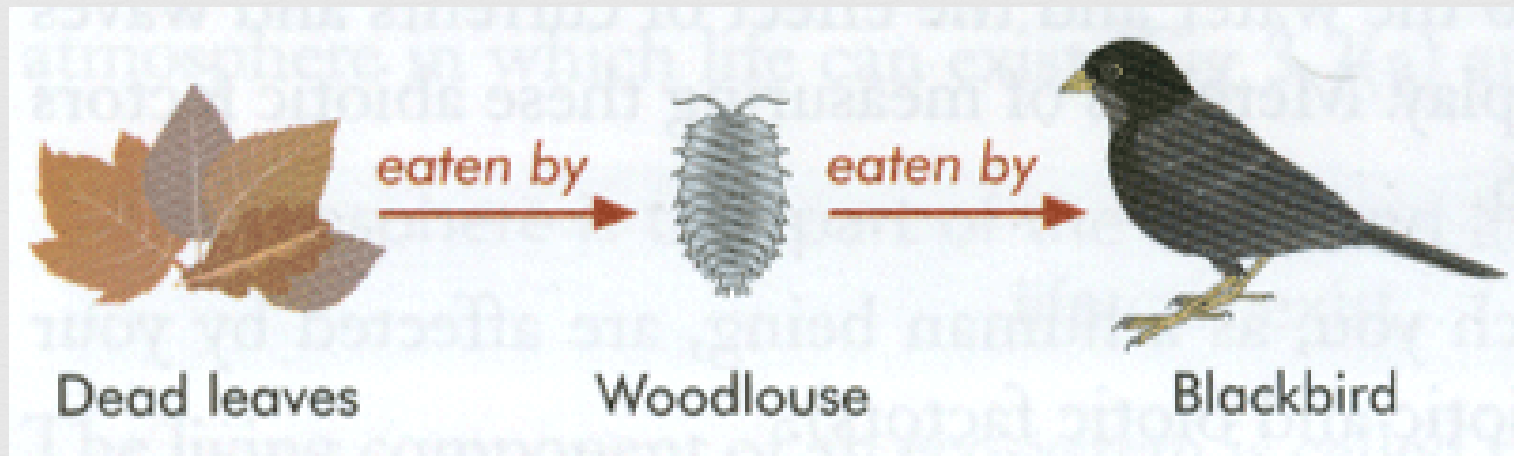


The Food Chain Of An Owl

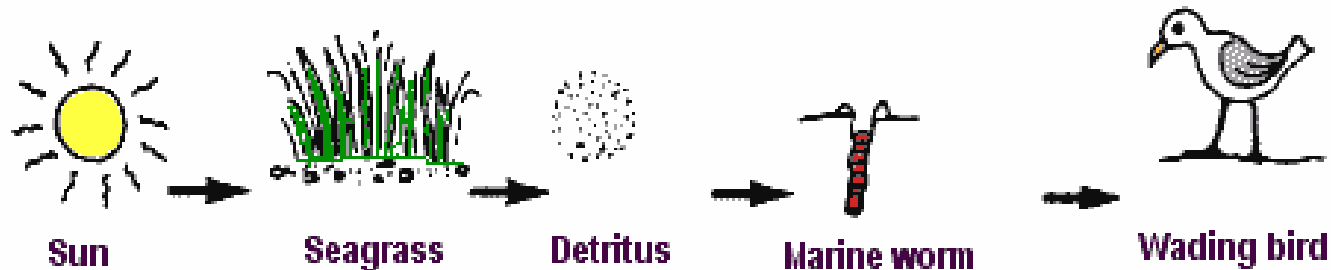
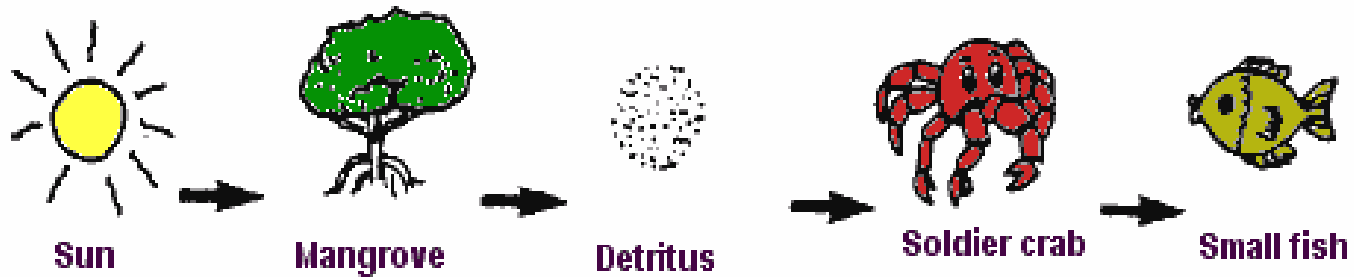


A food chain shows the path of energy from one living thing to another. Decomposers like bacteria, are necessary for all food chains.

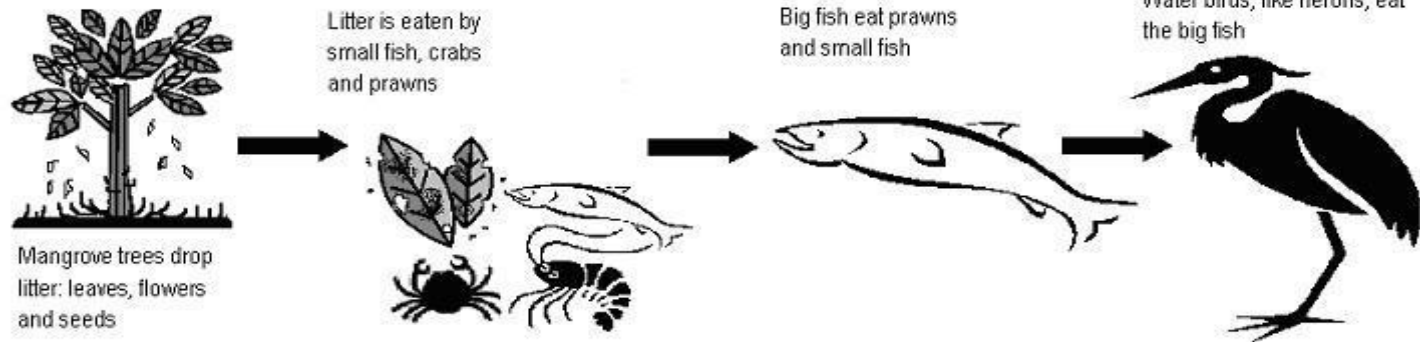
Detritus food chain



Mangrove Ecosystem



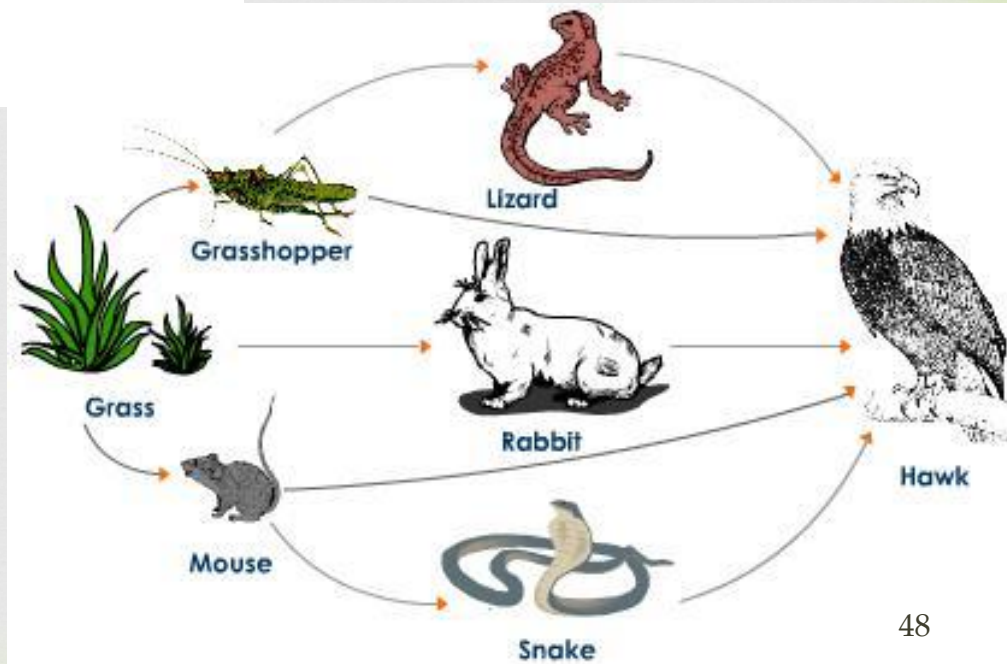
Mangrove food chain



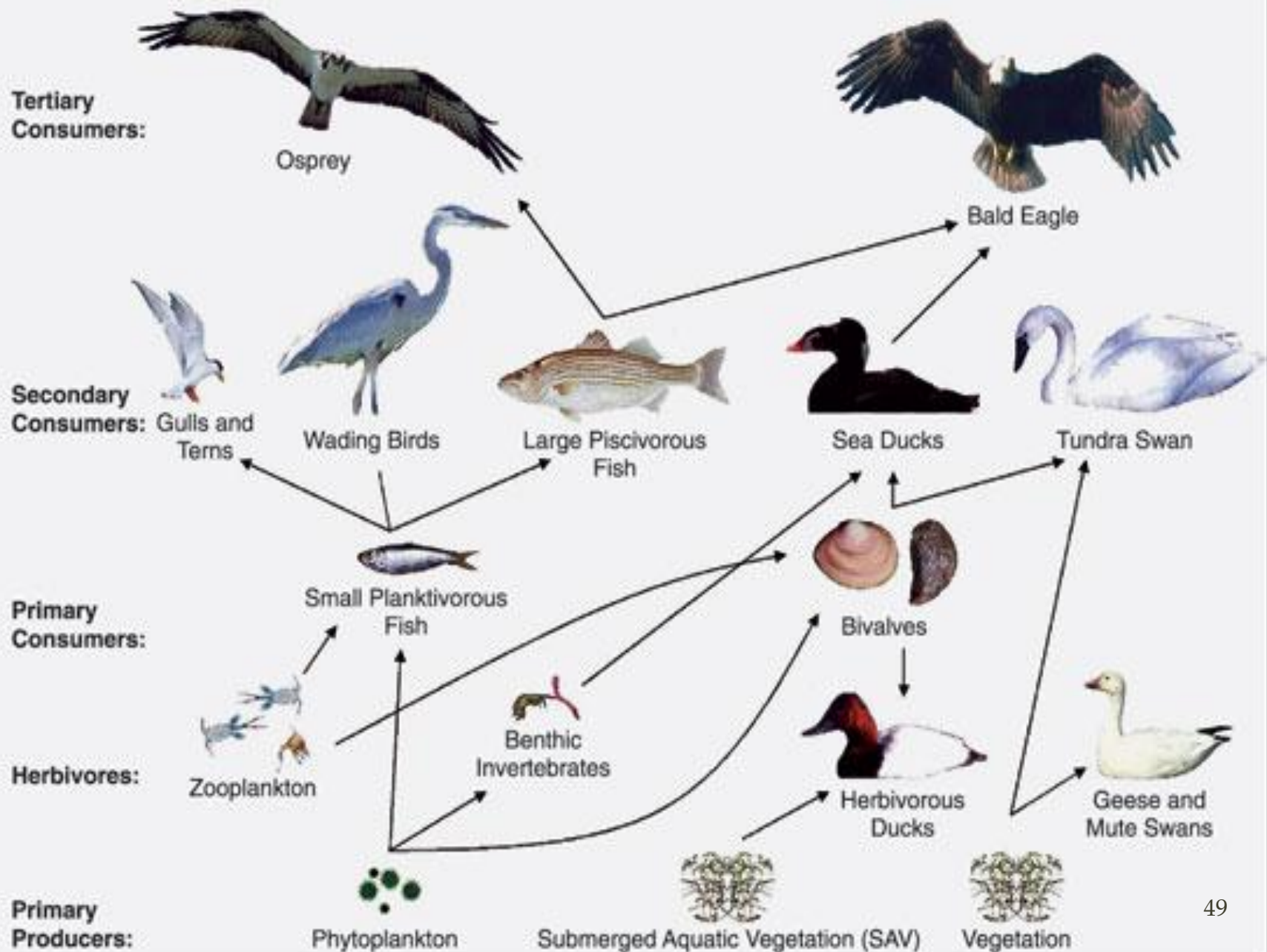
Food web



- ❧ No food chain is isolated.
- ❧ Organisms act at various levels in different food chains.
- ❧ Feed on more than one type of organism.
- ❧ Form a **Complex Food Web**.
- ❧ Thus, “Food Web - is a network of food chains where different types of organisms are connected at different trophic levels”
- ❧ so that there are a no. of options of eating and being eaten at each trophic level



Chesapeake Bay Waterbird Food Web



Significance: Food chain and Food Web

- ✧ Energy and nutrient flow

- ✧ Maintain population of different species and thus maintain **Ecological Balance**

- ✧ Bio magnification: a rather harmful phenomenon.
Eg: build up of DDT in higher animals.
(Case Study- Pesticides - Diclofenac in Vultures.)

Case Study



Vultures critically endangered: Banned veterinary drug **diclofenac** is a major culprit

SOURCE: FOREST DEPARTMENT & IUCN

How it works

Diclofenac is given to cattle



Vultures ingest diclofenac from cattle carcass



Vultures suffer: renal failure, loss of flight and ultimately death. Vultures lack the enzyme in their body to break down diclofenac

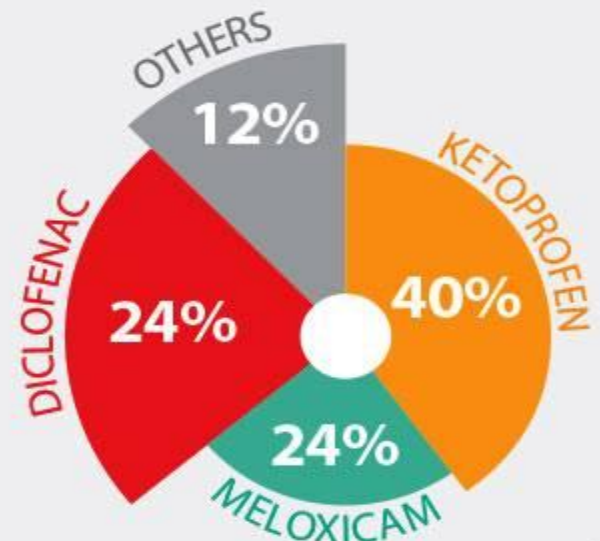


Points to ponder

- A 30 ml vial of diclofenac is enough to kill around 500 vultures
- 99.9% decrease in Indian subcontinent vulture population in just 20 years
- In Bangladesh the total vulture population is below 500
- Of 3 indigenous species of vulture, the country has already lost 2

Ecologists advocated the use of meloxicam as a substitute for diclofenac

VETERINARY DRUGS AVAILABLE THROUGHOUT THE COUNTRY



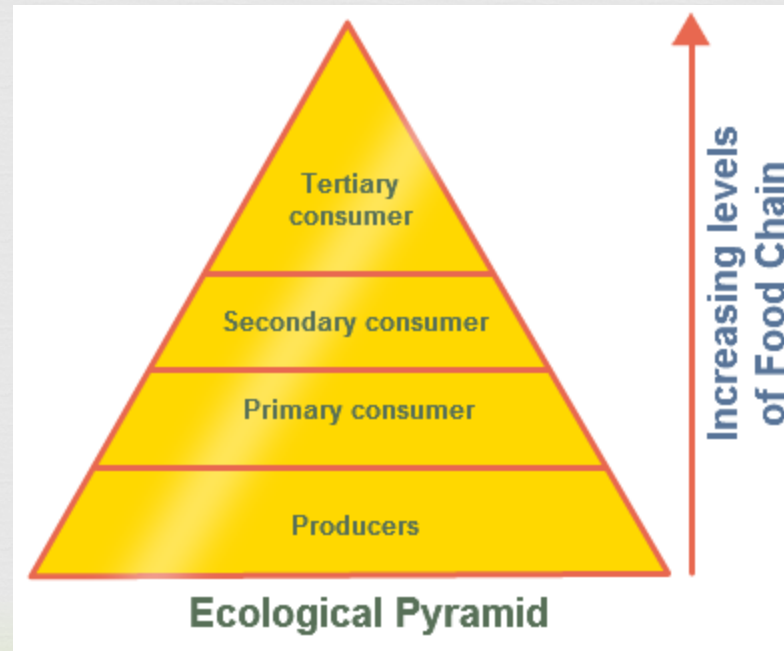
Ecological Pyramids

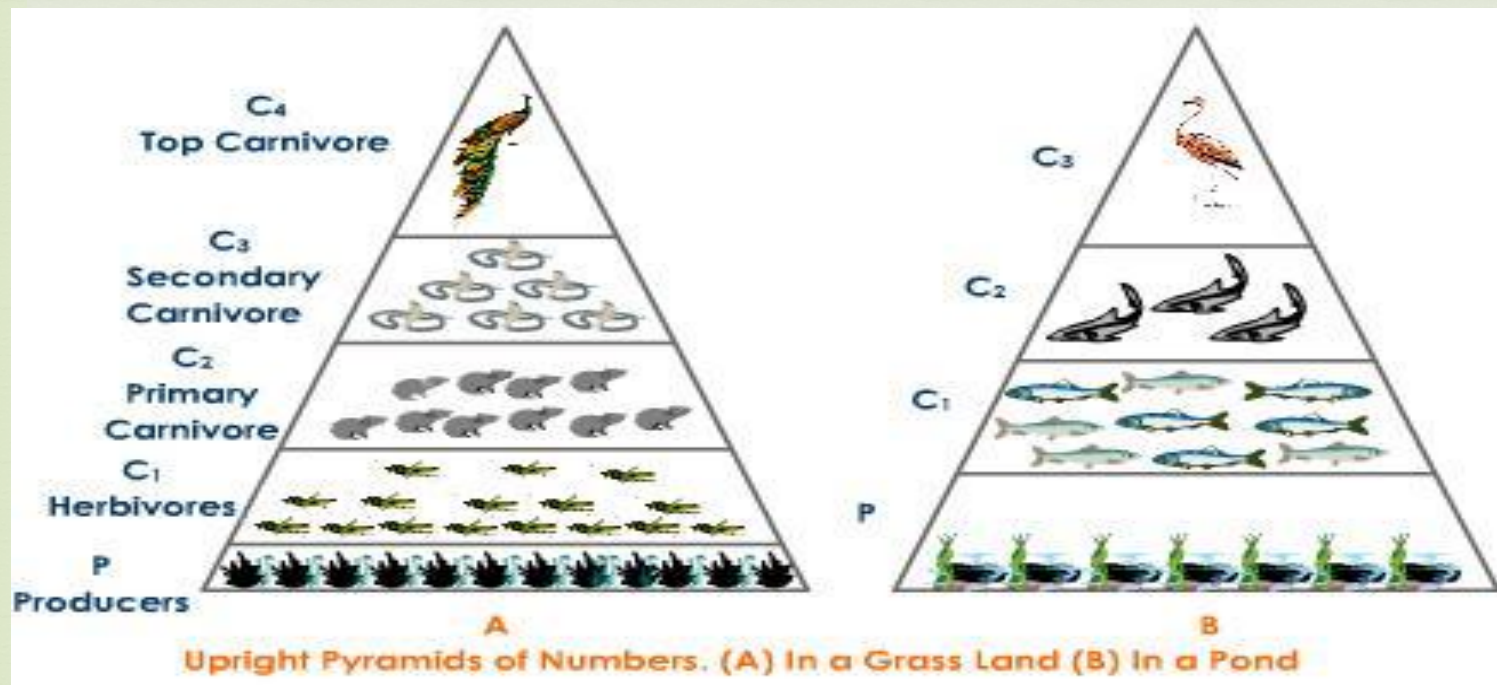


- ❧ Graphic representation of trophic structure and function of ecosystem
- ❧ Starts with producers at the base and consumers at successive levels towards apex is called as an “Ecological Pyramid”
- ❧ They are of 3 Types:
 - ❧ Pyramids of Numbers
 - ❧ Pyramids of Biomass
 - ❧ Pyramid of Energy

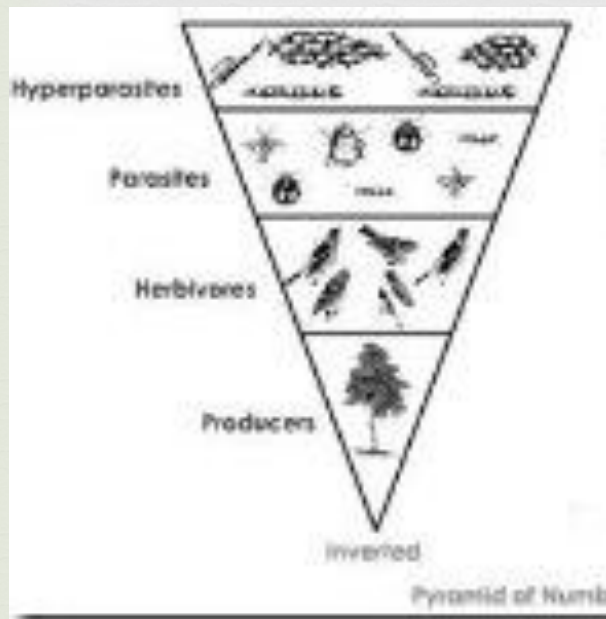
Pyramid of Number

- ❧ Represents Number of individual organism at each level.
- ❧ May be Upright, Inverted, Spindle.
- ❧ Of Forest, grassland and parasitic food chain

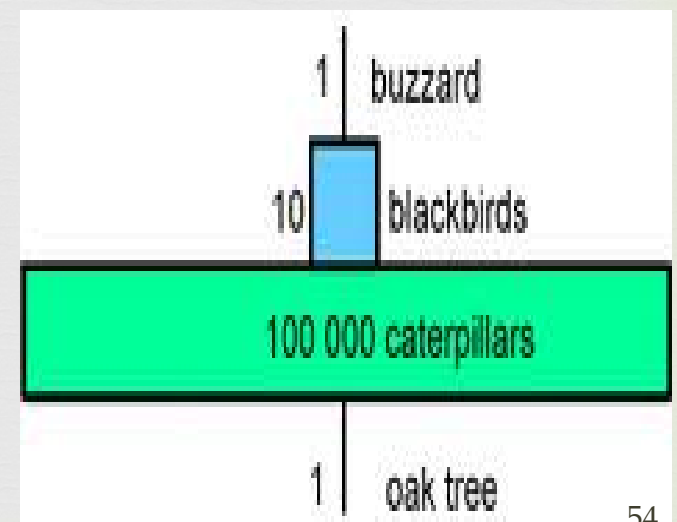




Upright -
Grassland
& Pond



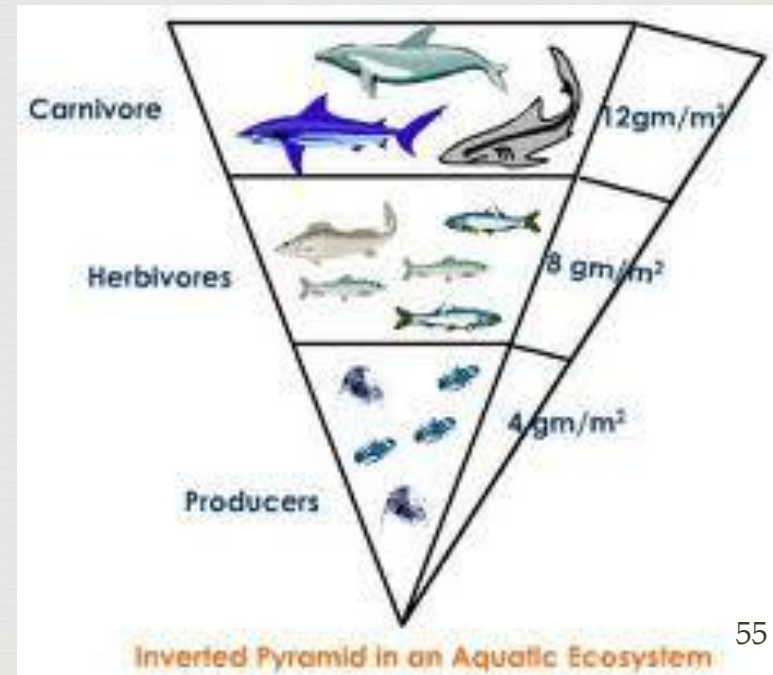
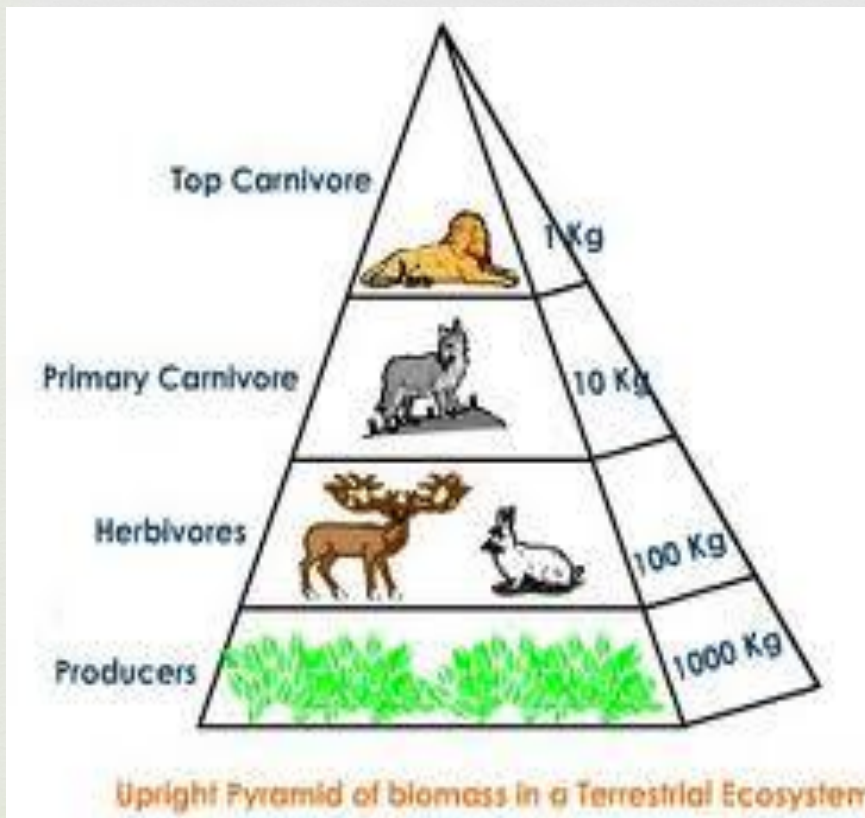
Inverted- Parasitic food Chain



Narrow Pyramid- Forest

Pyramid of Biomass

- Based on total biomass i.e dry matter at every level in a food chain
- Upright or Inverted.



Pyramid of Energy

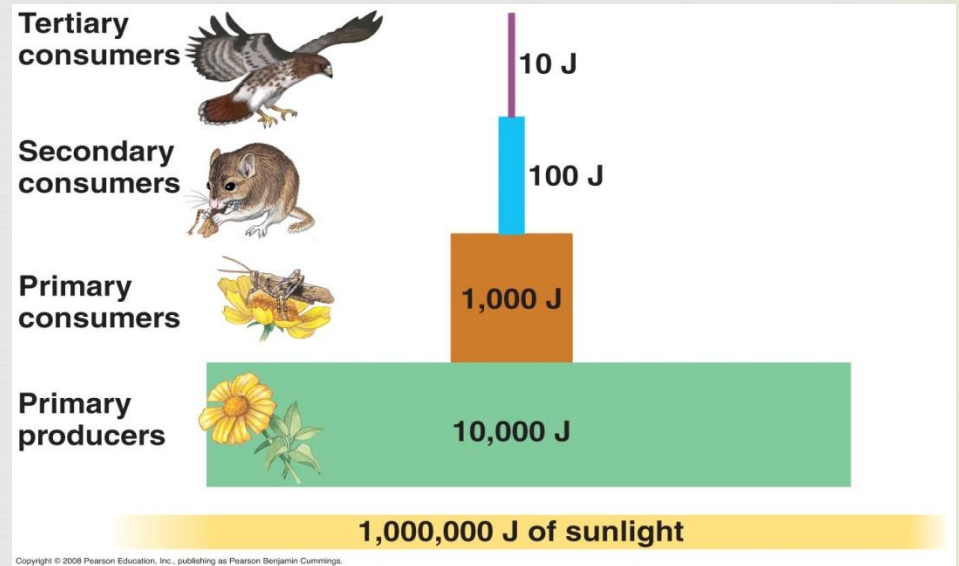
Amount of energy at each trophic level.

Always Upright

Energy goes on reducing at each level.

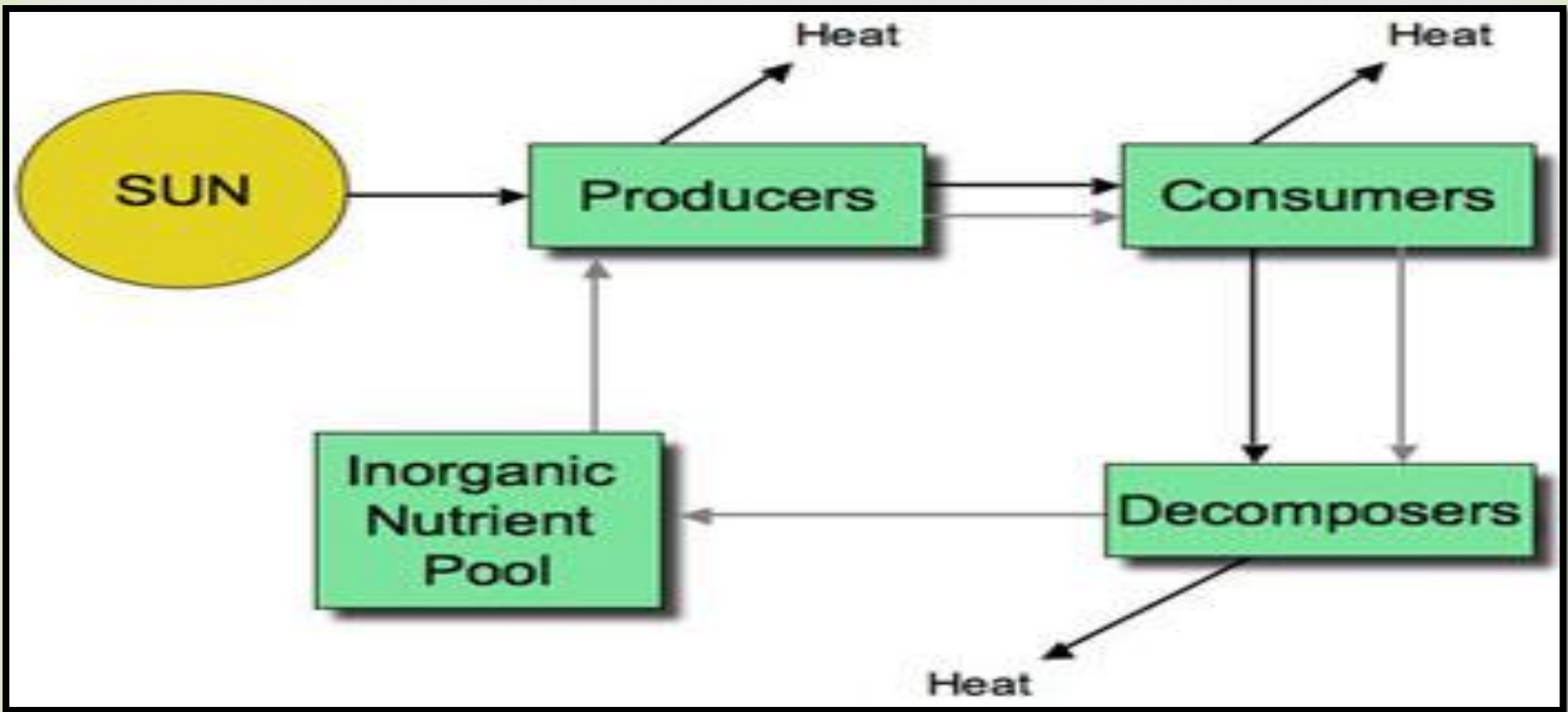
Loss in the form of heat, respiration.

Shows sharp decline from producers to top carnivores.



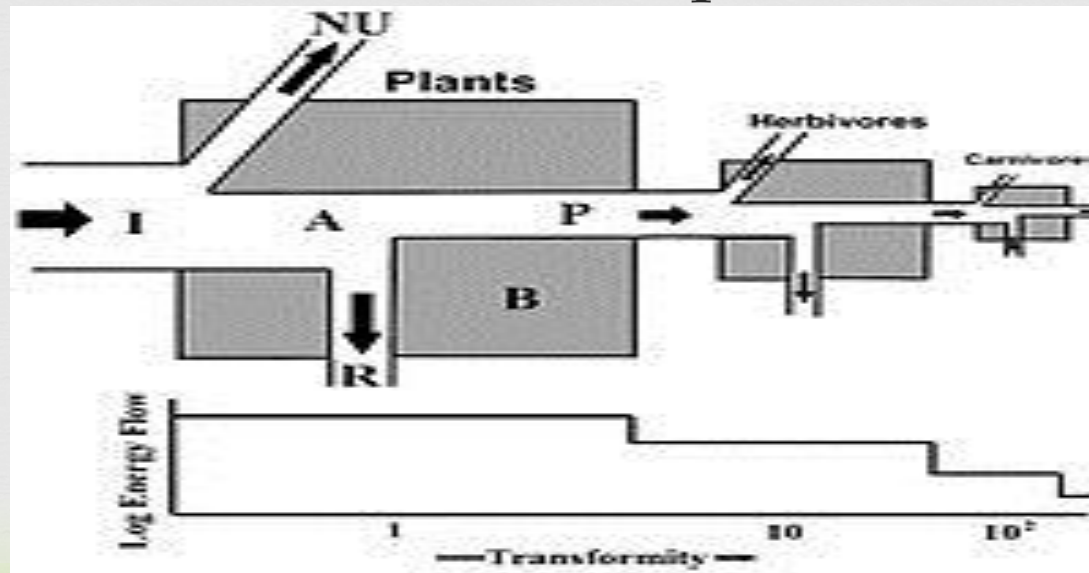
Energy Flow

- ❧ Energy flow in an ecosystem is **Unidirectional**
- ❧ Source of energy is sun
- ❧ Plants convert this energy into chemical energy
- ❧ Energy is lost in body functions like respiration
- ❧ Available passes to next trophic level
- ❧ Follows two laws of thermodynamics
 - ❧ 1st Law: Energy can neither be created nor destroyed, it can be converted from one form to another
 - ❧ 2nd Law: energy dissipates as it is used.
- ❧ Energy flow models: explain the flow of energy



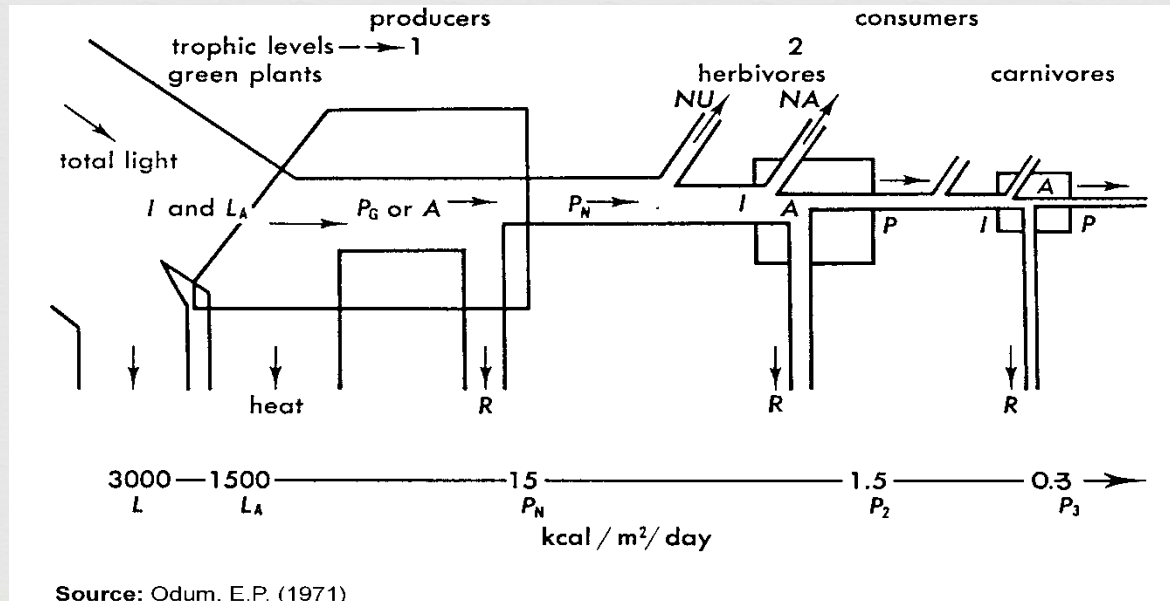
Universal energy flow model

- ✧ Explained by ecologist E. P. Odum
- ✧ Says, as flow of energy takes place there is a gradual decrease in energy.
- ✧ Thus less energy is available at each trophic level.
- ✧ Loss occurs by use in locomotion, excretion, respiration
- ✧ Rest is stored as biomass and passes further



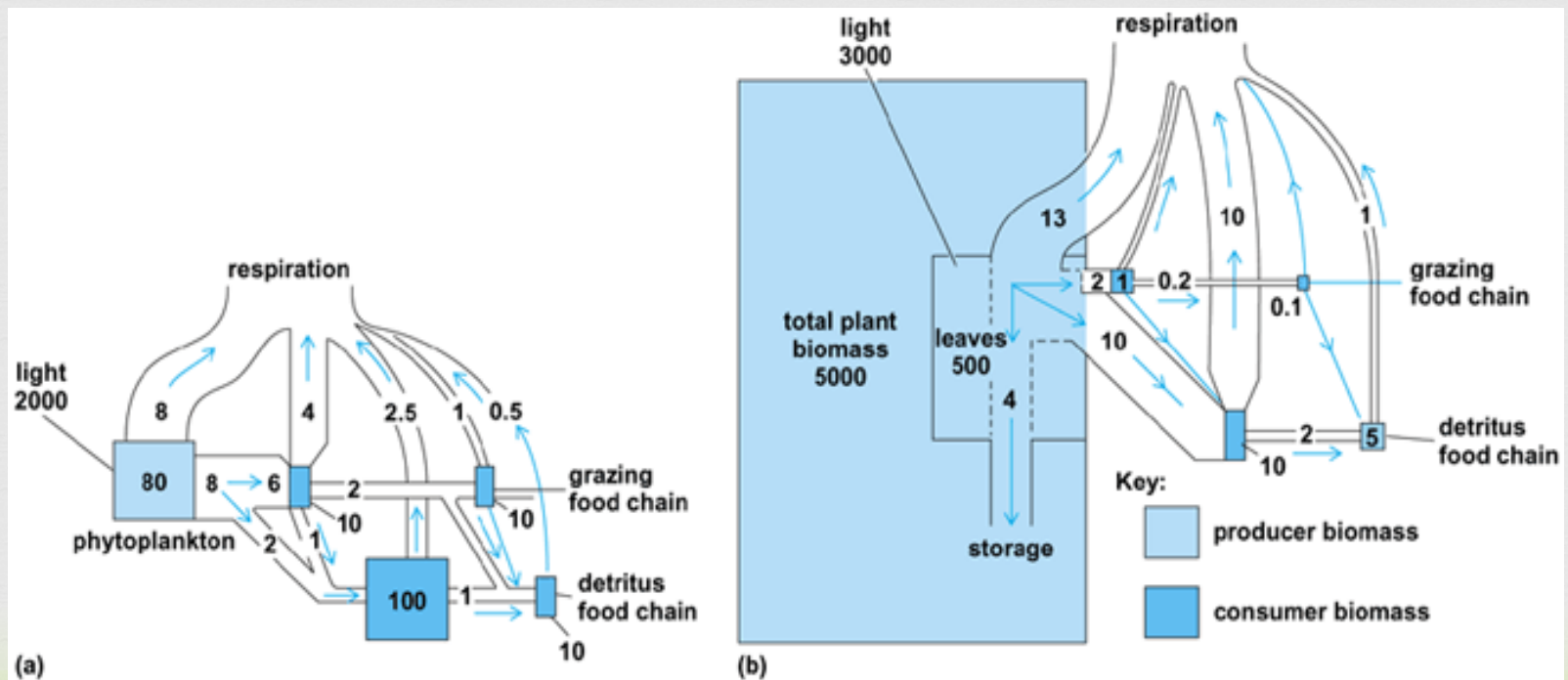
Single channel Energy flow model:

- Normal food chain...normal energy flow....
- Grazing food chain



Y shaped or double channel flow model:

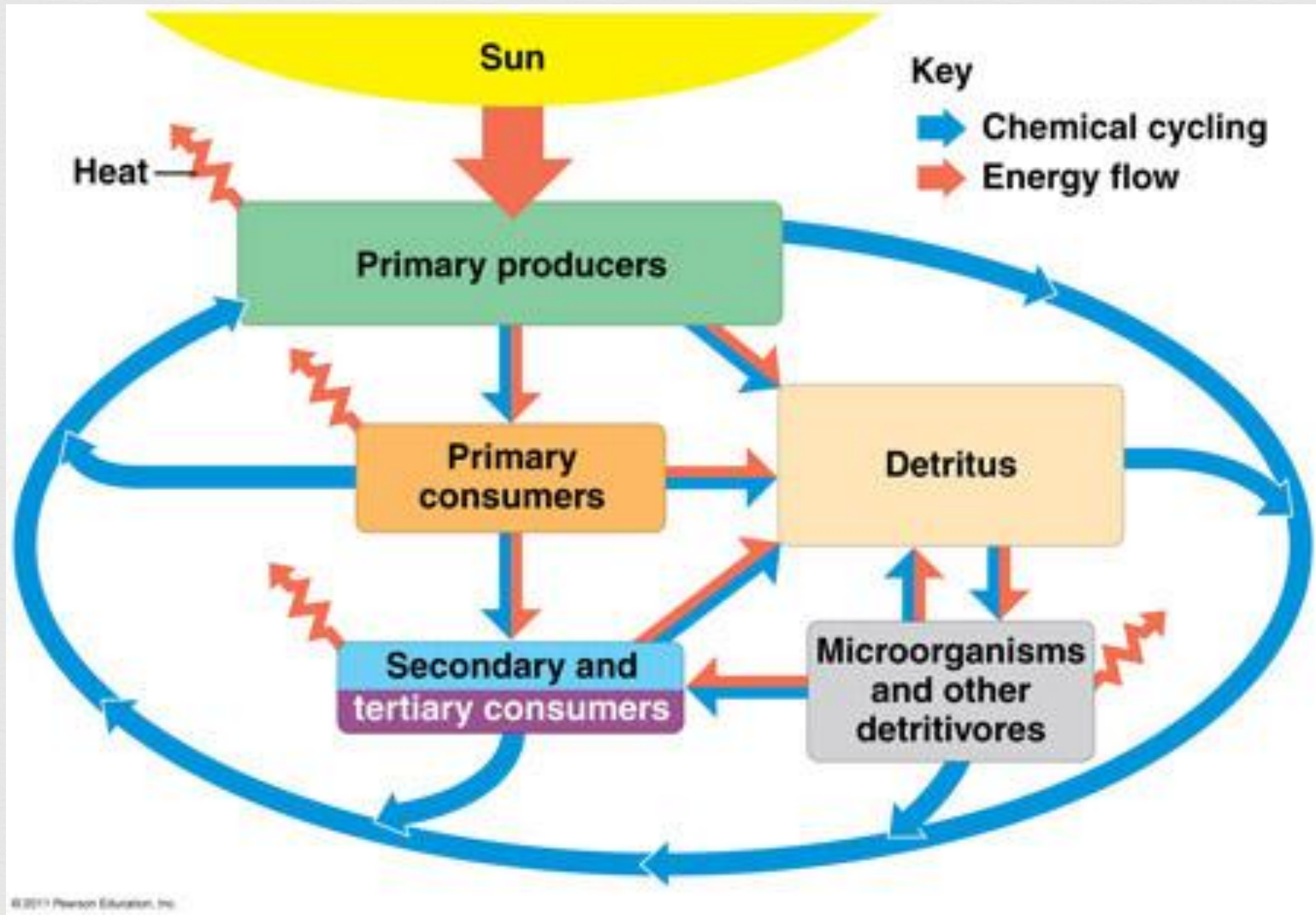
- Here entire biomass cannot be consumed as quantity is high.
- Here major biomass enters detritus food chain along with grazing food chain. Gives Y shape.



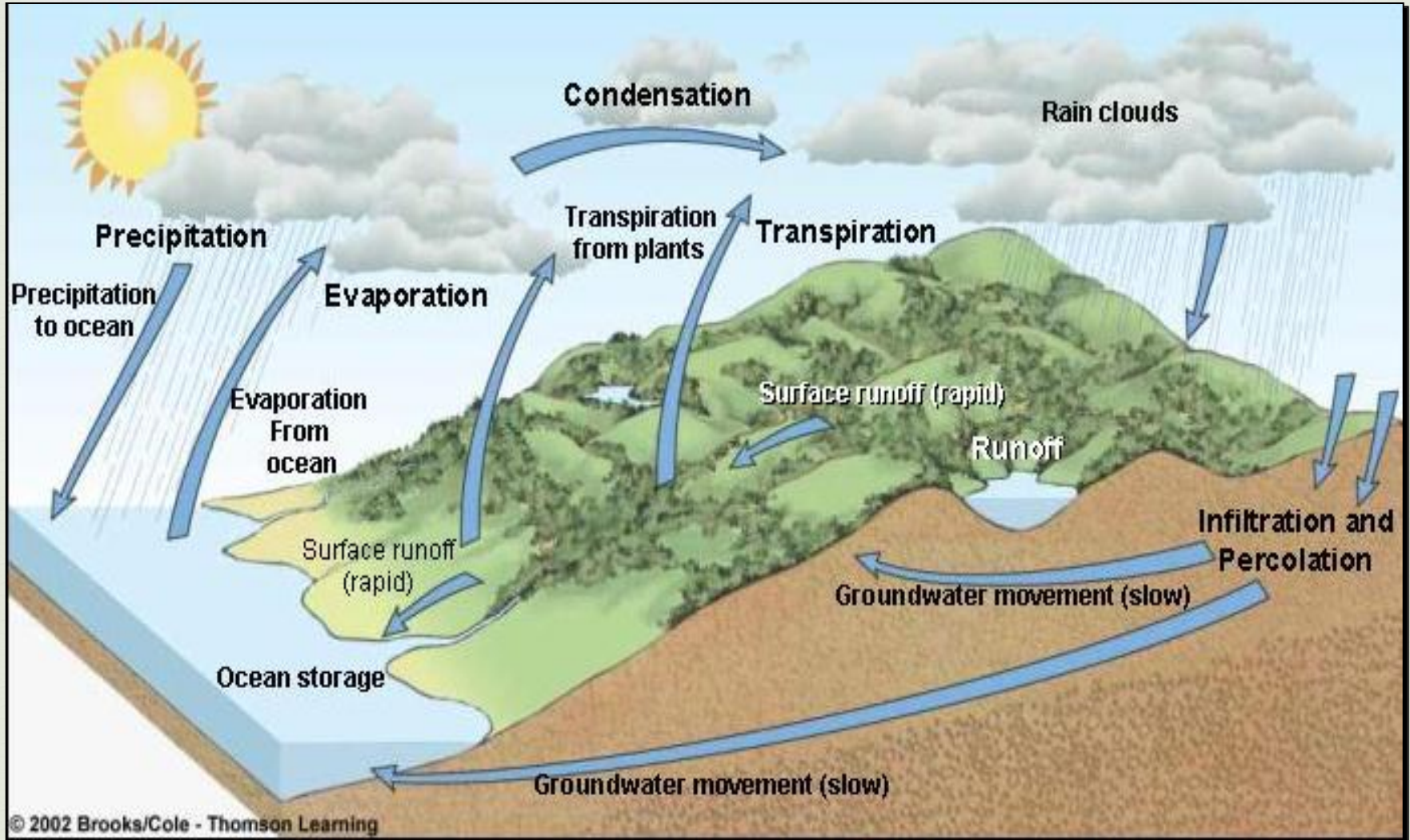
Nutrient Cycling

- ❧ Nutrients are important functional attribute.
- ❧ These nutrients are available to biotic components through natural resources
- ❧ Nutrients if not returned back would end up and not be available for future use.
- ❧ These nutrients are thus cycled through BIOGEOCHEMICAL cycles.
- ❧ Nutrients are decomposed, converted by micro-organisms and ready to use again..thus cycle continues.
- ❧ Water, Oxygen, Nitrogen, Carbon.

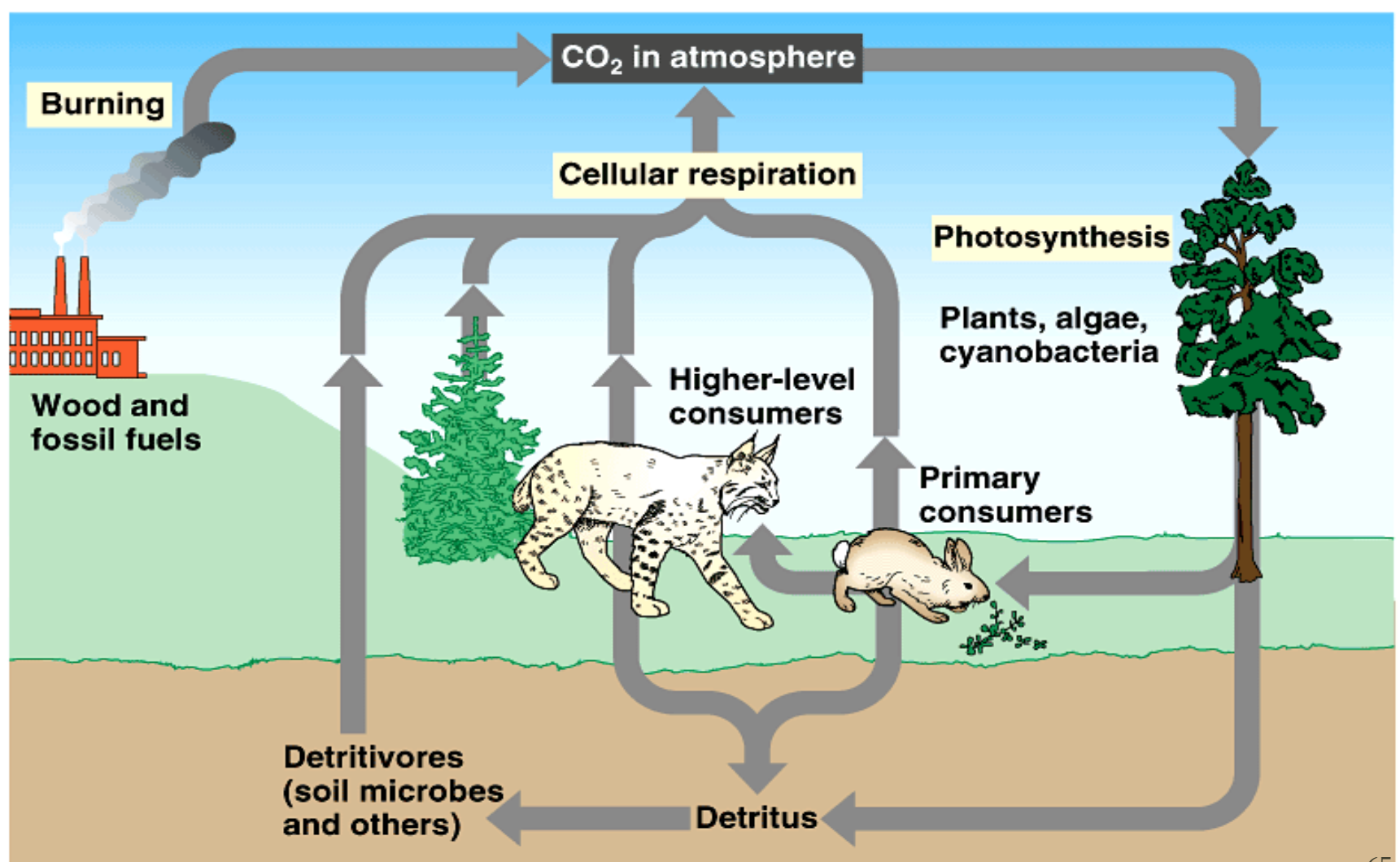
Nutrient Cycling & Energy Flow



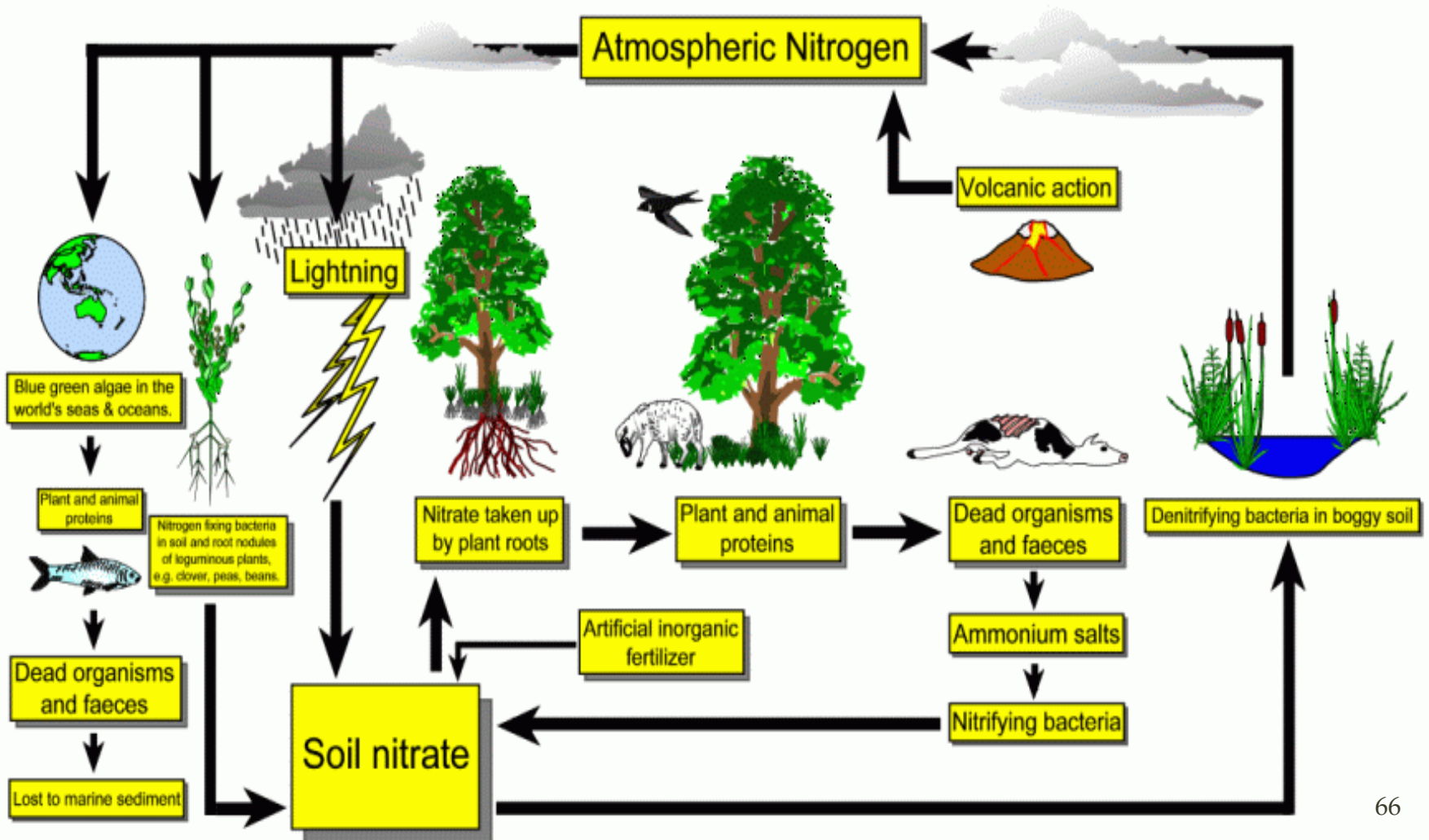
Hydrologic (Water) Cycle



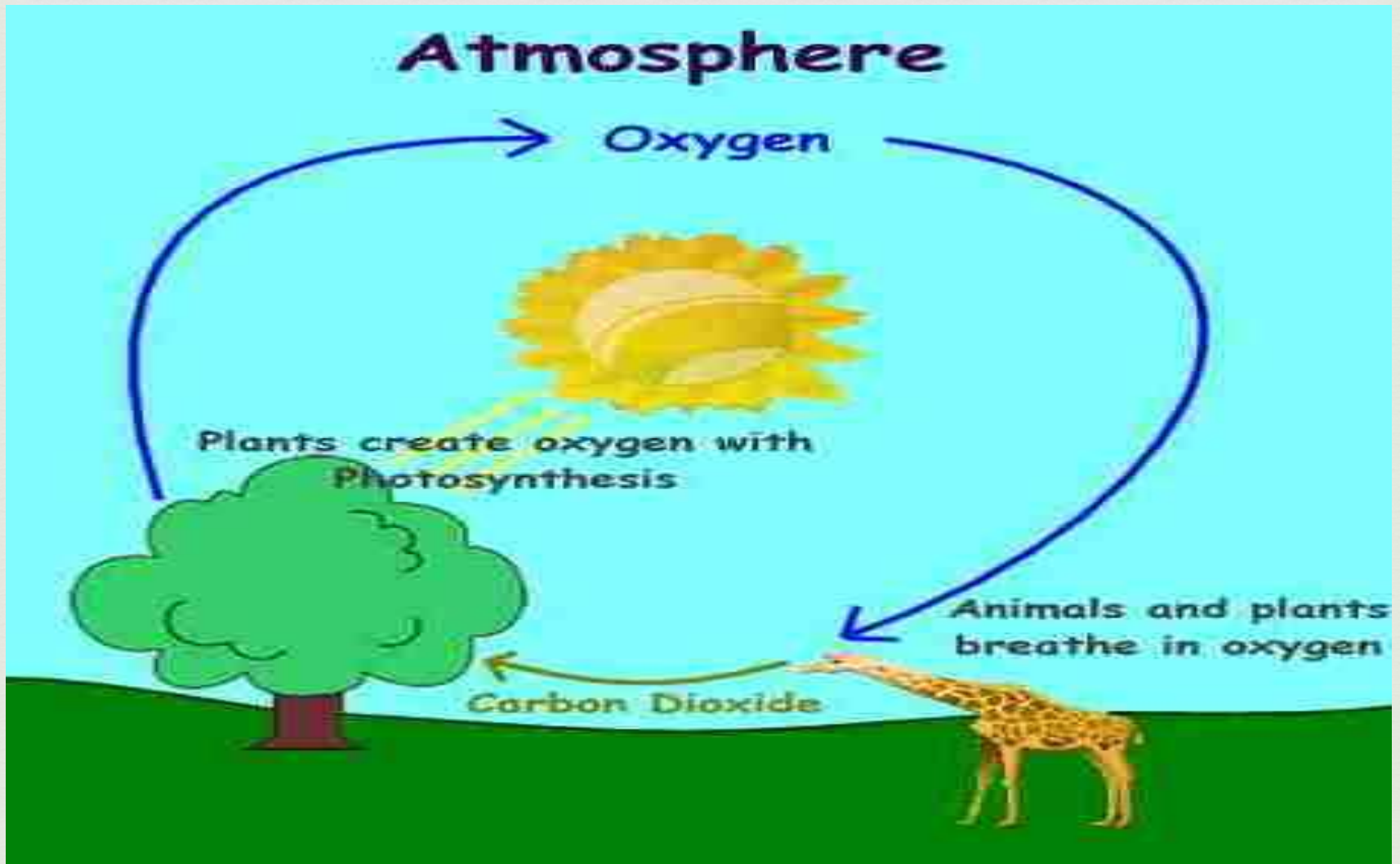
Carbon Cycle



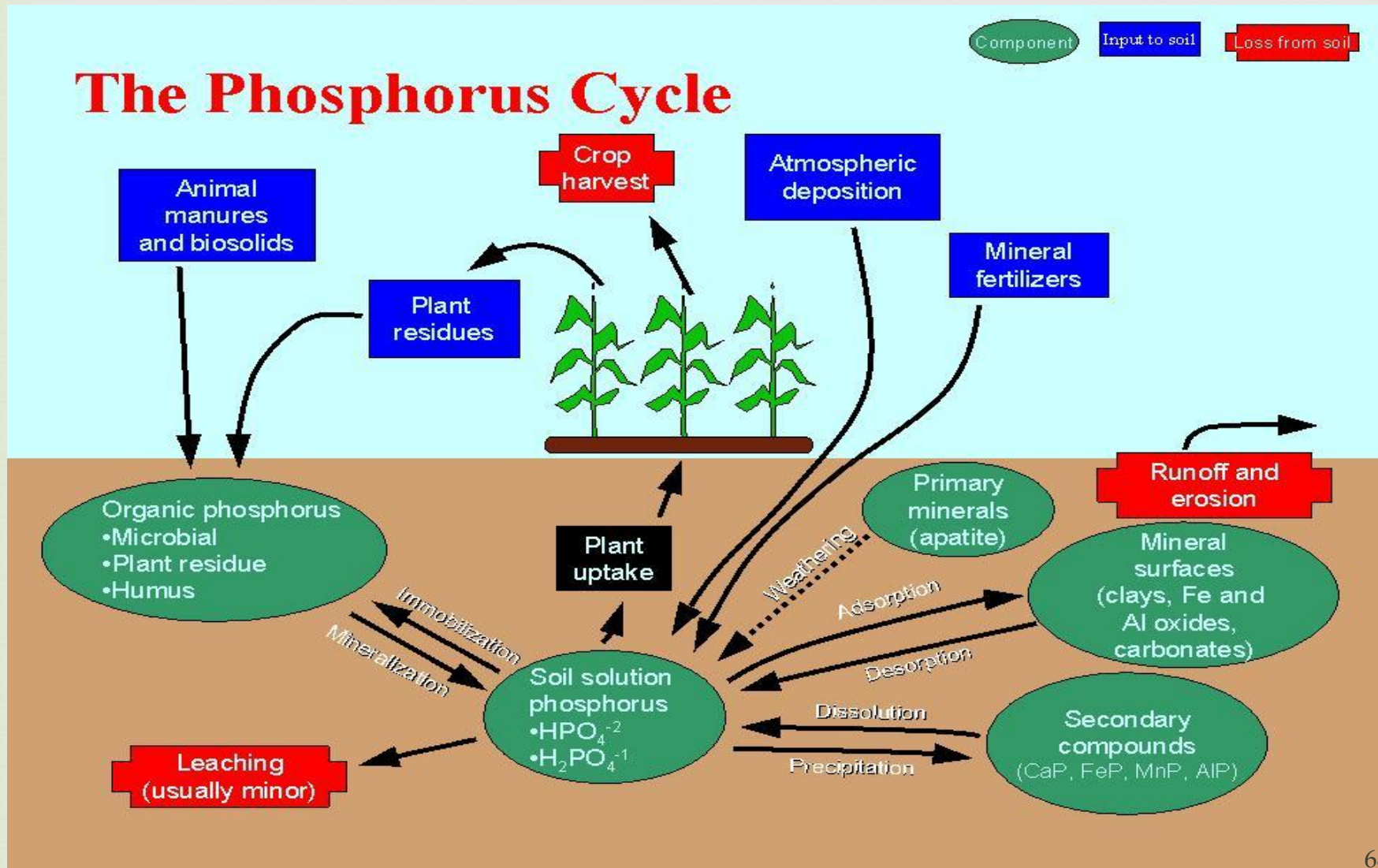
The Nitrogen Cycle



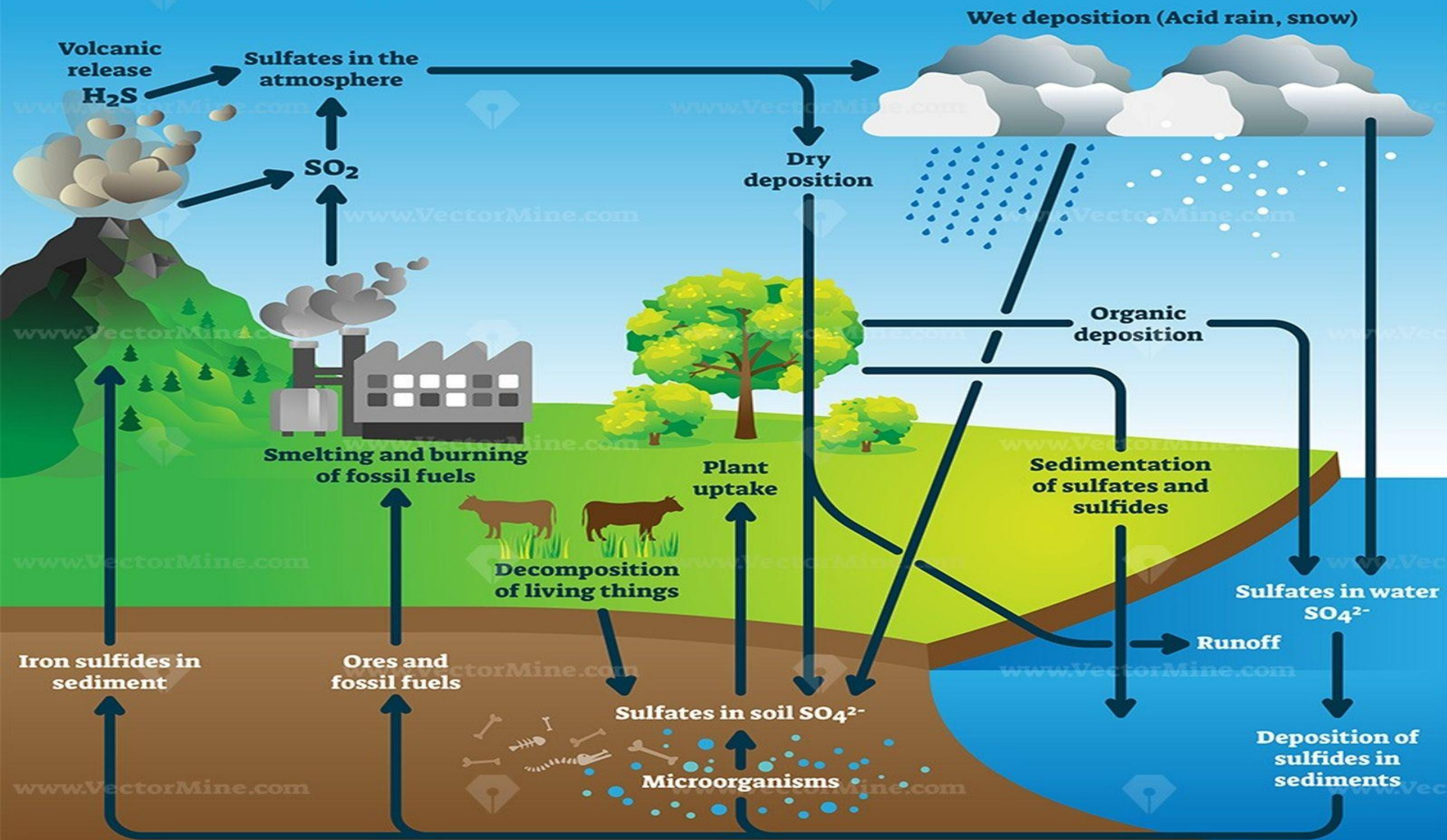
Oxygen Cycle



Phosphorous Cycle



SULPHUR CYCLE





 *Thank You*