



Ecosystem

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.



Ecology & Ecosystem

- Ecology can be defined as “the study of interactions between an organism and its physical environment; the relationship between animals and plants and how one species affect another.”
- The study of inter-relationship between living and nonliving is called ecology while a system in which both living and nonliving beings interact with each other as a self supported complete unit is called an ecosystem.



Concept of Ecosystem

- The term “Ecosystem” was coined by A.G.Tansley in 1935. He defined the ecosystem as “the system resulting from integration of all the living and non-living factors of the environment”.
Ecosystem is the basic functional unit in ecology.
- Ecosystem may also be defined as the interaction of biotic and abiotic components of the environment thereby exchanging matter and energy.



Structure of Ecosystems

- Structure of ecosystem consists of two basic components
- 1. Abiotic component
- 2. Biotic component



Abiotic components

- Inorganic substances
 - Carbon dioxide
 - Water
 - Dissolved Oxygen
 - Inorganic salts (Nitrates, phosphates, and sulphates) of calcium
 - Micro and macro nutrients.



Abiotic components ...

- **Organic substances**
 - carbohydrates, proteins and lipids.
- **Climatic and edaphic factors**
 - Rainfall
 - Average Temperature
 - The sunlight & shade
 - Humidity
 - Soil type, availability of water
 - Altitude & Topography.
 - Wind



Biotic Components

- The plants, animals and microorganisms present in an ecosystem make the biotic component. These organisms obtain their food through different sources are therefore categorized as Producers or Consumers, based on how do they get their food.
- According to the role of the organisms in ecosystem, biotic components may be classified into three main categories.



Biotic Components

- **Producers**
- **Consumers** (heterotrophs)
 - Primary consumers (Herbivores or plant eaters)
 - Secondary consumers (Carnivores or meat eaters)
 - Tertiary consumers (feed on other carnivores)
- **Decomposers** (Detritivores or Saprotrophs)



Producers

- Producers are green plants which produce their food by chemically combining water and carbon dioxide to produce carbohydrates utilizing solar energy (sunlight). This process by which all green plants produce their food is called photosynthesis.
- Producers make their food by self hence they are also called autotrophs (auto means self and trophs means feeder). Solar energy is converted to chemical energy by plants, which they utilise for their growth.



Producers

- Some microorganisms can also produce organic matter through oxidation of certain chemical compounds in the absence of sunlight. They are known as chemosynthetic organisms or chemoautotrophs.
- In the deep ocean regions where no sunlight is present, chemoautotrophic sulphur bacteria can utilize the heat present in the surroundings to convert dissolved hydrogen sulphide and carbon dioxide into organic compounds.



Consumers

- All organisms which get their organic food by feeding upon other organisms are called consumers. They are also called heterotrophs (hetero means other and trophs means feeder)
- Consumers can be divided into three categories.
 - Primary consumers (Herbivores or plant eaters)
 - Secondary consumers (Carnivores or meat eaters)
 - Tertiary consumers (feed on other carnivores)



Primary consumers

- Primary consumers are also called herbivore (plant eater)
- They are first order consumers.
- They are mainly grass eaters or herbivores because they derive nutrition directly from plants.
- Some examples are deer, rabbit, goat, cow grasshopper, small insects
- In aquatic system microscopic plants are abundant (phytoplankton) and tiny herbivores are also present.



Secondary consumers

- They are also called Carnivores (meat eaters)
- They are second order consumers.
- Secondary consumers include primary carnivores since they directly feed on herbivores.
- Some examples of primary carnivores are frog, birds, fox, small fish etc.



Tertiary consumers

- They are known as secondary carnivores
- They are third order consumers.
- These include large carnivores which feed on secondary consumers.
- Some examples of large carnivores are wolves, hawks, snake, big fish etc.



Decomposers

- Decomposers include microorganisms which decompose dead organic matter to simple organic substances like water, ammonia and carbon dioxide and other byproducts.
- They derive their food by breaking down the complex organic molecules to simpler organic compounds and ultimately into inorganic nutrients. They help in recycling of nutrients.
- Decomposers include microorganisms like bacteria and fungi. Usually, bacteria attacks on animal tissues while fungi prefer plant tissues.



Functions of Ecosystems

- 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.
- Every organism is the food of other organism.
- The producers, consumers, and decomposers of each ecosystem make up a food chain.
- There are many food chains in an ecosystem.
- Food chains show where energy is transferred and not who eats who.

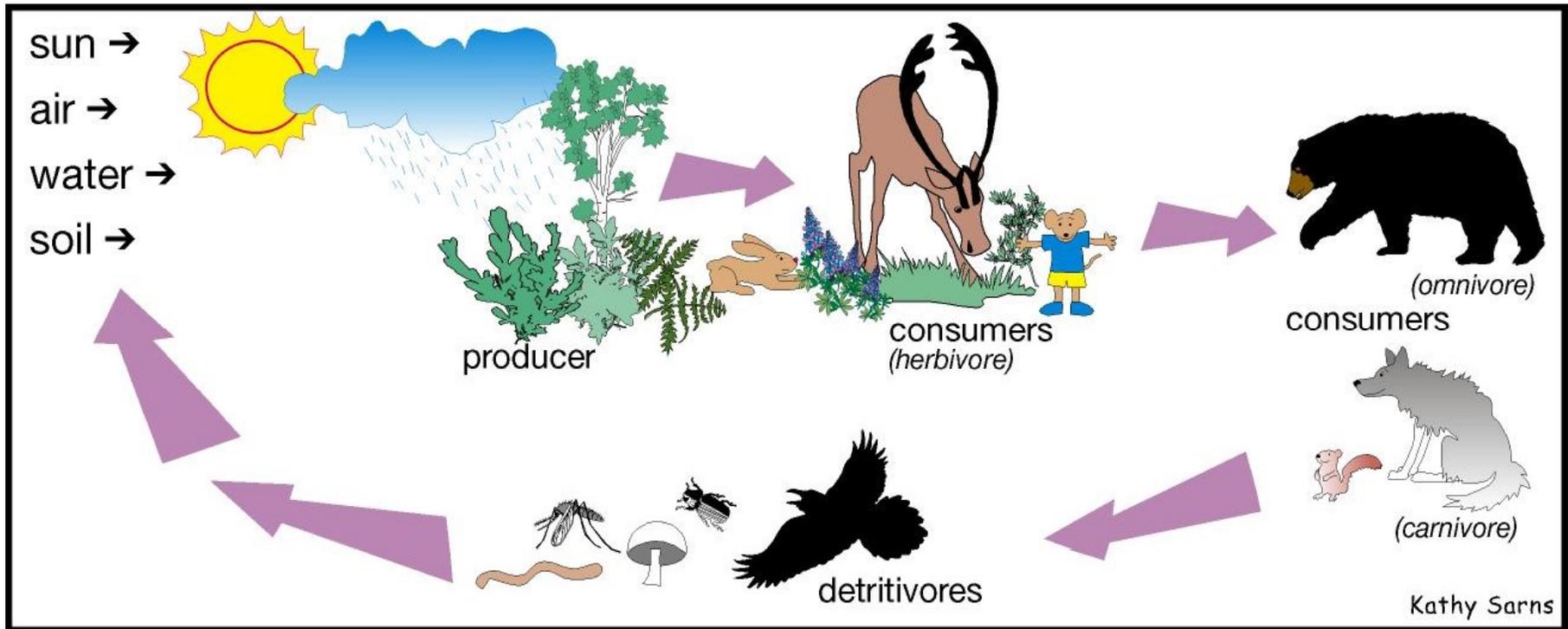


Food chain

- Grass → grasshopper → Frog → Snake → Hawk
(Grassland ecosystem)
- Phytoplanktons → water fleas → small fish → Tuna
(Pond ecosystem)
- Lichens → reindeer → Man (Arctic tundra)



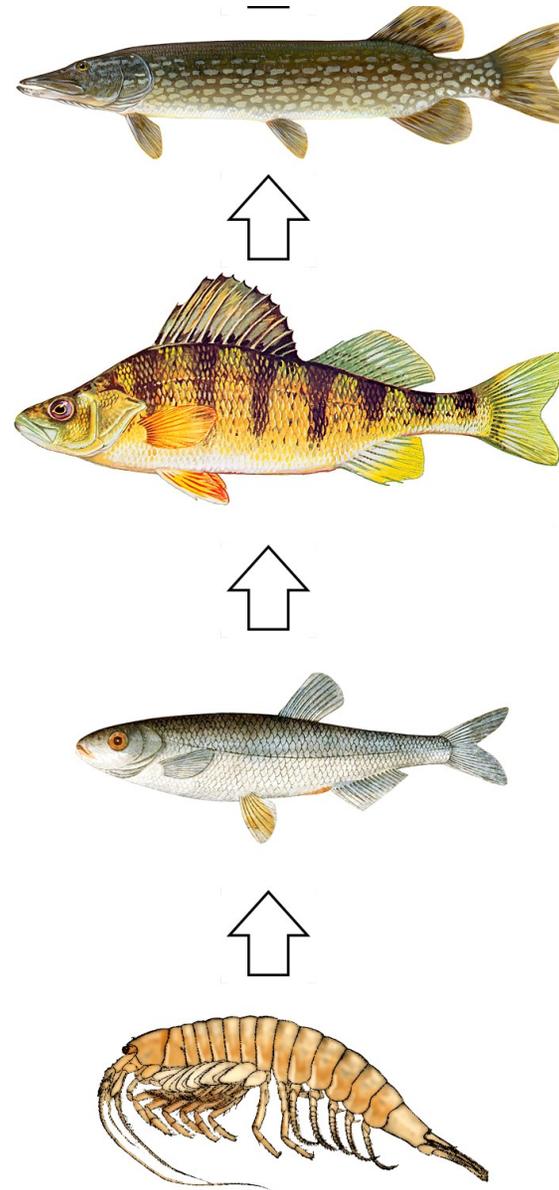
Grazing food chain



Terrestrial Food Chain

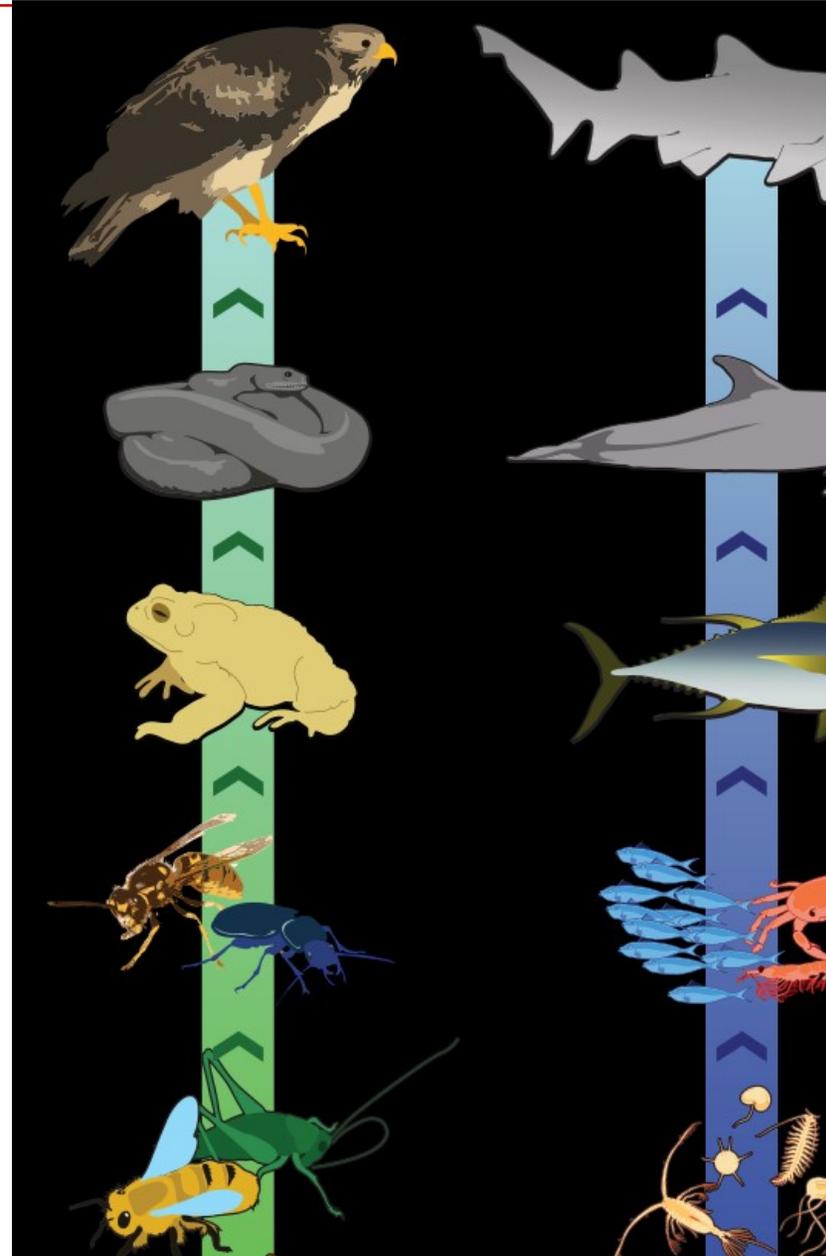


Marine Food Chain



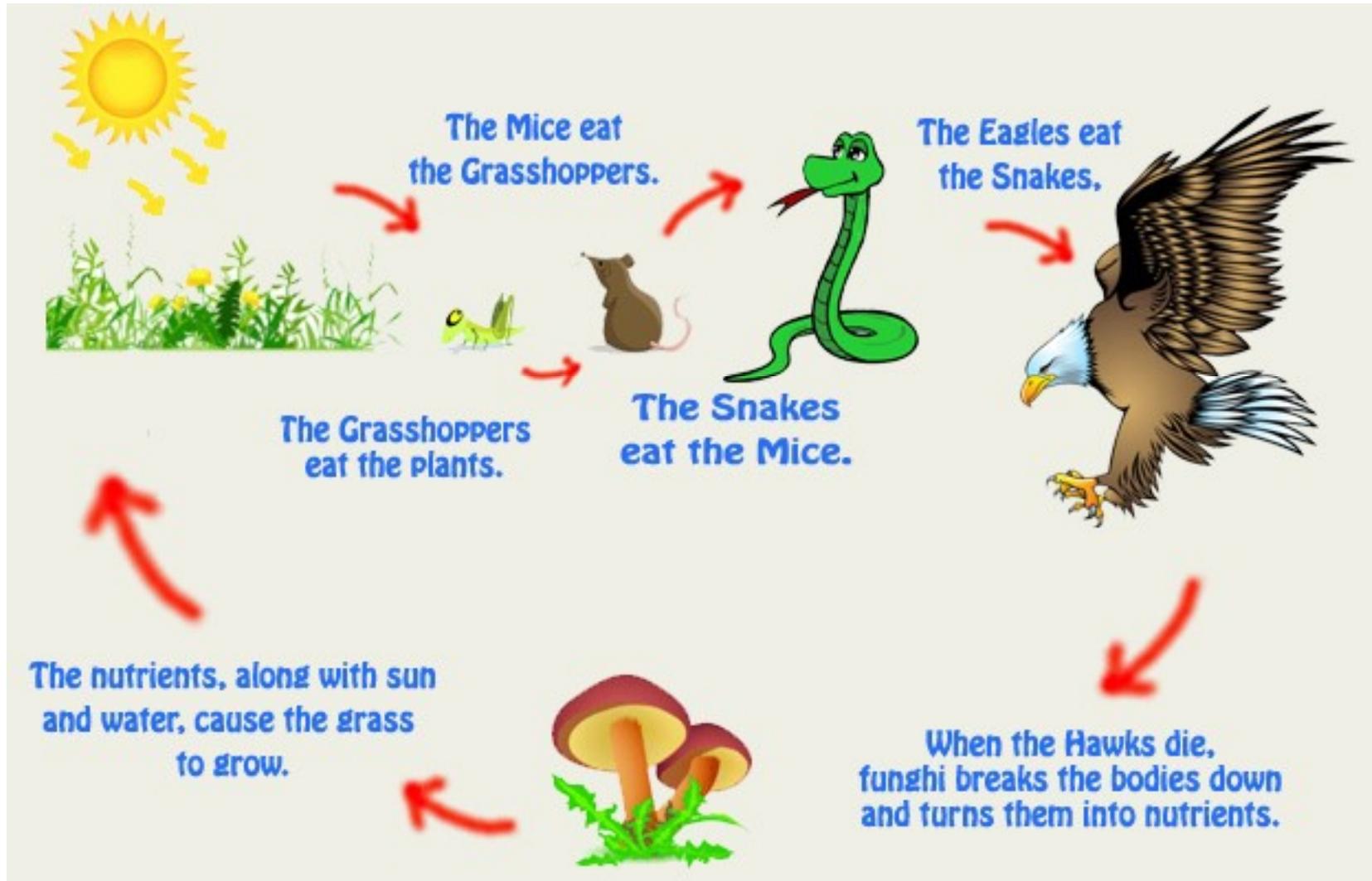


Food Chain





Food Chain – Complete cycle



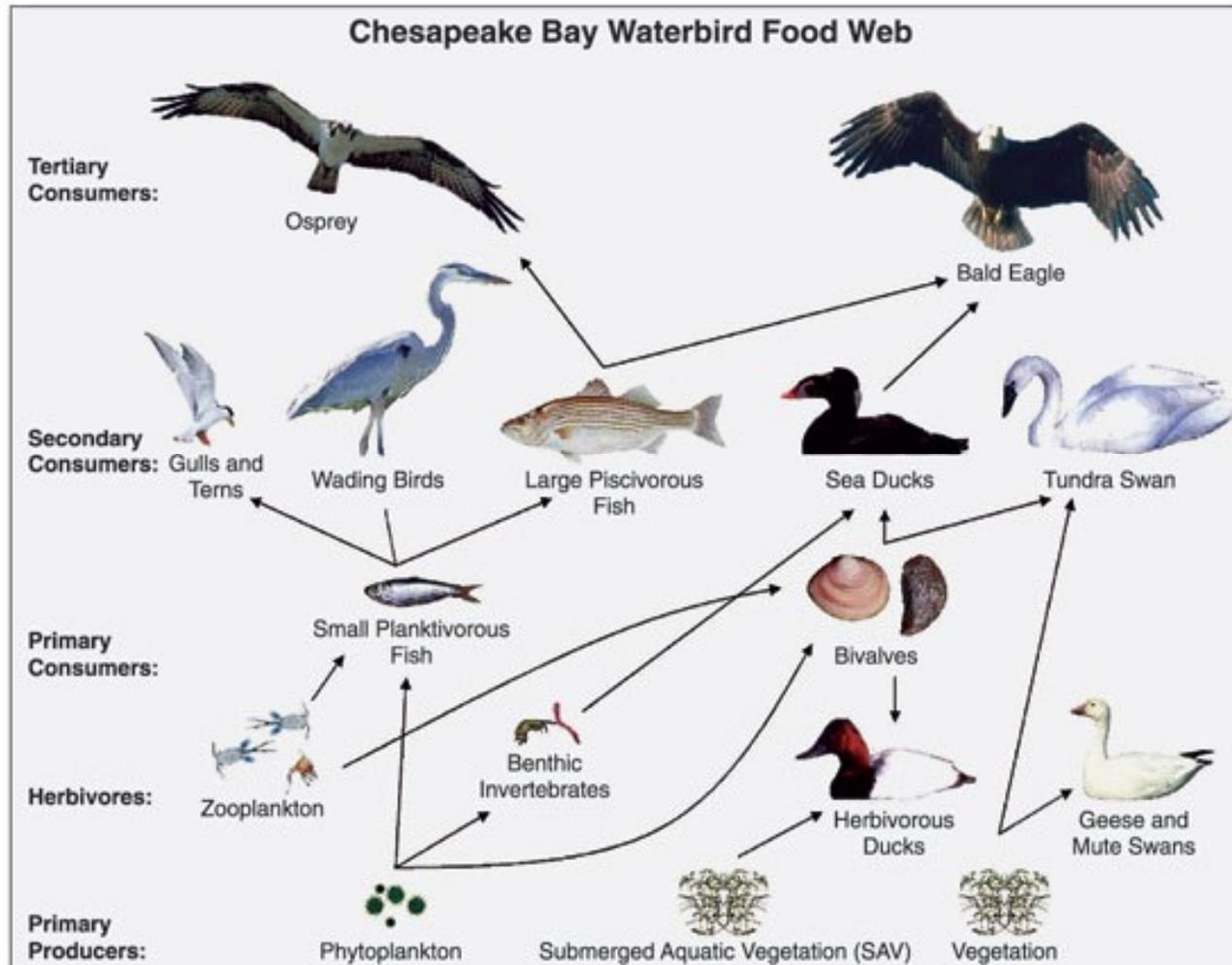


Food web

- No food chain is isolated.
- Organisms interact with each other at various levels in different food chains.
- Feed on more than one type of organism.
- Form a **Complex Food Web**.
- Food Web - is a network of food chains where different types of organisms are connected at different trophic levels

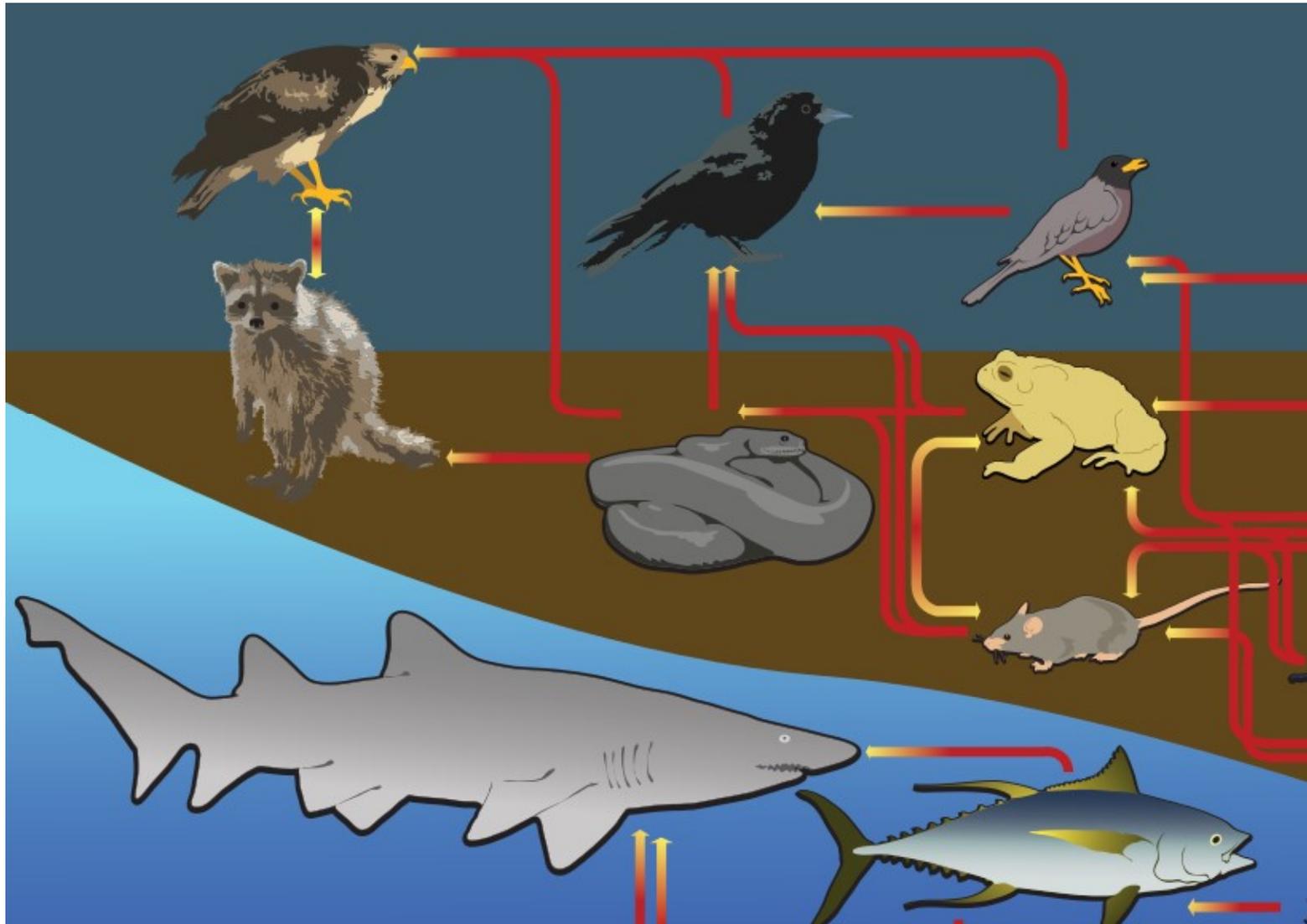


Food Web



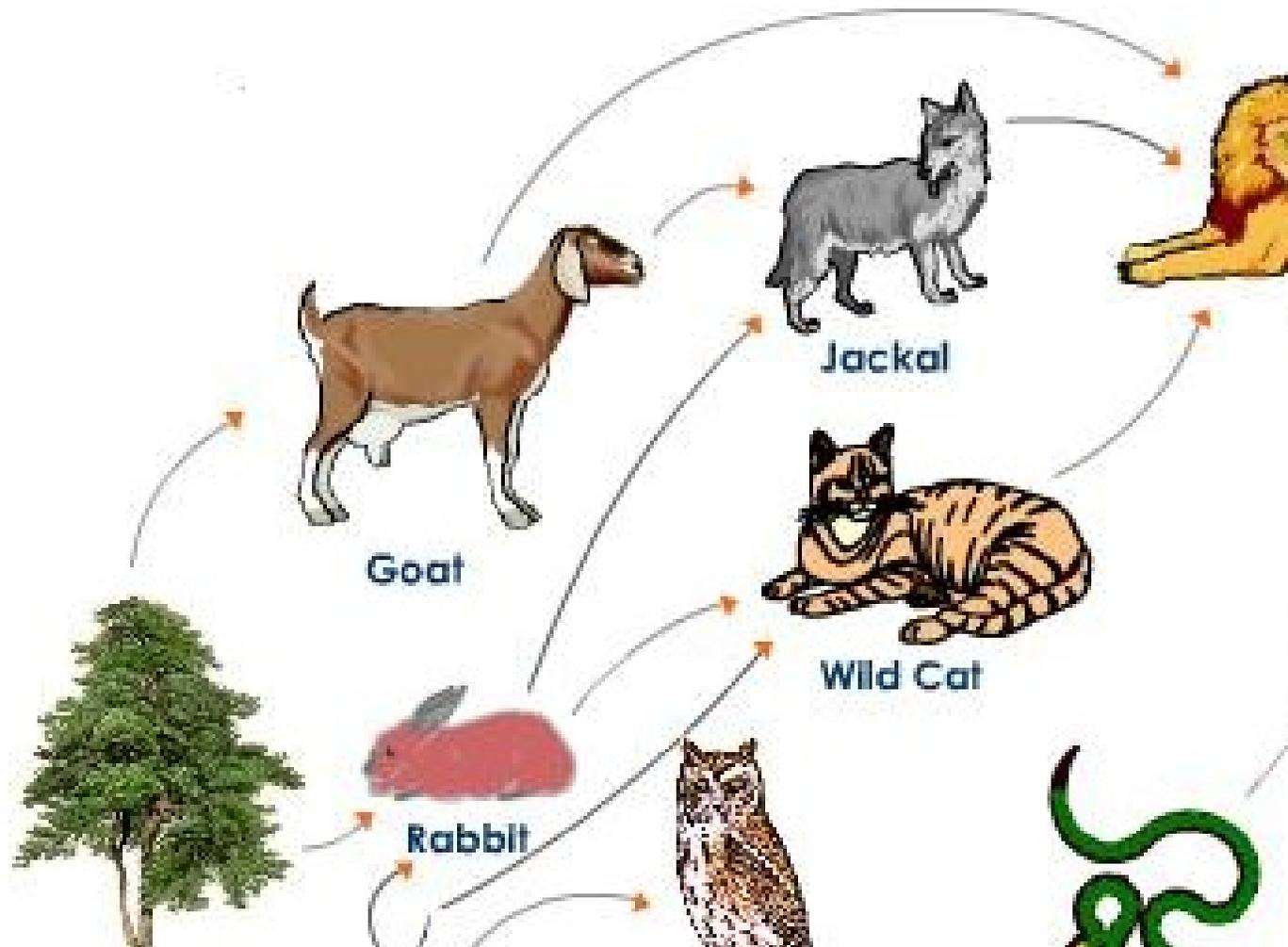


Food Web



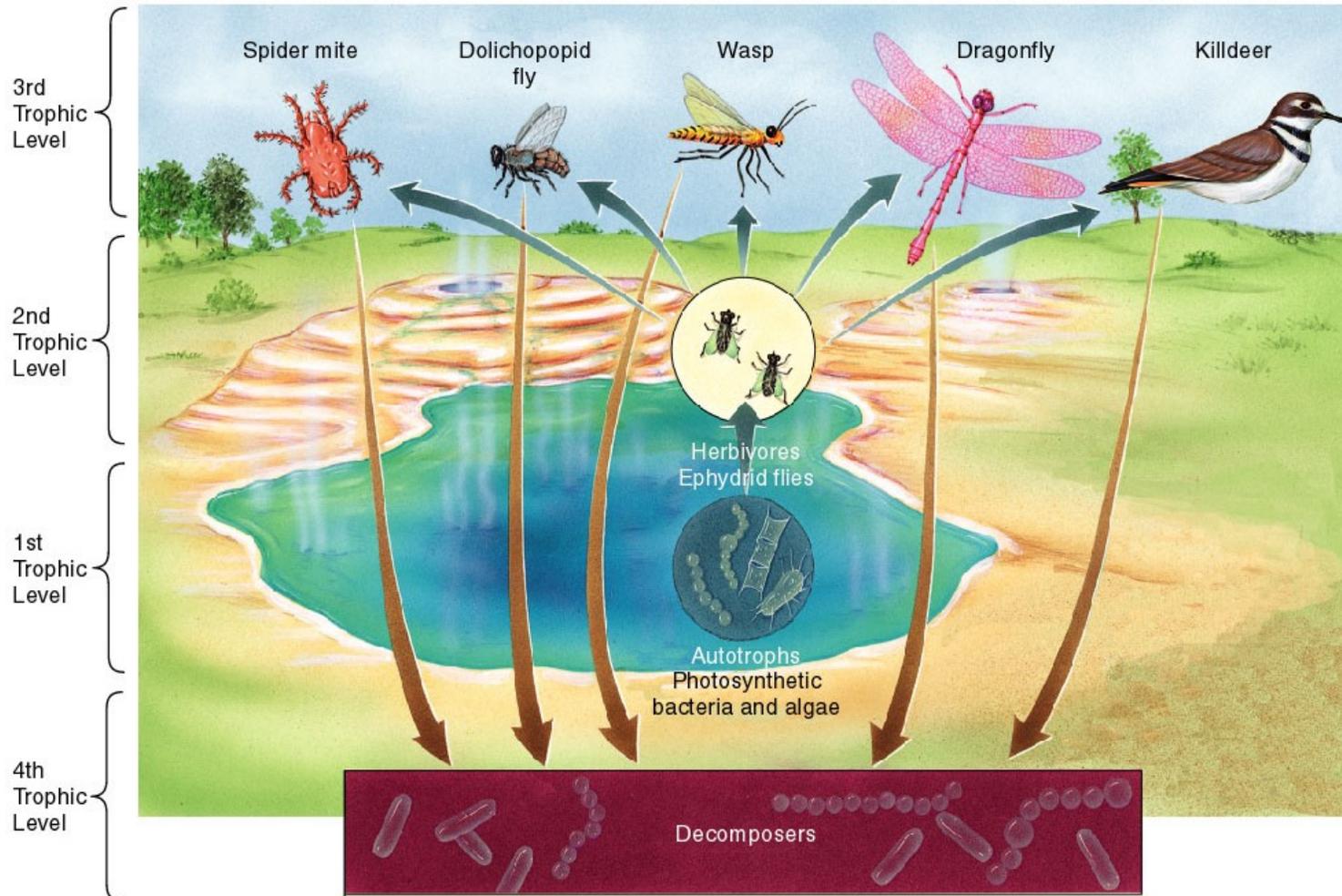


Food Web





Food web of a hot spring





Significance of Food chain and Food Web

- Energy and nutrient flow
- Maintain population of different species and thus maintain **Ecological Balance**

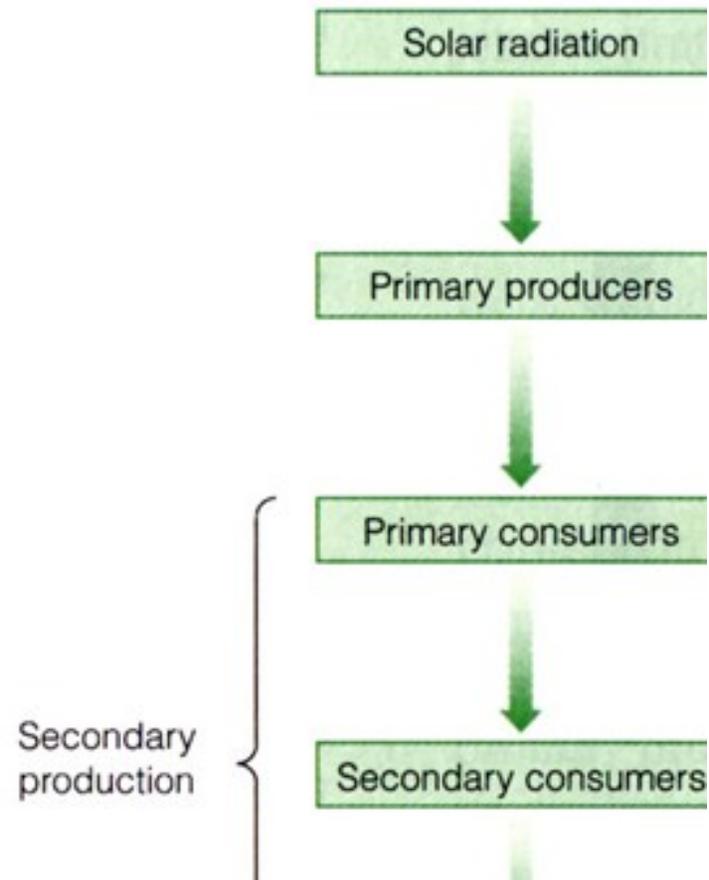


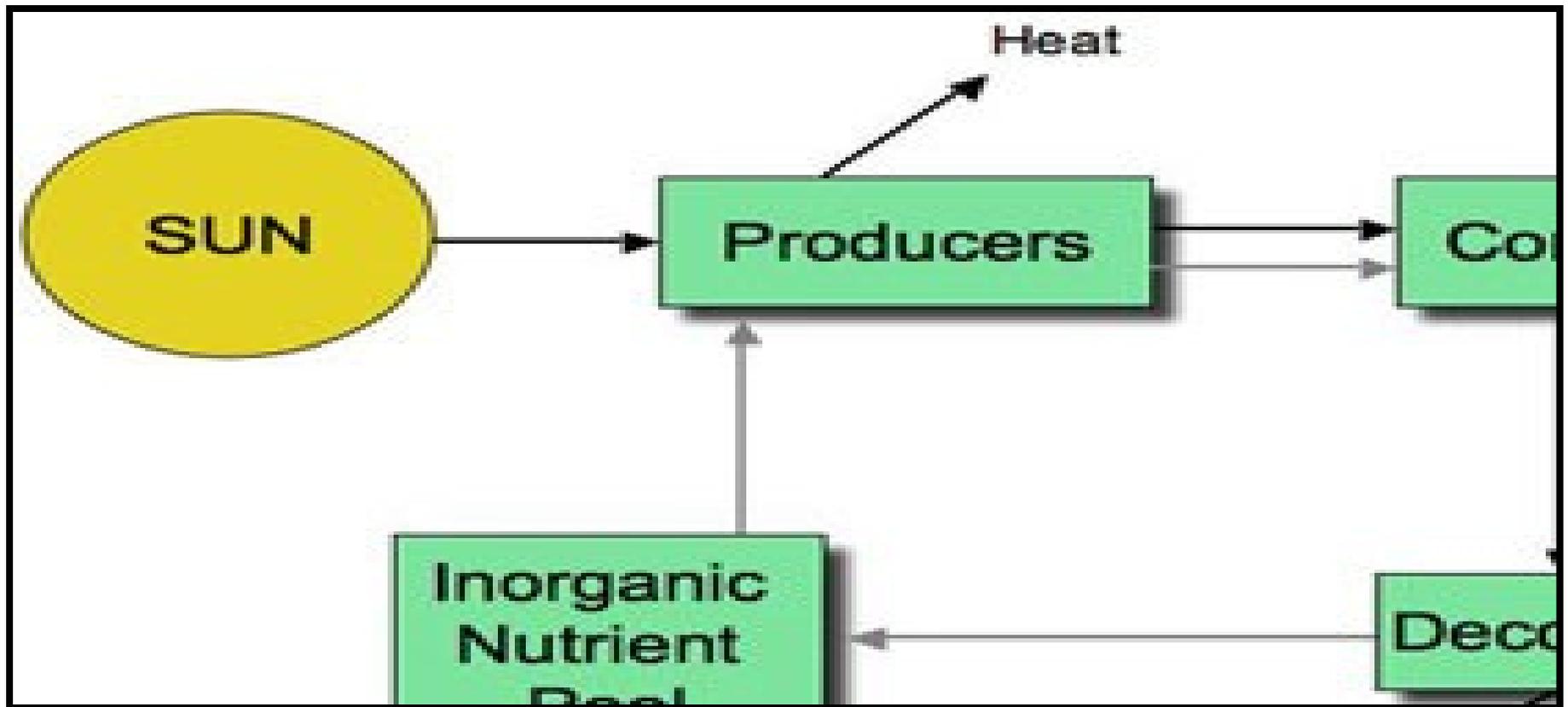
Energy Flow in Ecosystem

- 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 in the ecosystem

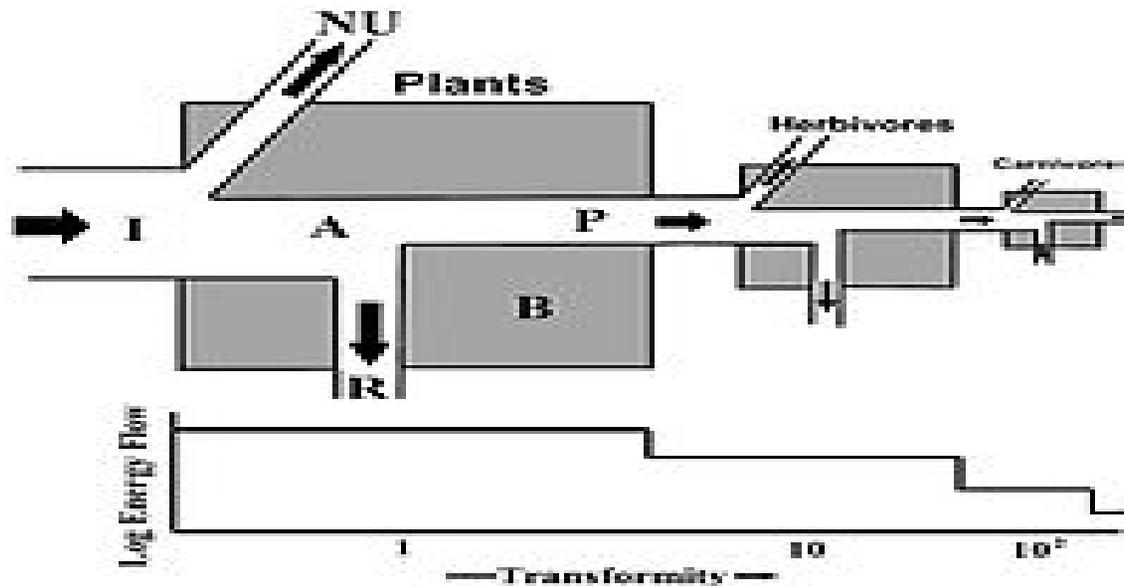






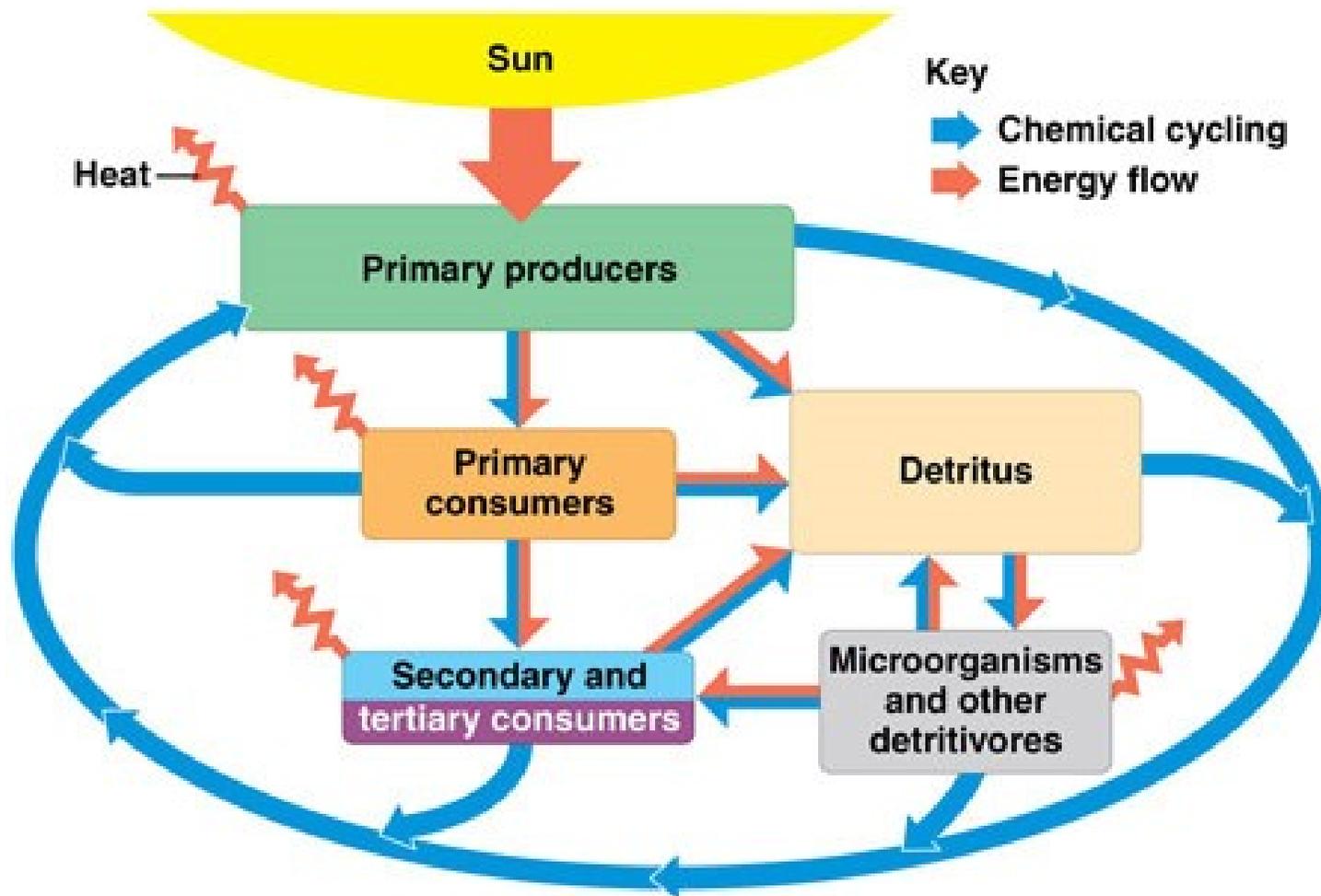
Universal energy flow model

- 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





Nutrient Cycling & Energy Flow



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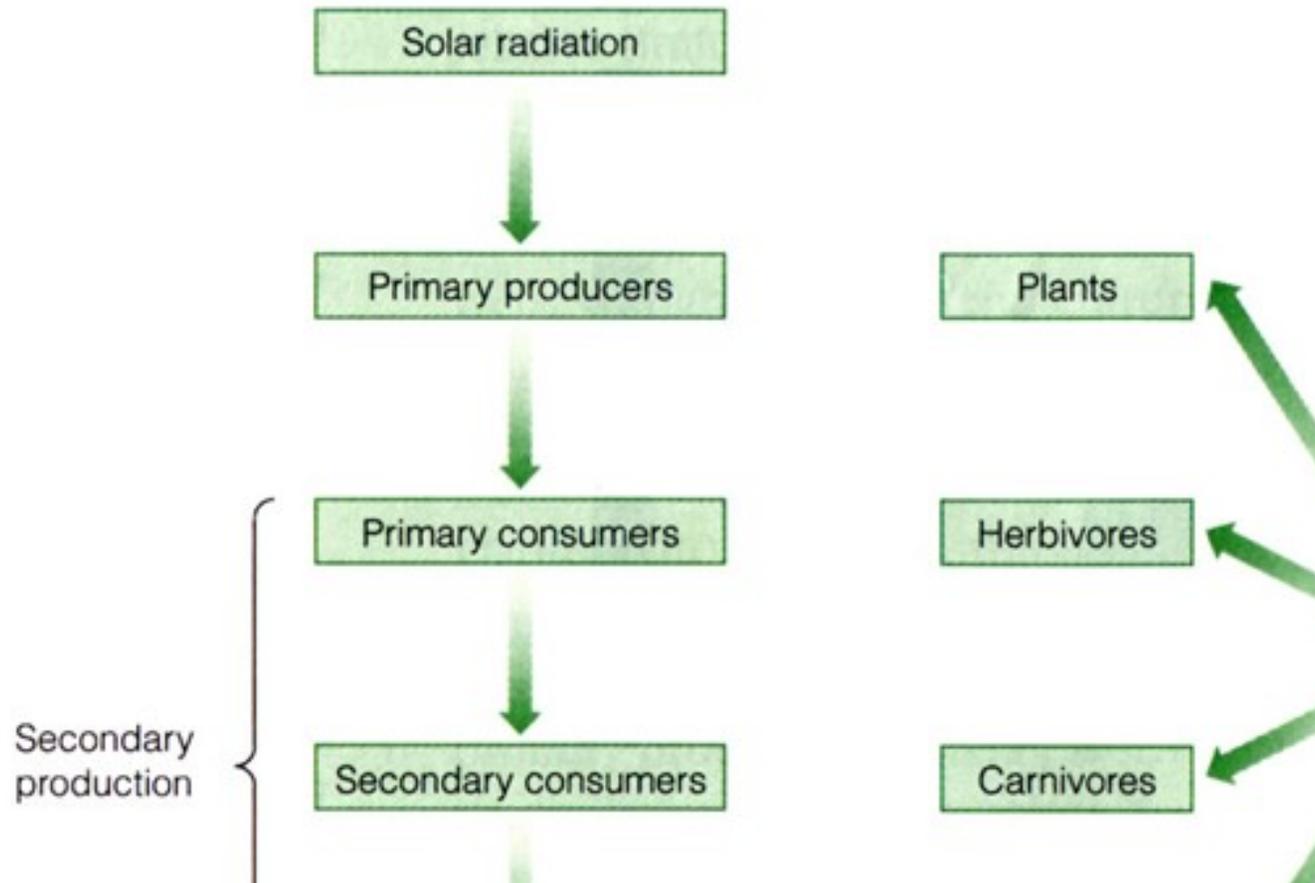


Trophic Levels

- A trophic level is the position occupied by an organism in a food chain.
 - Trophic levels can be analyzed on an energy pyramid.
 - **Producers** are placed at the base of the pyramid and comprise the **first trophic level**.
 - **Primary consumers** are placed at the **second trophic level**.
 - **Secondary consumers** are placed at the **third trophic level**.
 - Finally **tertiary consumers** are placed at the **top trophic level**.
-



Trophic level





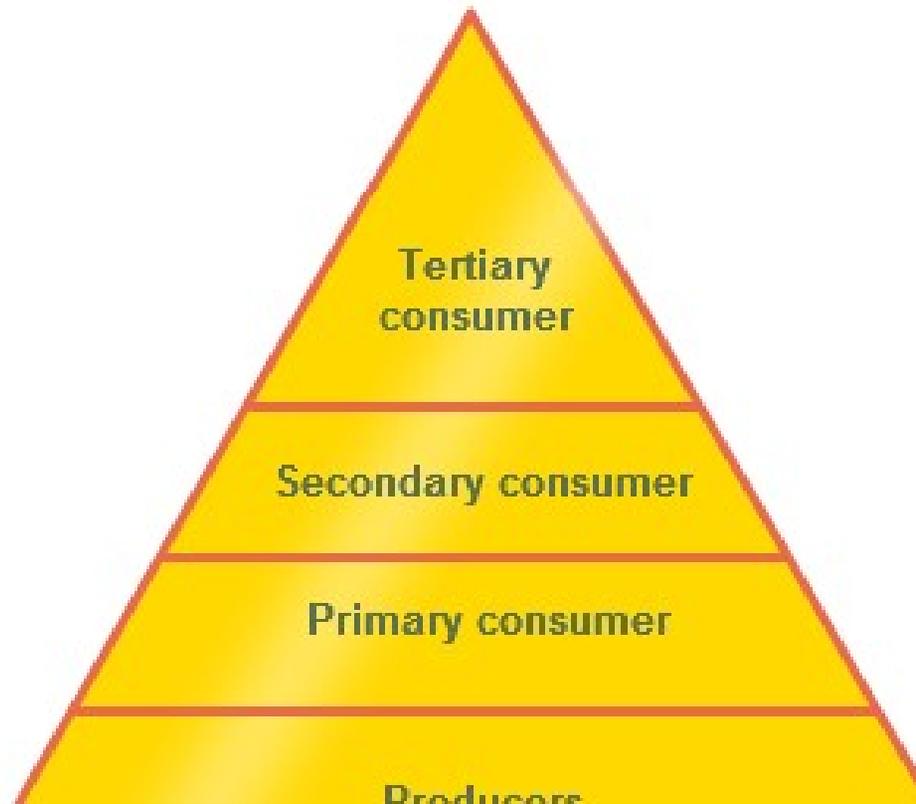
Ecological Pyramids

- 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

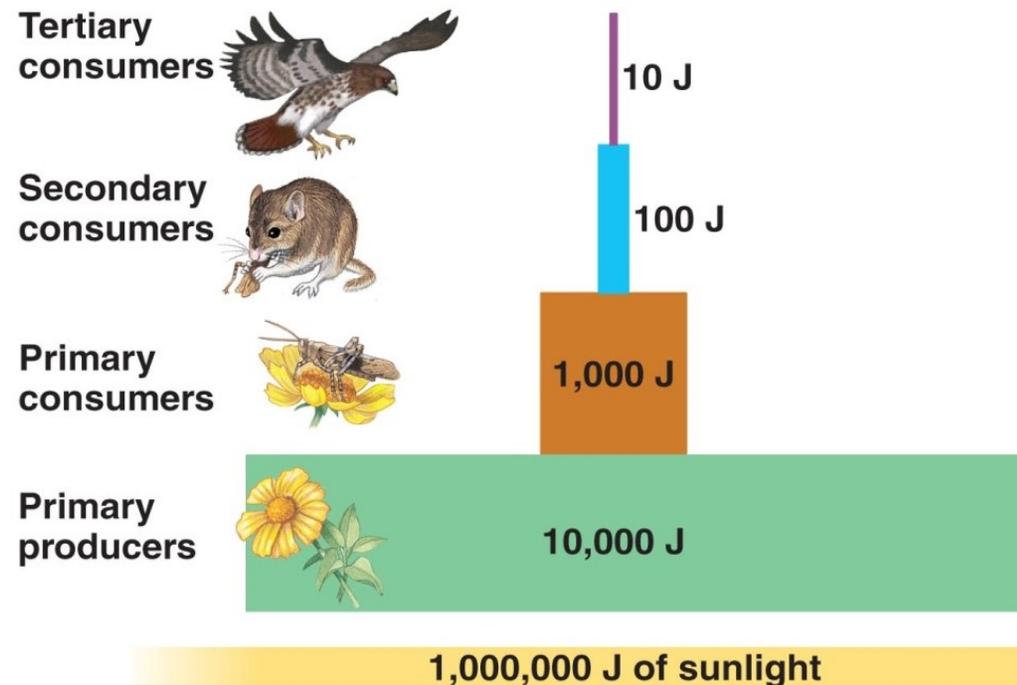
- Represents number of individual organism at each level.
- May be upright or inverted.





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.

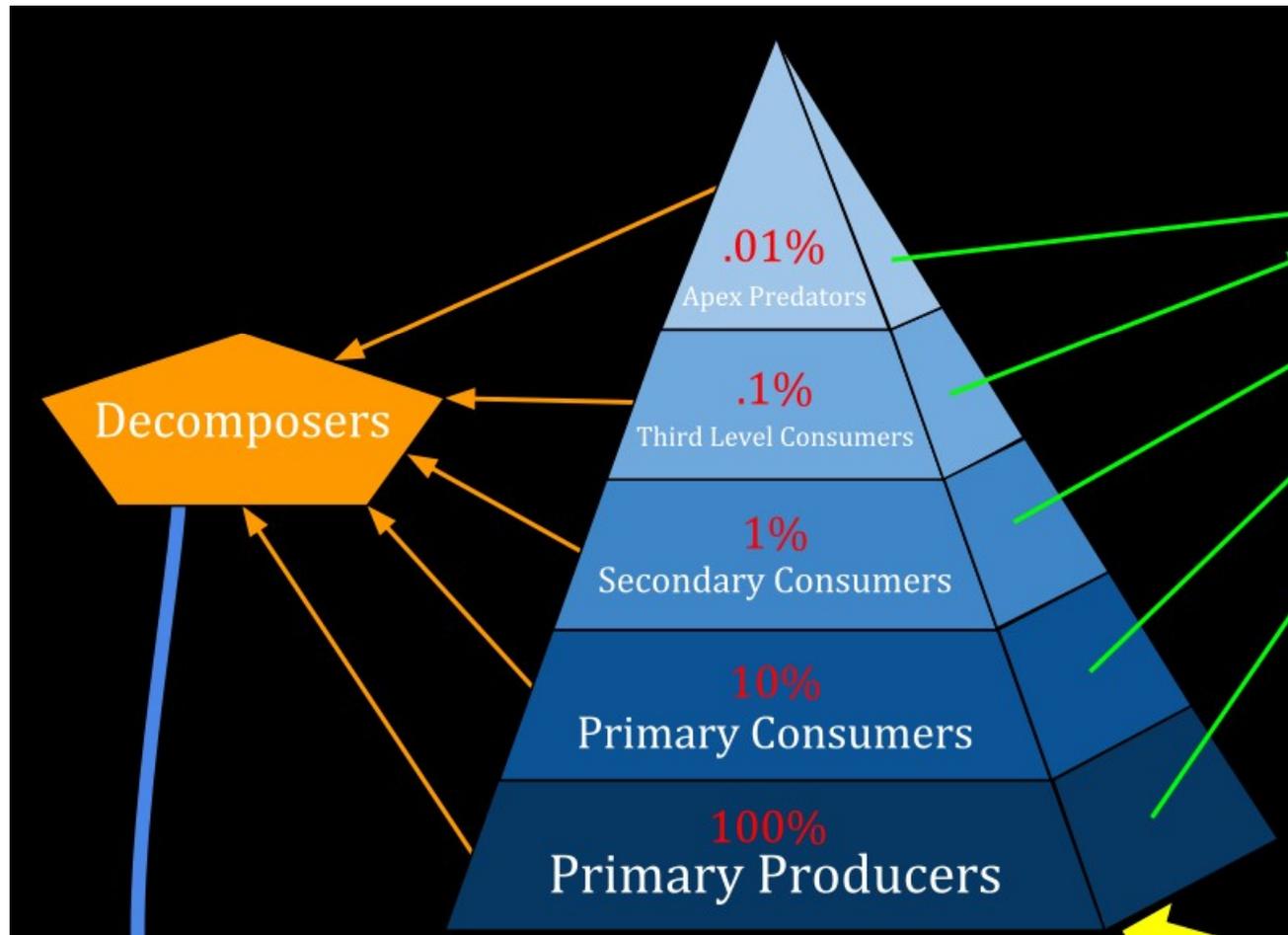


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Pyramid of Energy

The amount of energy present at each trophic level is shown in this type of pyramid. It is always upright.





Pyramid of Biomass

It is based upon the total biomass (organic matter) at each trophic level in a food chain. It can also be upright or inverted.





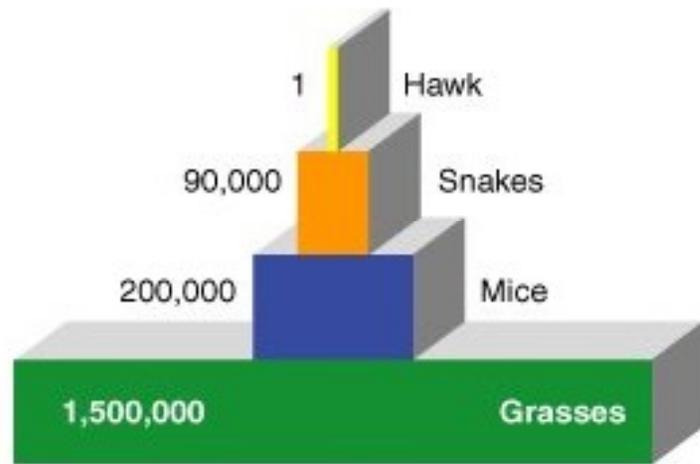
Pyramid of Numbers

**Represents number of individual organism at each level.
May be upright or inverted.**

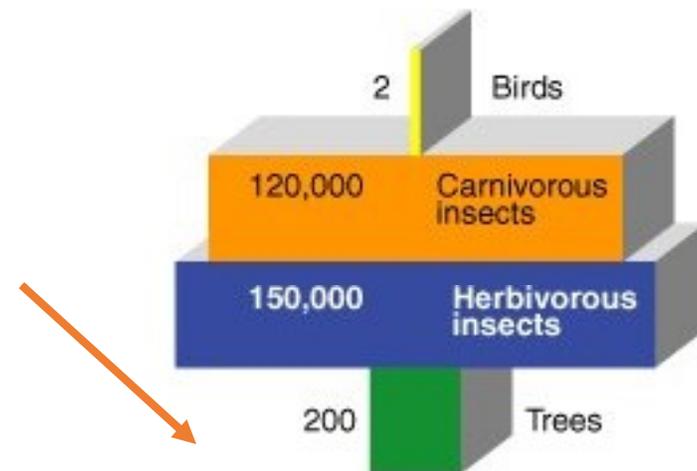




Ecological Pyramids



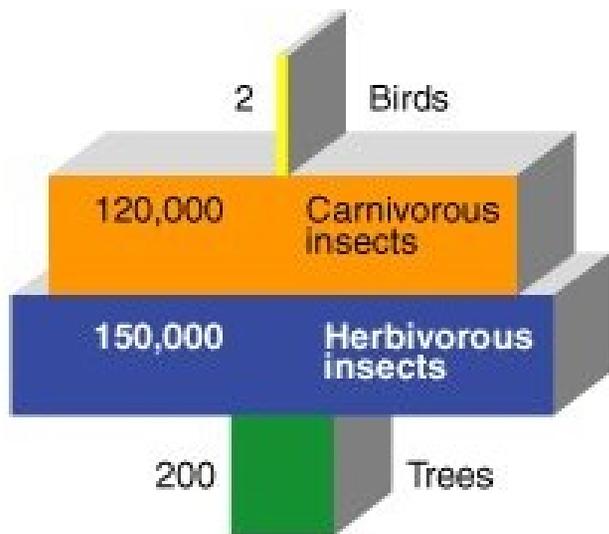
(a) Grassland community



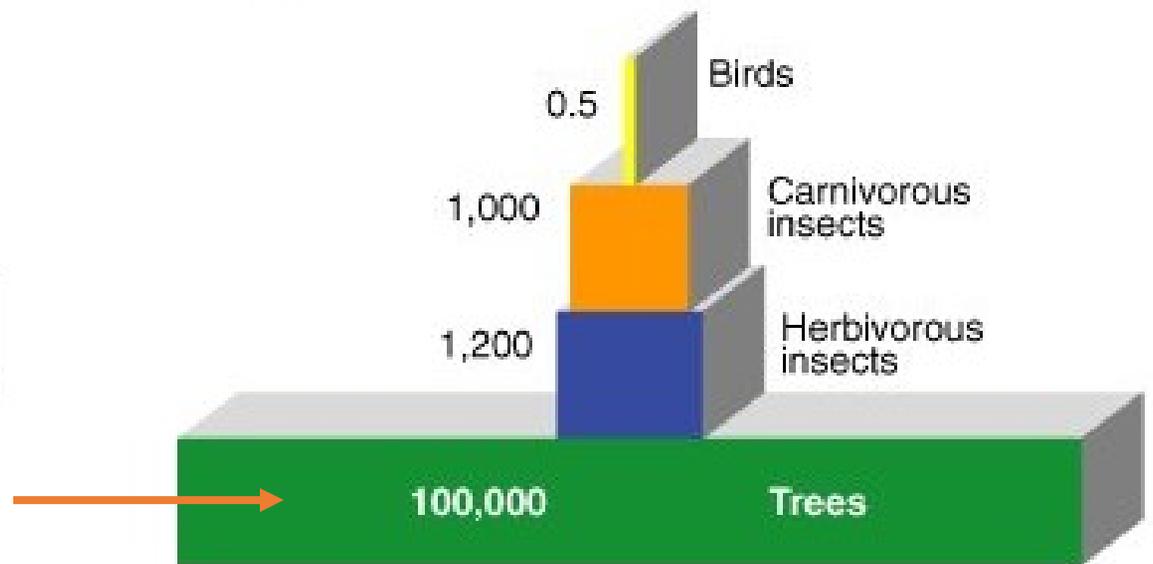
(b) Forest community



Ecological Pyramids



(b) Forest community



(c) Biomass of forest community

(kg)



Ecological Succession

- Ecological succession is defined as an orderly process of changes in the community structure and function with time mediated through modifications in the physical environment and ultimately culminating in a stabilized ecosystem known as climax.



Process of Ecological Succession

- Nudation
 - It is the development of a bare area without any life form.
- Invasion
 - It is the successful establishment of one or more species on a bare area through dispersal or migration
- Competition and coaction
 - Inter-specific and intra-specific competition for space, water and nutrition.



Process of Ecological Succession

- Reaction
 - The living organisms grow, use water and nutrients from the substratum, and in turn, they have a strong influence on the environment which is modified to a large extent and this is known as reaction.
- Stabilization
 - The succession ultimately culminates in a more or less stable community called climax which is in equilibrium with the environment.



Process of Ecological Succession

