

EWCE 131
Ecology and Environmental Pollution

Lecture 5

Instructor

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Lecture outline

Food Chain in Ecosystem

Topics

- Ecological communities and food chain
- Types of food chains
- Food webs
- Ecological pyramids

Ecological Communities



Producer





Decomposers





Consumers

Food Chain

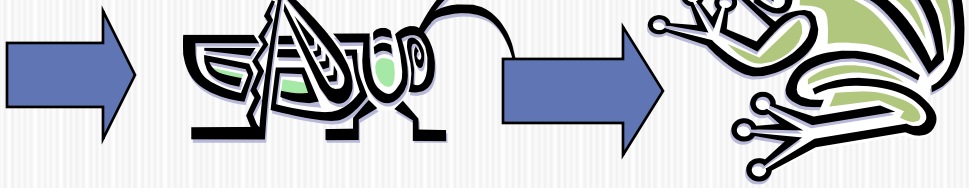
- Flow of energy in an ecosystem is one way process.

- **Food chain - sequence of organism**, i.e., from producer to consumer, through which the energy flows.



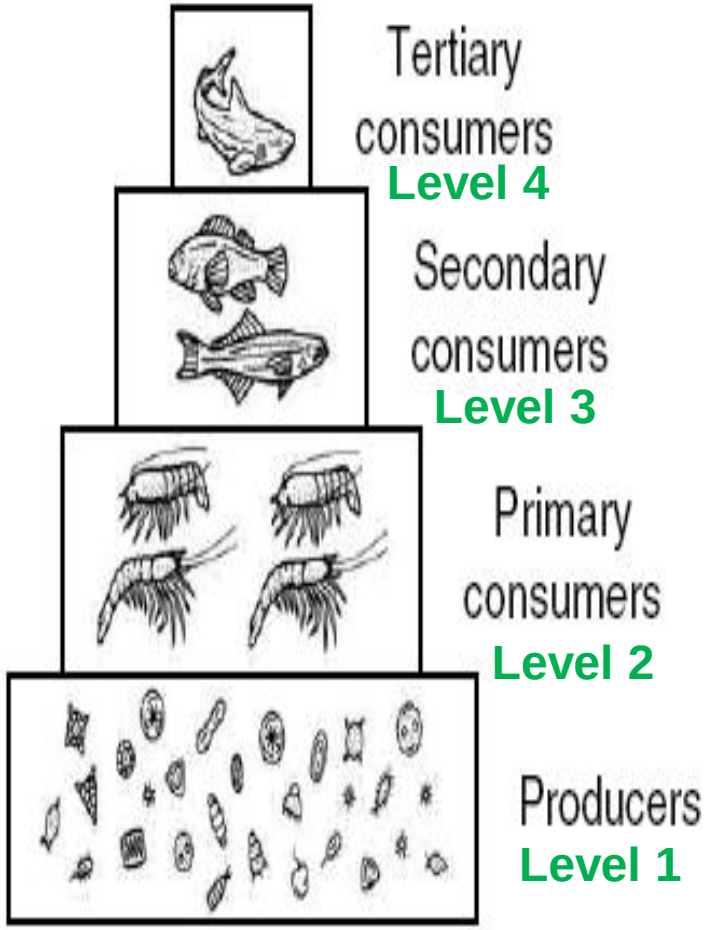


Grass → Zebra → Lion


Trophic Level in Food Chain

- **Level 1** – Producers (organisms that make their own food)
- **Level 2** – Primary Consumers (herbivores that eat plants)
- **Level 3** – Secondary Consumers (carnivores that eat herbivores)
- **Level 4** – Tertiary Consumers (carnivores or omnivores that eat other carnivores)

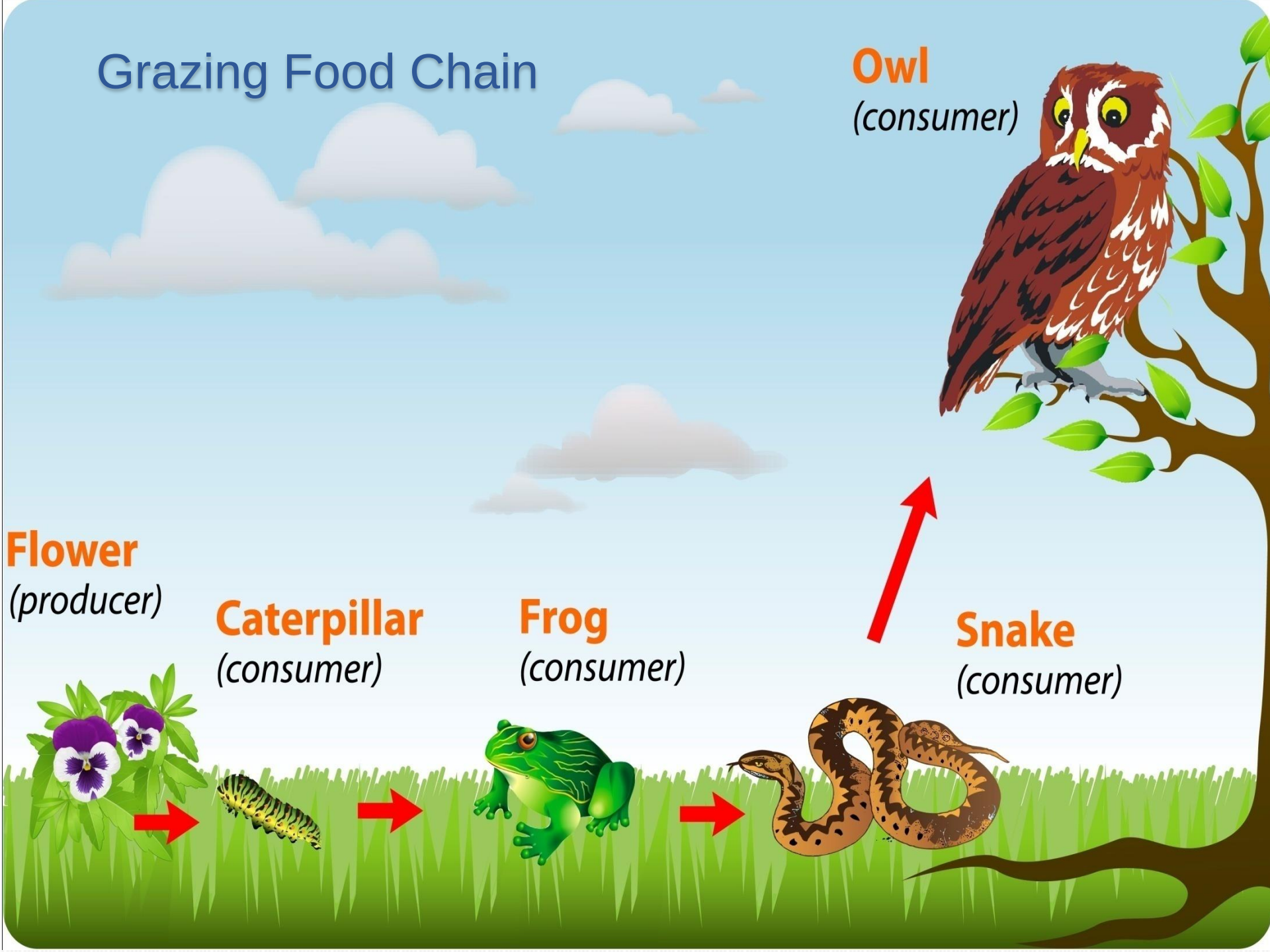


Types of Food Chain

Grazing Food Chain

- Consumers utilize plants as their food.
- Begins from green plants and the primary consumer is herbivore.
- Most of the natural ecosystems follow grazing food chain.
- Example: **grass => grasshopper => birds => falcon**

Grazing Food Chain



Types of Food Chain

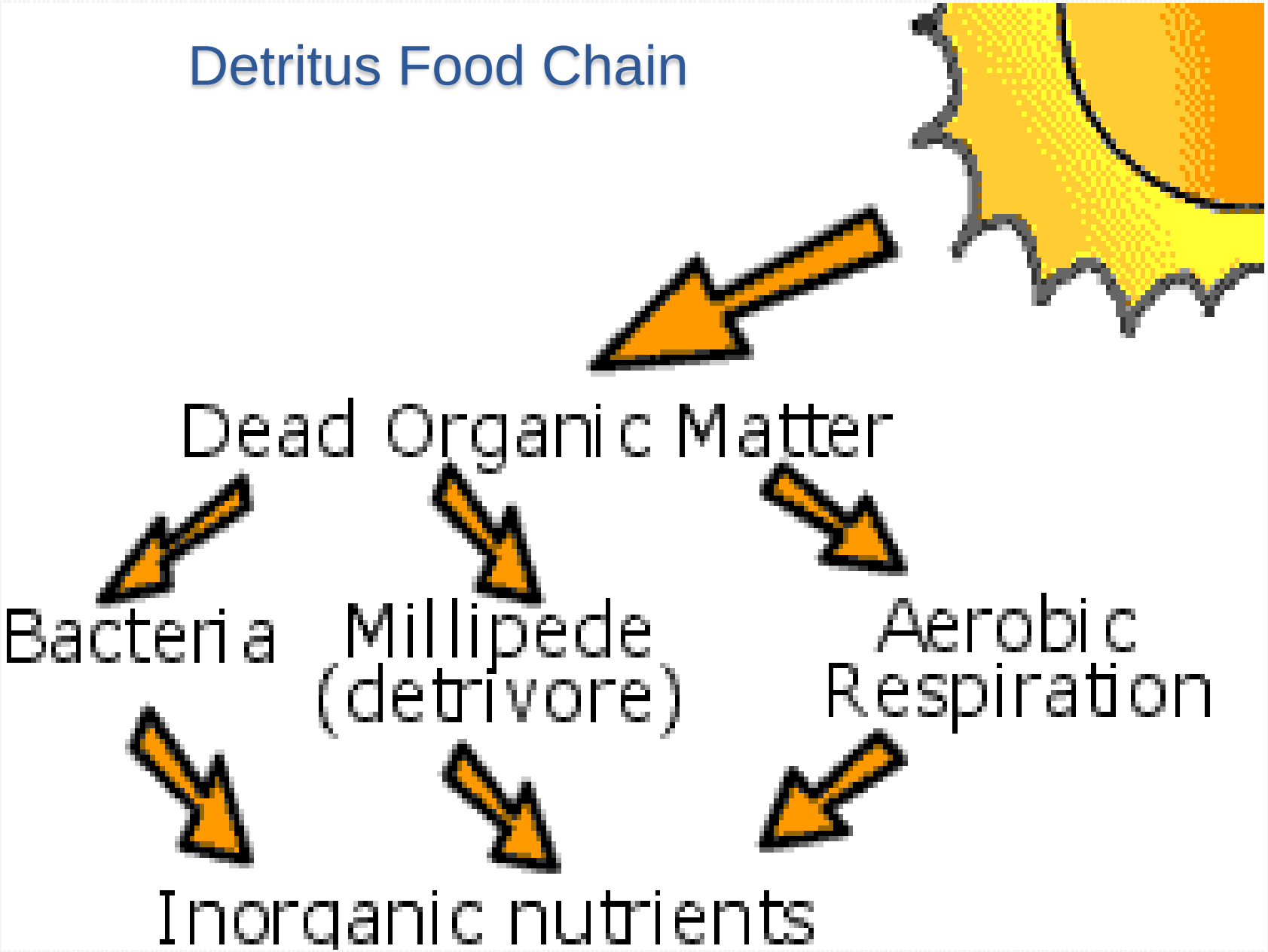
Detritus Food Chain

- Starts from dead organic matter of decaying animals and plant bodies to micro-organisms and then to detritus feeding organism and to other predators.

- Depends mainly on influx of organic matter produced in another system.

- Organisms include algae, bacteria, fungi, protozoa, insects, nematodes etc.

Detritus Food Chain



Significance of Food Chain

- To understand -

  ✓ Feeding relationship as well as the interaction between organism and ecosystem.

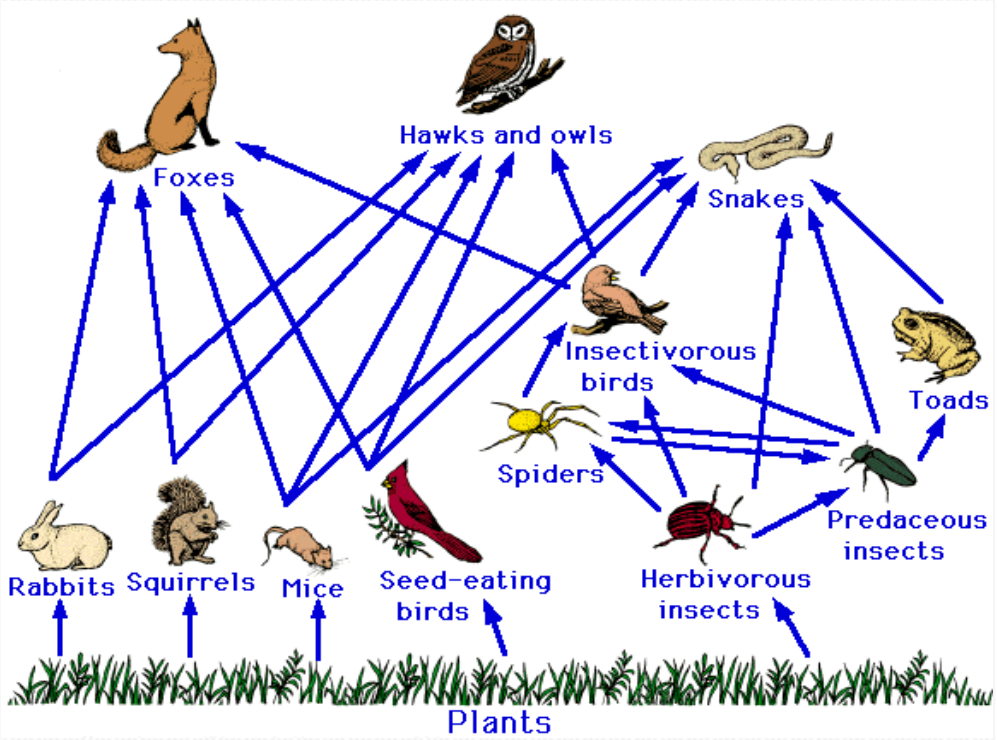
  ✓ Mechanism of energy flow and circulation of matter in ecosystem.

  ✓ Movement of toxic substance and impact of biological magnification in ecosystem.

Food Web

- **Food web** - a network of food chains, which are interconnected at various tropic levels, forming a number of feeding connections amongst different organisms of a biotic community".

- Also known as consumer-resource system.



Important Terms

- **Node** – an individual species, or a group of related species or different stages of a single species.

- **Link** – connects two nodes. Arrows represent links, and always go from prey to predator.

- **Basal species** – the lowest tropic level

- **Top predator** – the highest tropic level

- **Nutrient** movement – cyclic

- **Energy** movement – unidirectional and non-cyclic.

Types of Food Web Representation

TOPOLOGICAL WEB	• Simply indicates a **feeding relationship**
BIO-ENERGETIC/ FLOW WEB	• Includes information on the **strength of feeding interaction**
INTERACTION WEB	• Arrows show how **one group influences another**

Significance of Food Web

- Distinguish levels of producers and consumers

- Identify and define the importance of animal relationships and food sources

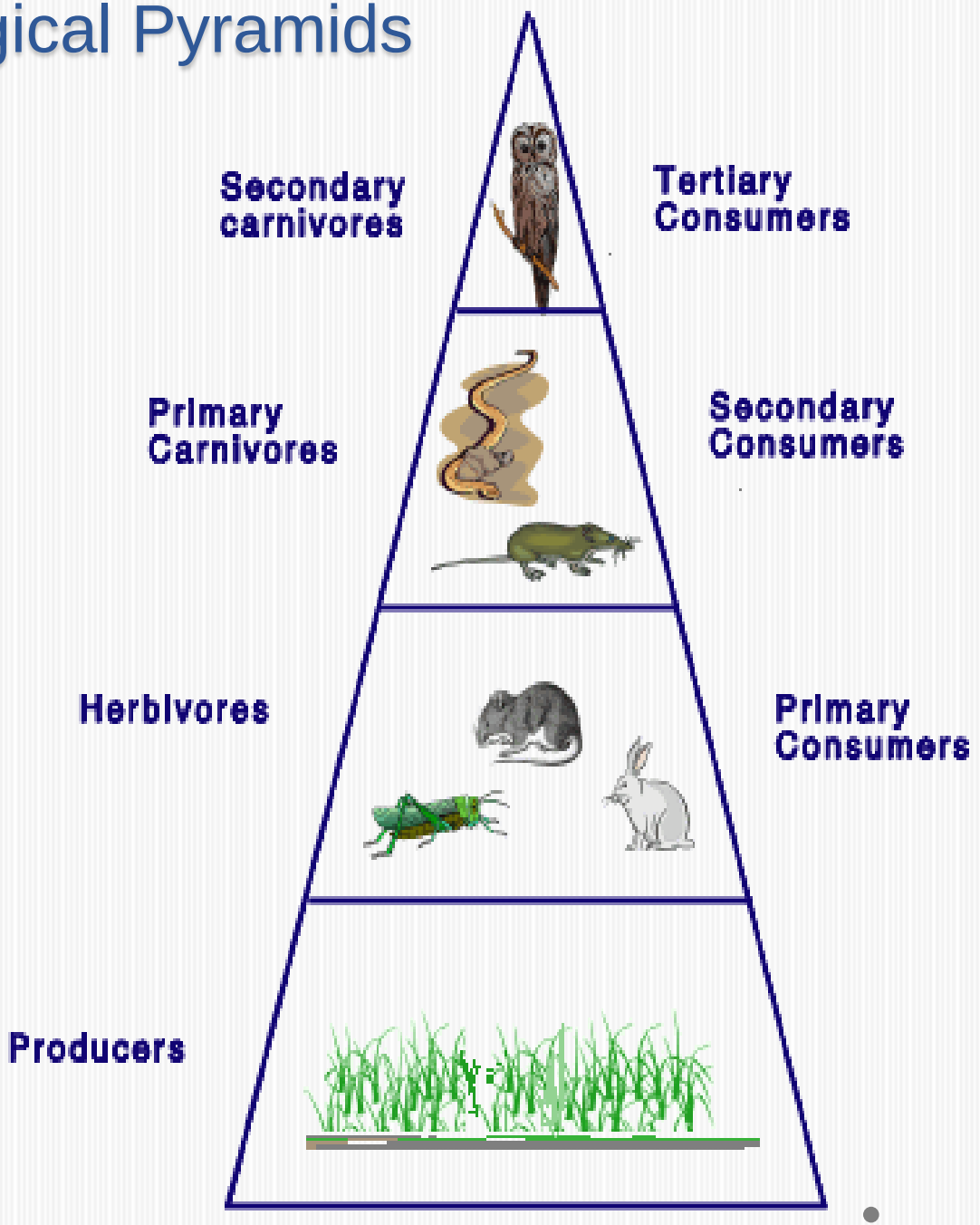
- For understanding that plants are the base of all ecosystems and food chains, sustaining life by providing nourishment and oxygen needed.

- Provides stability to the ecosystem.

Ecological Pyramids

- Graphical representation of the structure and function of tropic levels of an ecosystem.

- **Tropic levels** - feeding positions in a food chain such as primary producers, herbivores, primary carnivore etc.



Principle of Ecological Pyramids

- Graphically represent the quantitative differences between the amount of living materials stored at each trophic level of a food chain.

- Provides easier observation of energy transfers and losses.

- Give an idea on what feeds on what and what organisms exist at the different trophic levels.

Principle of Ecological Pyramids

- They also help to demonstrate that ecosystems are unified systems; that they are in balance.
- It is often drawn from the autotrophic level up.
- It can be used to examine how the population of a certain species affects another.

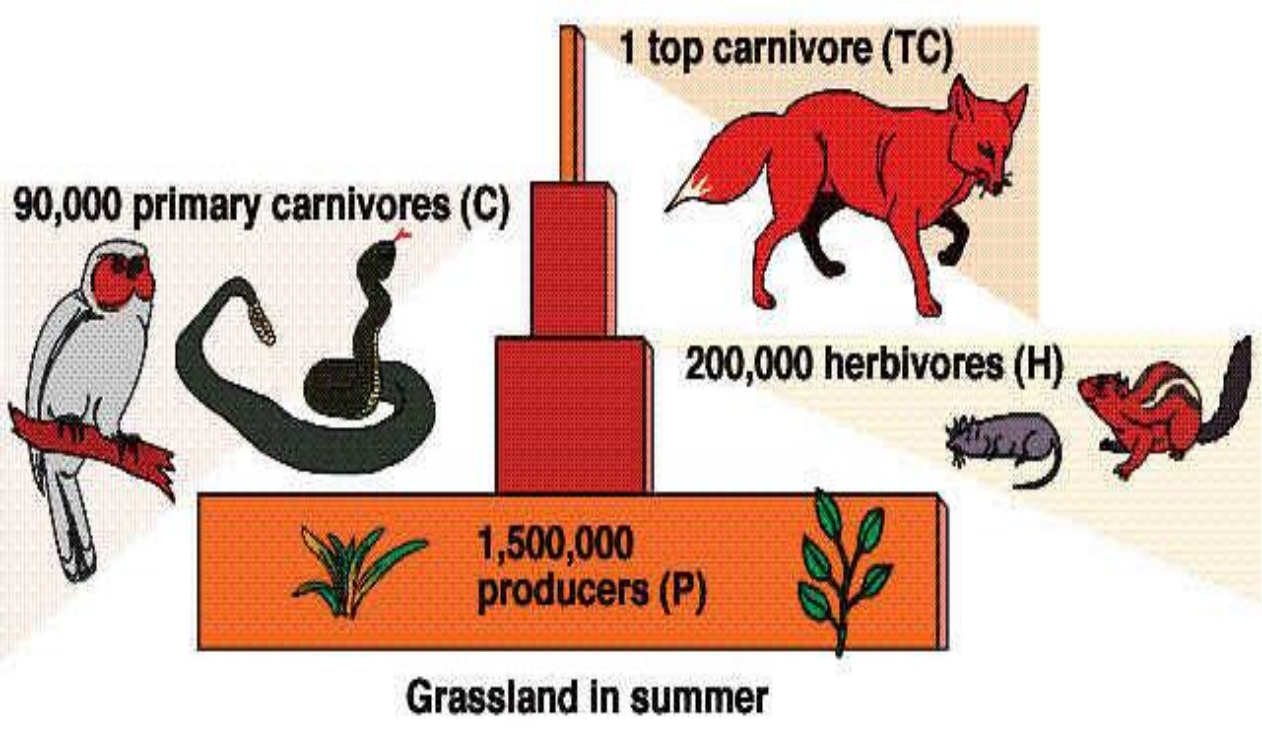
Types of Ecological Pyramids

- Pyramid of numbers
- Pyramid of biomass
- Pyramid of productivity

Pyramid of Numbers

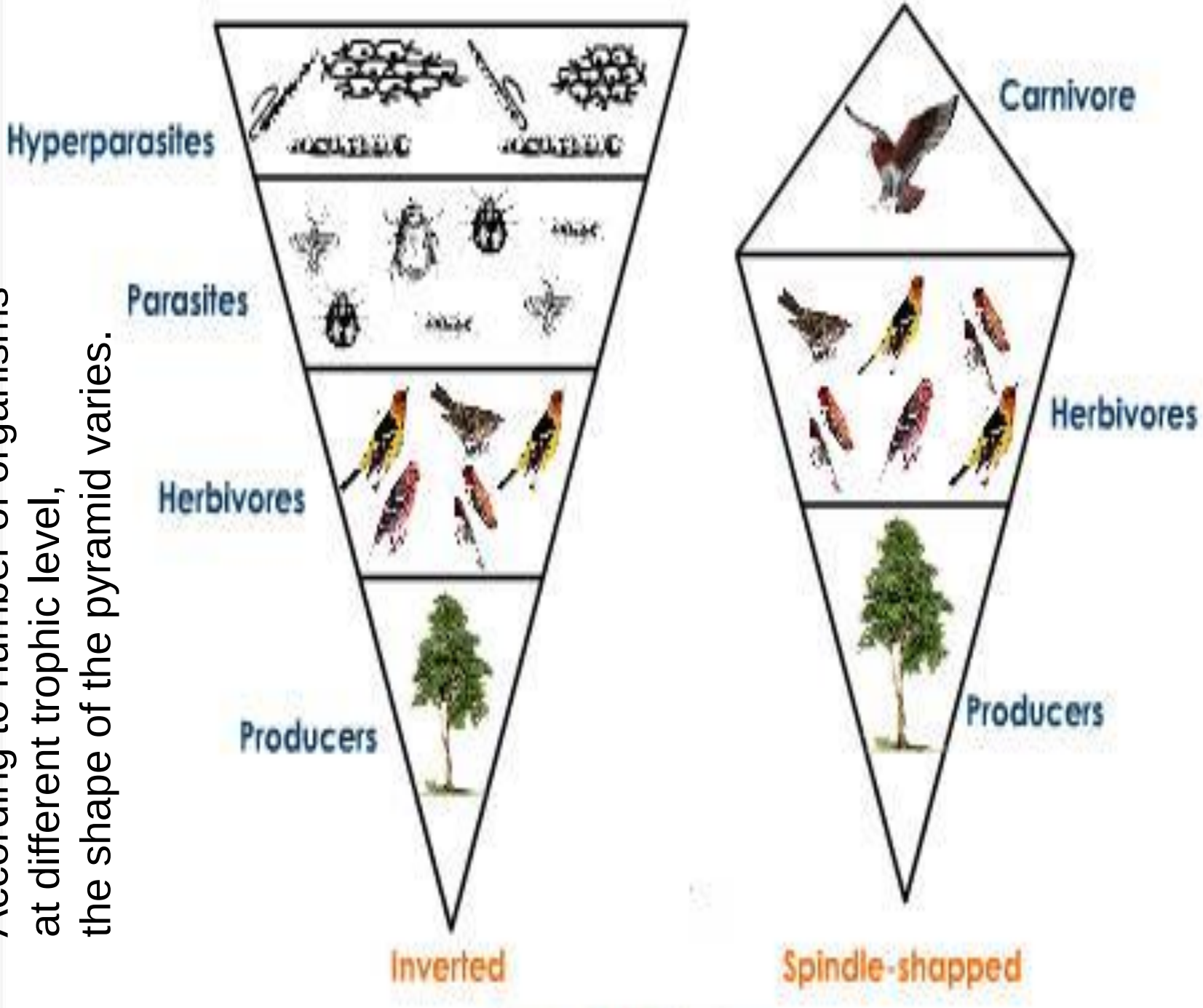
- Shows the number of organisms/ individuals per unit area at each trophic level in a food chain.

- Large number of producers tend to form the base.
- Lower numbers of top carnivores occupy the tip.



Pyramid of Numbers

- According to number of organisms at different trophic level, the shape of the pyramid varies.



Pyramids of Biomass

- Shows the relationship between biomass and trophic level by quantifying the amount of biomass present at each trophic level.

- **Biomass = mass of each individual x number of individuals at each trophic level**

- **Units** -
  - ✓ mass per unit area,
  - ✓ grams per square meter (g m^{-2})
  - ✓ volume of water (g m^{-3})
  - ✓energy content (joules, J).

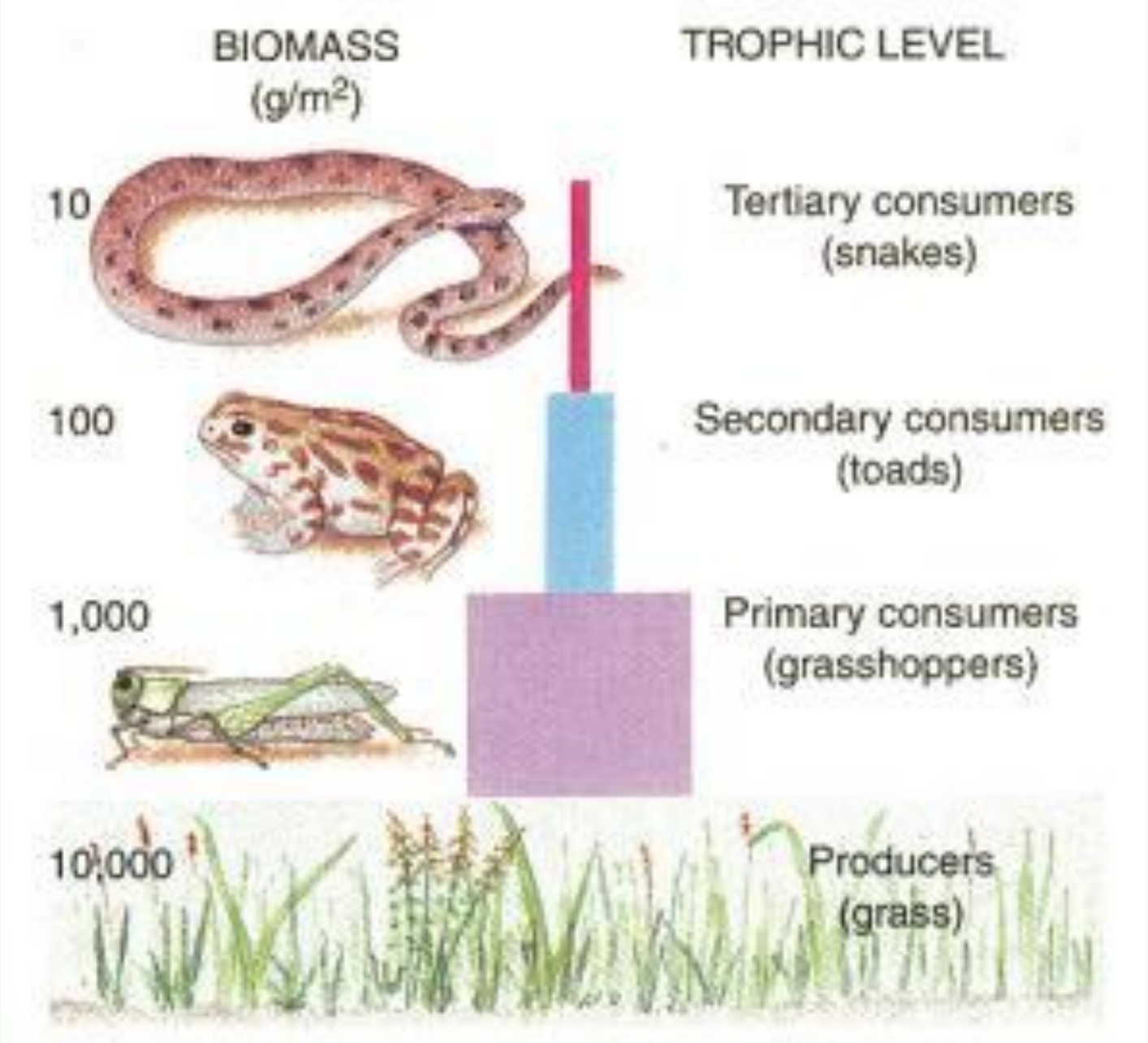
Pyramids of Biomass

- **Biomass** –

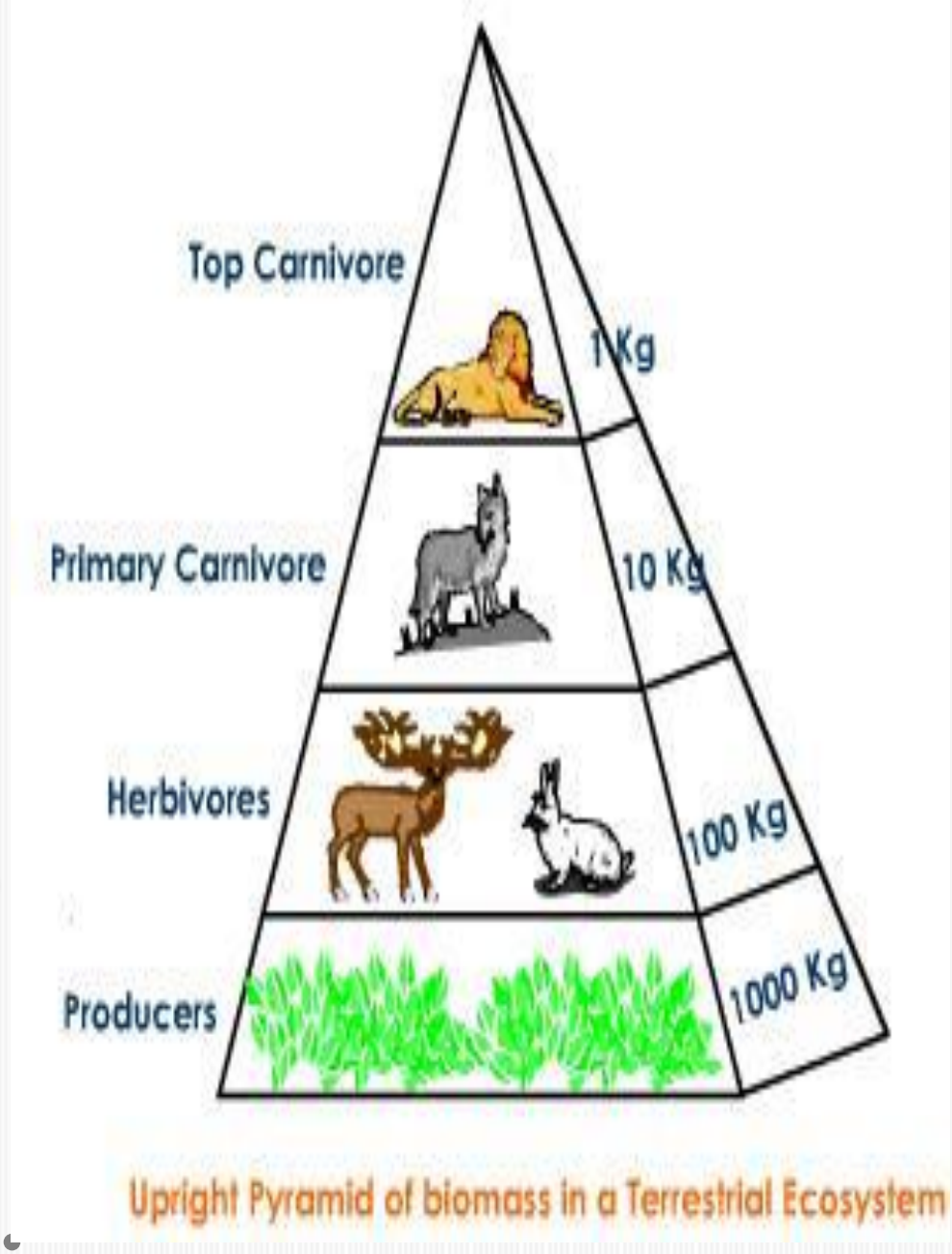
  ✓ quantity of (dry) organic material in an organism, a population, a particular trophic level or an ecosystem

  ✓ represents chemical energy stored in the organic matter of a trophic level

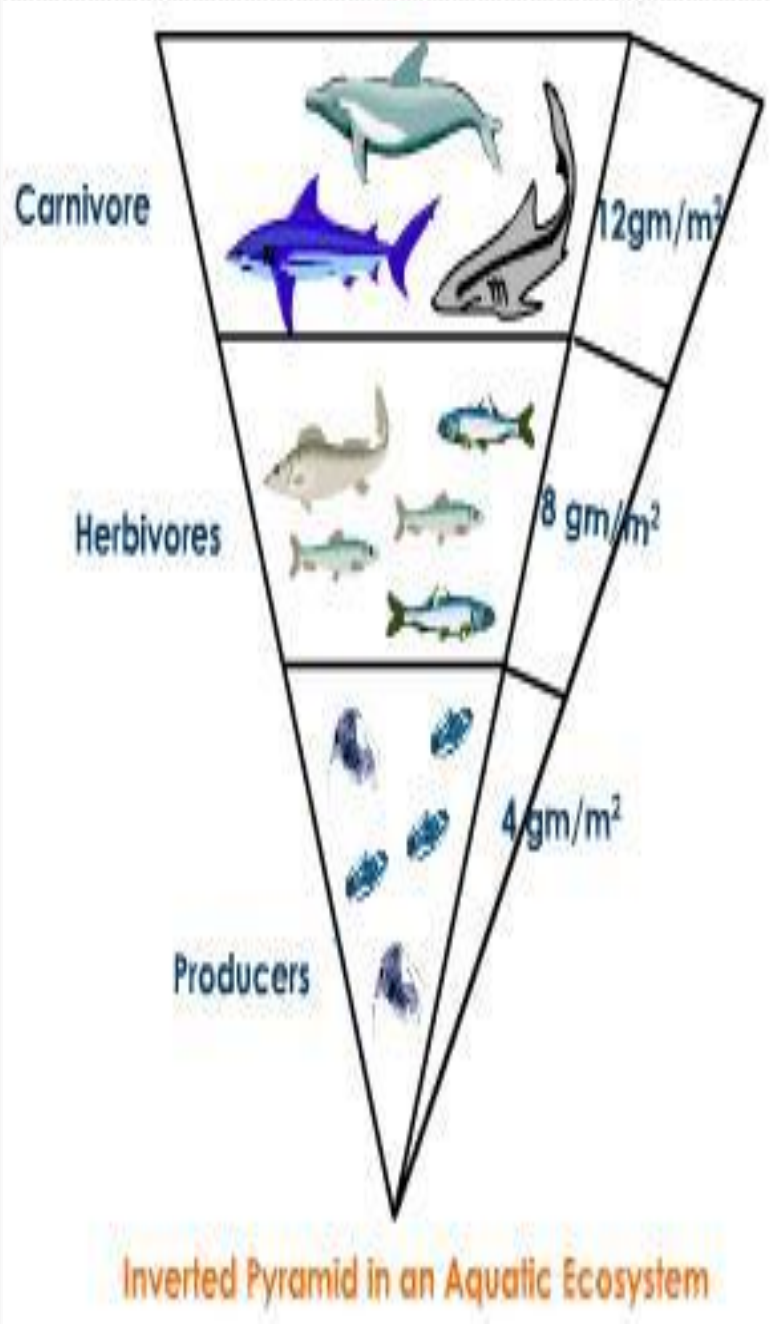
Pyramids of Biomass



Pyramid of Biomass



Upright Pyramid of biomass in a Terrestrial Ecosystem



Inverted Pyramid in an Aquatic Ecosystem

Pyramids of Productivity/ Energy Pyramid

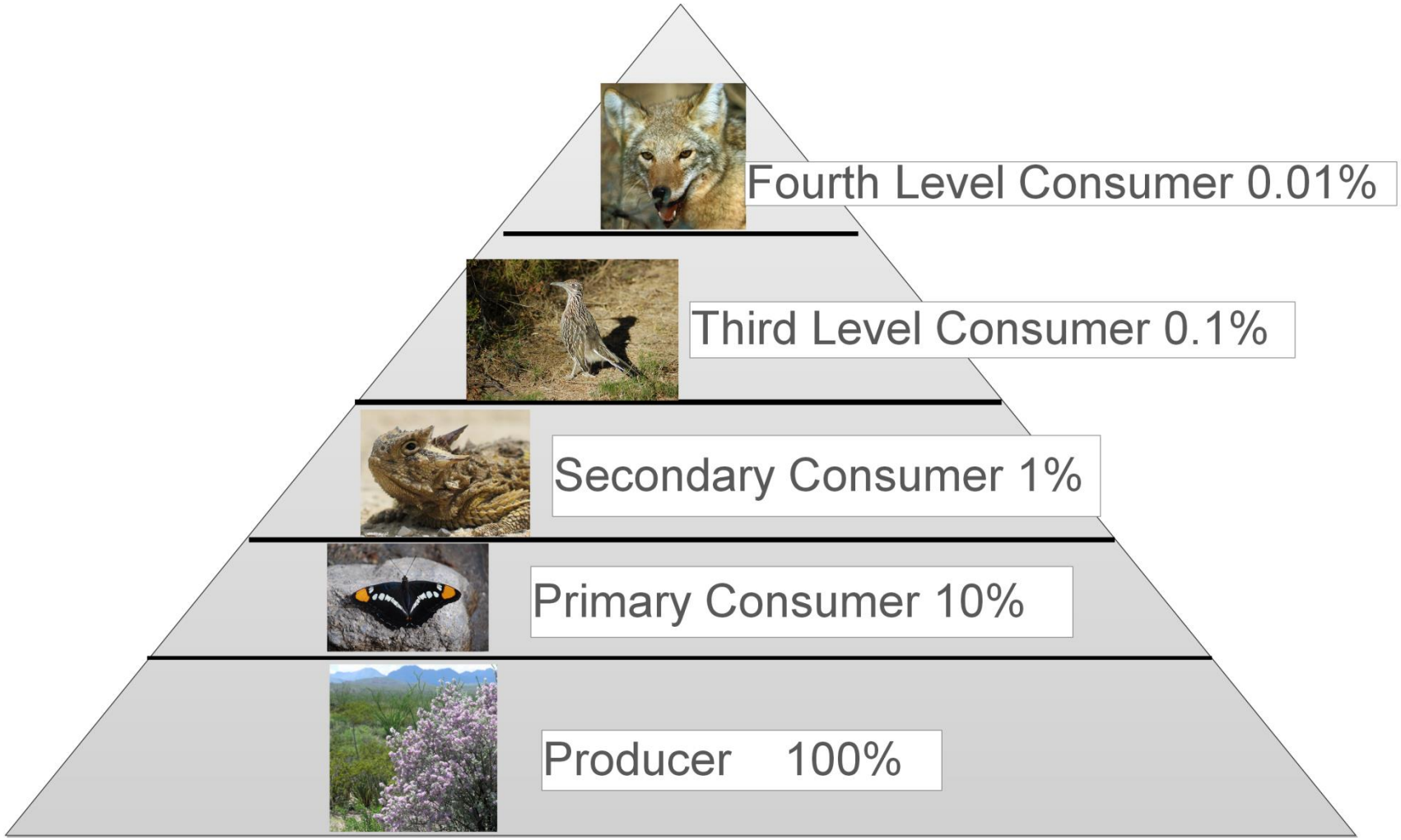
- Refer to the flow of energy through a trophic level and invariably show a decrease along the food chain.
- Show the energy being generated and available as food to the next trophic level during a fixed period of time.
- Show the flow of energy over time.
- **Units** –
  - ✓ J m^{-2} yr^{-1}
  - ✓ kJ m^{-2} yr^{-1}

Pyramids of Productivity/ Energy Pyramid

- On average 90% of the available energy is used for life processes such as respiration, photosynthesis, and reproduction and transformed to heat energy before an organism is consumed.

- Remaining 10% of the original energy is left to feed the next level.

Pyramids of Productivity/ Energy Pyramid



Pyramids of Productivity/ Energy Pyramid

"Rule of 10" **Only ~10% passes to next level. Therefore, ~90% LOSS at each trophic level**

