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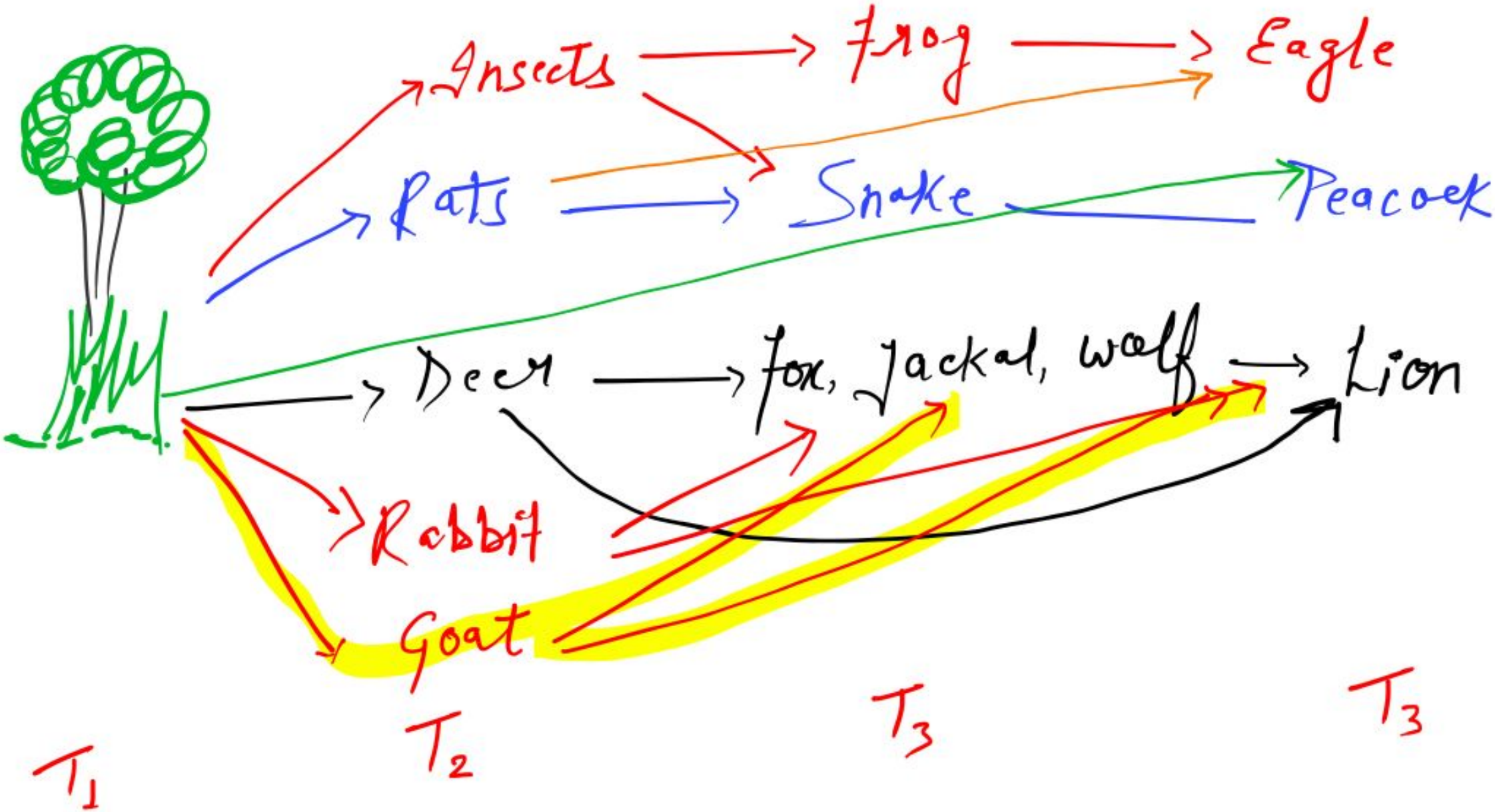
# Environment & Ecology

## Ecosystem, Food Chain, Web


Insects
Frog
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fox, Jackal, wolf
Lion
Rabbit
Goat
T1
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# Ecological Hierarchy

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1. Organism
2. Population (Species)
3. Community

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4. Ecosystem
5. Biome
6. Biosphere

# Ecology

- Study of interaction or inter-relationship of organism with their environment is called Ecology
- Organism and environment are always interdependent, inter related or mutually reactive

# Ecosystem

- Smallest structural & functional unit of the nature
- A bio system that includes all the organisms that function together (the biotic community) in a given area, interacting with the physical environment (abiotic component)
- Example - Pond, Aquarium, Forest etc.
- Abiotic factors: **Temperature**, **Light**, **Water**, **Air** ,**Soil** etc.
- Ecosystem Structure -

  i) Input (Productivity)

  ii) Transfer of Energy (food chain, nutrient cycling)

  iii) Output (Degradation/Energy loss)

# Ecosystem

- The boundaries of ecosystem are indistinct and have a overlapping character
- It is a self regulatory and self sustaining unit
- It may be temporary or permanent
- Types:

1. Natural Ecosystem -
    a. Terrestrial - forest, grassland, tree, desert ecosystem
    b. Aquatic -
        i. Lentic ecosystem
        ii. Lotic ecosystem
2. Artificial Ecosystem - Man made: cropland, gardens etc

# Functions of Ecosystem

1. Energy flow through food chain
2. Nutrient cycling (biogeochemical cycles)
3. Ecological succession or ecosystem development
4. Homeostasis (or cybernetic) or feedback control mechanisms

# Ecosystem Services

1. Supporting Services - Nutrient cycle, Pollination etc.
2. Provisioning Services - Food, water, timber etc.
3. Regulating Services - Regulating climate etc.
4. Cultural Services - Recreation, Spiritual benefits etc.

# Components of the Ecosystem

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A. Biotic factors
    a. Producers
    b. Consumer
        i. Macroconsumers (Phagotrophs or Holozoic)
            1. Primary Consumer
            2. Secondary Consumer
            3. Top Consumers
        ii. Microconsumers / Decomposers / Saprotrophs

B. Abiotic factors

    Temperature, Light, Air, Soil, Water, Humidity etc

# Components of the Ecosystem

## Biotic factors - Producers & Consumers

- The biological or biotic components of an ecosystem interact in an abiotic background and include:
- Organisms, basically green plants, certain bacteria and algae, that in the presence of sunlight can synthesise their own food from simple inorganic substances. Organisms that are able to manufacture their own food are called autotrophs or primary producers
- All other organisms  that are unable to make their own food but depend on other organisms for food to meet their energy needs for survival are called heterotrophs or phagotrophs or consumers

# Components of the Ecosystem

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## Types of Consumers

- Animal such as cow, goat, deer, rabbit and insects which eat green plants are called primary consumers or herbivores
- Organisms which eat a herbivores are called secondary consumers
- Organisms which eat secondary consumers are called tertiary consumers or top carnivores
- There are some animals which eat both plants and animals are called omnivores
- Certain fungi and bacteria, which are responsible for the decomposition are called decomposers or saprotrophs or reducers

# Components of the Ecosystem

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## Types of Consumers

- Certain decomposers are also called scavengers
- Scavengers are animals that consume dead organisms that have died from causes other than predation. Generally carnivores, it is also a herbivorous feeding behavior. Scavengers play an important role in the ecosystem by consuming dead animal and plant material.
- Some animals such as earthworms, soil inhabiting nematodes and arthropods are also detritus feeders and called detritivores
- Detritivores, also known as detrivores, detritophages, detritus feeders, or detritus eaters, are heterotrophs that obtain nutrients by consuming detritus (decomposing plant and animal parts as well as faeces)

# Trophic Levels in the Ecosystem

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In a ecosystem, complex natural community obtain their food from plants through one, two, three or four steps. Accordingly these steps are known as the first, second, third and fourth trophic (Trophe = nourishment) levels or food levels.

Trophic levels to which autotrophs and different types of heterotrophs belong to:

- Green plants (producers); trophic level I - Autotrophs
- Herbivores (primary consumers); trophic level II - Hetrotrophes
- Carnivores (secondary consumers ); trophic level III - Hetrotrophes
- Carnivores (tertiary consumers ); trophic level IV - Hetrotrophes
- Top carnivores (secondary consumers ); trophic level V - Hetrotrophes

# Trophic Levels in the Ecosystem

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- The energy flows through the trophic levels: from producers to subsequent levels
- This energy always flows from lower (producer) to higher (herbivore, carnivores) trophic level
- It never flows in the reverse direction
- There is a loss of some energy in the form of unusable heat at each trophic level so that energy level decreases from the first trophic level upwards - 10% Transfer
- The study of trophic gives us an idea about the energy transformation in an ecosystem

*The number of organisms at any trophic level depends upon the availability of organism which are used as food on lower level - so - availability of the food is main factor*

# Ecological Pyramids

Graphical representation of ecological parameters at different trophic level in the ecosystem

Three kinds of Ecological pyramids:

1. Pyramid of Numbers
2. Pyramid of Biomass
3. Pyramid of Energy

- Pyramid of Numbers: Represents the no. of organisms in its trophic levels. Mostly upright pyramid. Exceptions: Inverted Pyramid for Tree ecosystem and Parasitic ecosystem.

# Ecological Pyramids

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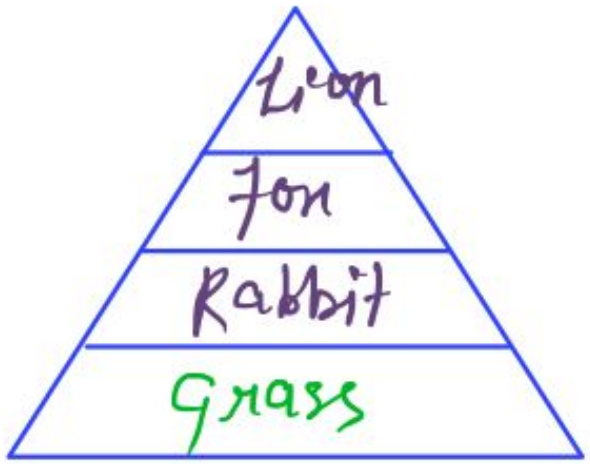
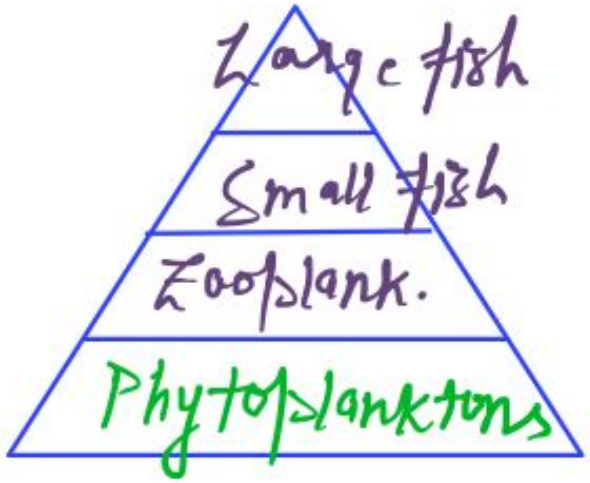
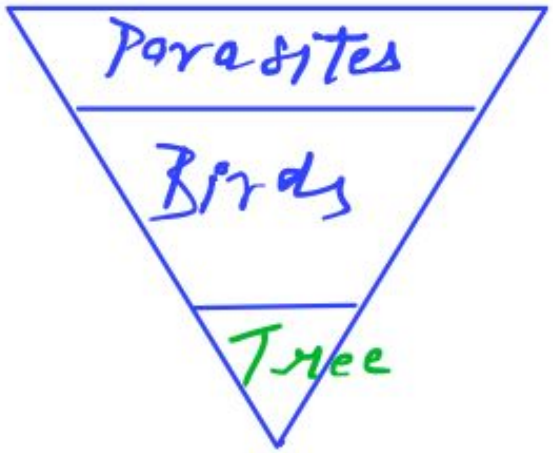
## 1. Pyramid of Numbers:

- Represents the no. of organisms in its trophic levels. Mostly upright pyramid. Exceptions: Inverted Pyramid for Tree ecosystem and Parasitic ecosystem.



# Ecological Pyramids

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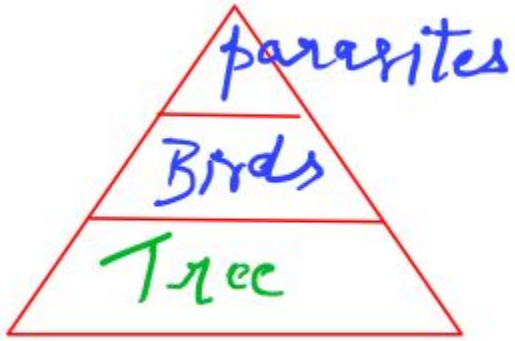
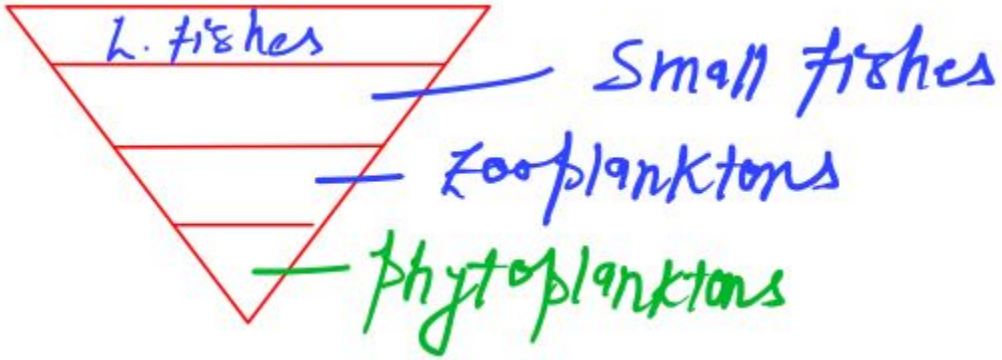
## 2. Pyramid of Biomass:

- Represent the total amount of biomass of each trophic level of ecosystem
- Mostly, these pyramids are also upright (tree ecosystem, forest ecosystem), but there can be exceptions like in aquatic ecosystem - it is inverted, because in this ecosystem producers are microorganisms (phytoplanktons) and their biomass is very less.
- The pyramids of biomass show the standing crop of the ecosystem
- Standing Crop - Total amount of living organic matter per unit of area at that time



# Ecological Pyramids

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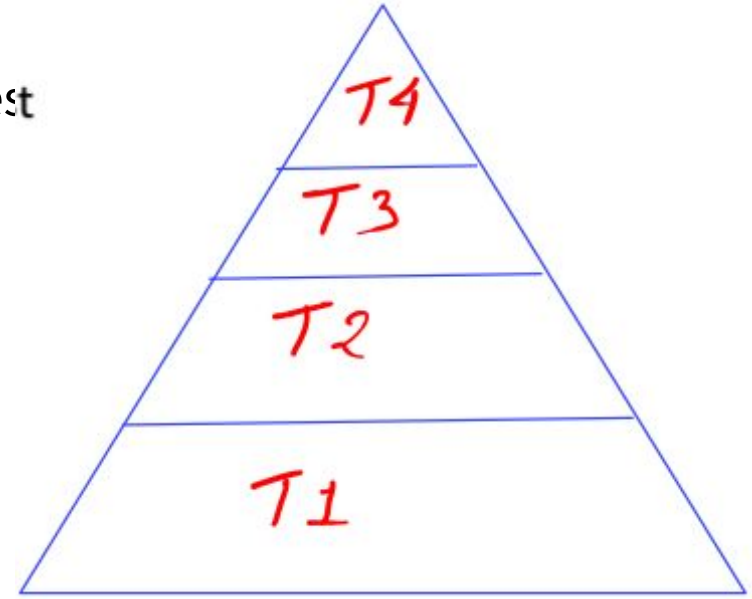
## 3. Pyramid of Energy:

- Represents the amount of energy & productivity at different trophic levels
- Always upright, as there is gradual decrease in energy transfer to subsequent trophic levels
- No Exceptions
- 10% law of Lindemann
- Top consumers like lion are ecologically weakest



# Food Chain

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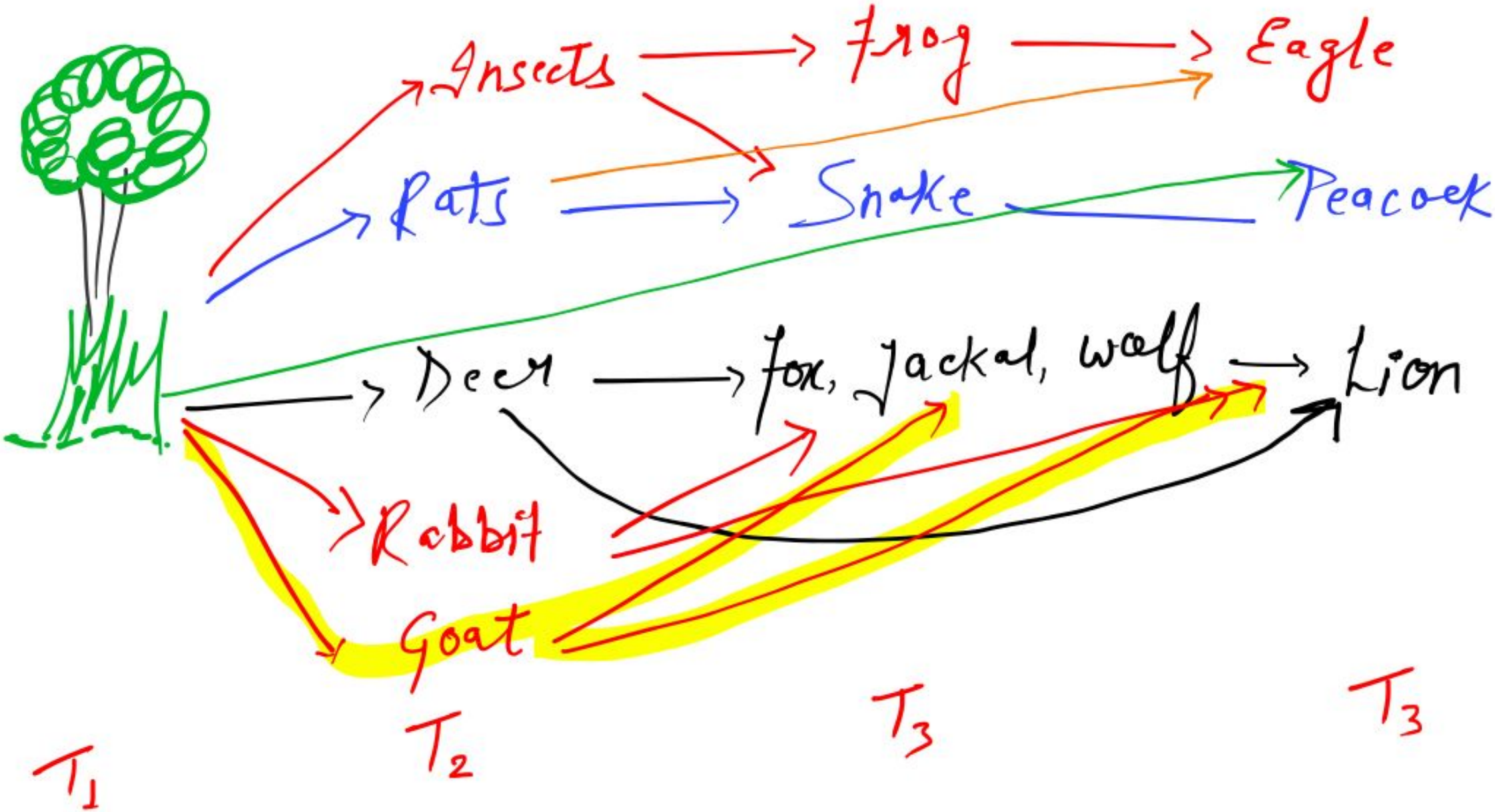
- A sequence of organisms that feed on one another, form a food chain

# Food Web

- Many food chains are interlinked together on different trophic levels to form the food web
- A food web illustrate, all possible transfer of energy and nutrients among the organisms in an ecosystem, whereas a food chain traces only one pathway of the food
- In food web, the transfer of energy is unidirectional but from many different alternative pathway
- More flexible than food chain
- Complex food web - More stability of the ecosystem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# Productivity of an Ecosystem

- The amount of organic matter formed in a unit time per unit area of ecosystem is called Productivity of an Ecosystem
- It is the rate of production or energy fixation

A. Primary Productivity
    a. Gross Primary Productivity - Total
    b. Net Primary Productivity - remaining after respiratory losses

B. Secondary Productivity - Total energy storage at consumer level - T2

# Flow of energy in an ecosystem - Important Function

- The flow of energy is unidirectional and it is converted into chemical energy through photosynthesis by plants, which also incorporates in their protoplasm a number of inorganic elements and compounds
- These green plants are grazed subsequently heterotrophs
- This means that chemical energy in the form of carbohydrates, fats, and proteins as well as a host of other nutrients are transferred into herbivores
- This process continues up to the decomposer level through the carnivores
- Another feature of the process - 10% Lindemann Law

# Components of the Ecosystem

## Abiotic Factors - Water

- Aquatic ecosystem can be LOTIC (running fresh water) or LENTIC (stagnant freshwater like swamp).
- Xerophytes (Succulents), store water in their stems and leaves. Leaves turned into thorns to reduce water loss, act as a deterrent to herbivores.
- On basis of water needs organisms can be classified as:

1. Hydrocoles: Aquatic animals needing large quantity of water.
2. Mesocoles: Animals needing moderate amount of water, includes most of terrestrial animals
3. Xerocoles: Terrestrial animal that can tolerate extremely dry conditions, go many days without water (Camels, Kangaroos)

# Components of the Ecosystem

## Abiotic Factors - Temperature

- The distribution of species decreases as we move away from the equator and go above Mean Sea Level (MSL) because temperature decreases
- Decrease in temperature can limit biodiversity by causing Desiccation, Chilling and Freezing injury
- Eurythermal - Organisms that can tolerate and thrive in a wide range of temperatures.
- Stenothermal - Organisms that are restricted to a narrow range of temperatures.

# Components of the Ecosystem

## Abiotic Factors - Temperature

Plant Classification - based on the ambient temperature:

- Megatherms: plants adapted to living in high temperature throughout their lifespan. ex: tropical rain forests
- Mesotherms: plants adapted to living in alternating high and low temperature throughout their lifespan. ex: tropical deciduous forests
- Microtherms: plants adapted to living in low temperature throughout their lifespan. ex: mixed coniferous forests
- Hekistotherms: plants adapted to living in extremely low temperature throughout their lifespan. ex: alpine forests

# Components of the Ecosystem

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## Abiotic Factors - Soil

- Uppermost layer of the earth crust, formed by weathering of rocks
- Known as Edaphic factors
- Soil formation is called Pedogenesis, its study is called Pedology
- Loamy soil (70% Sand + 30% Clay or Silt) is best for plant growth due to its high water holding capacity, high aeration and root penetration. It also has Humus
- In ancient times, soils used to be classified as Urvara (fertile) and Usara (sterile)

# Components of the Ecosystem

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## Abiotic Factors - Light