Bharathidasan University

Centre for Differently Abled Persons

Khajamalai Campus
Tiruchirappalli-620 023
Tamilnadu

Bachelor of Computer Applications

(For Students with Speech and Hearing Impairment)

course: Environmental Studies

unit-3

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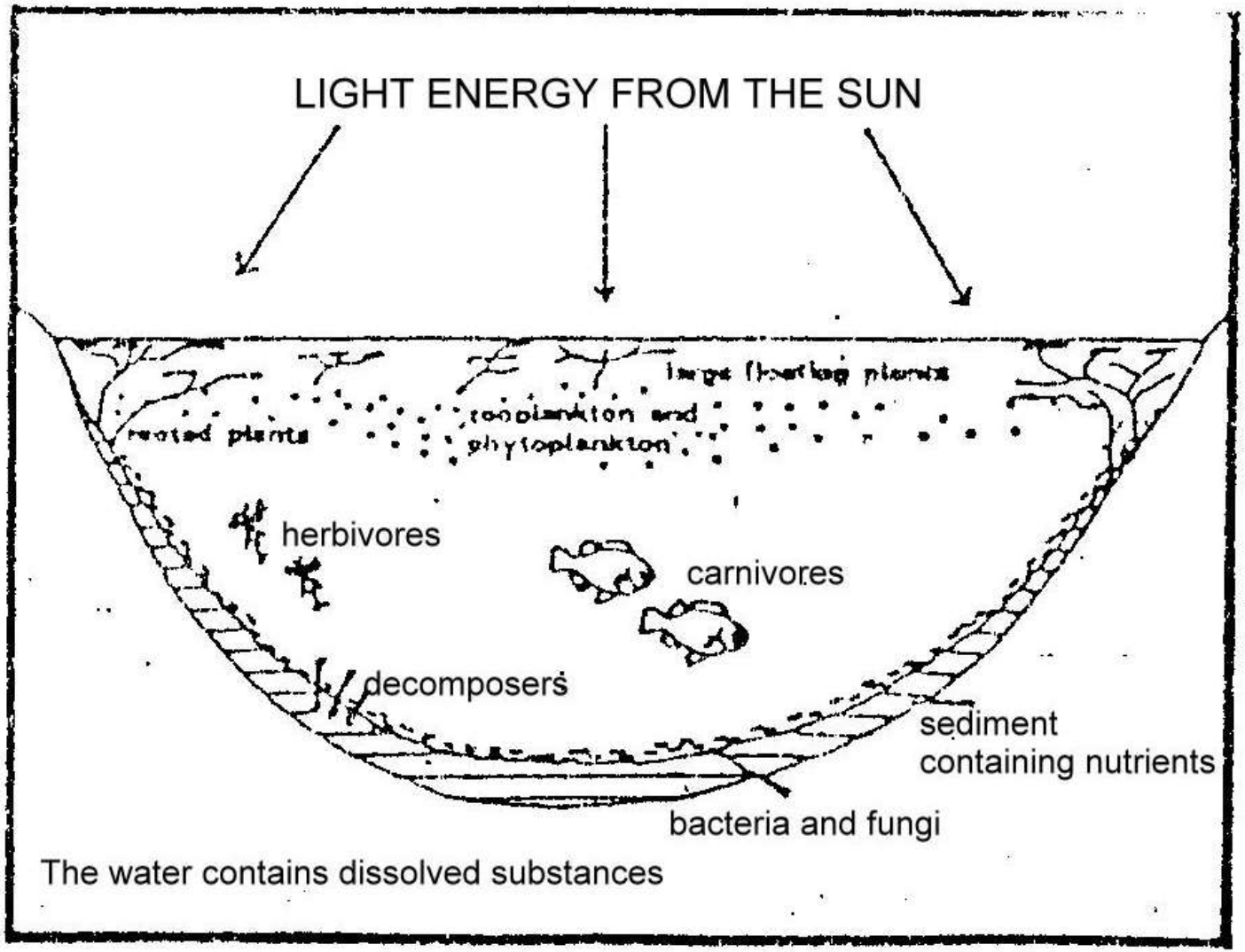
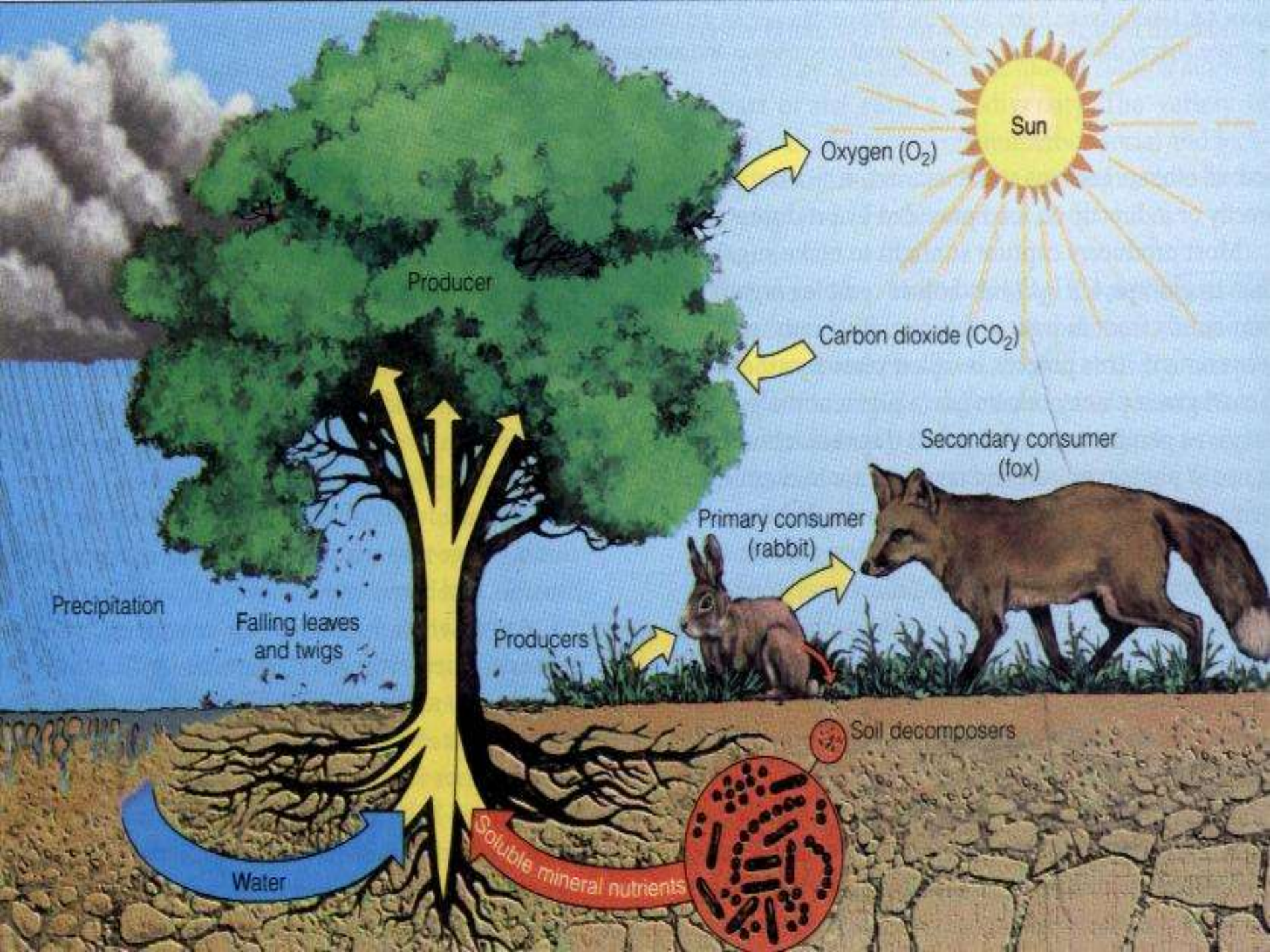
Contents

- What is an ecosystem
- Three major principles of ecosystem
- Components of an ecosystem
  - Abiotic components
  - Biotic components
- Movement of energy and nutrients
  - Food chain
  - Food webs
  - Trophic levels, biomass and biome
- Linkages and interactions in an ecosystem
  - Carbon cycle and oxygen cycle
  - Model of nutrient cycle
- Environmental Limitation in ecosystem development.

What is an ecosystem

- An ecosystem is a grouping of organisms that interact with each other and their environment in such a way as to preserve the grouping.
- There is a great variety of ecosystems in existence, all of them are characterized by general structural and functional attributes.

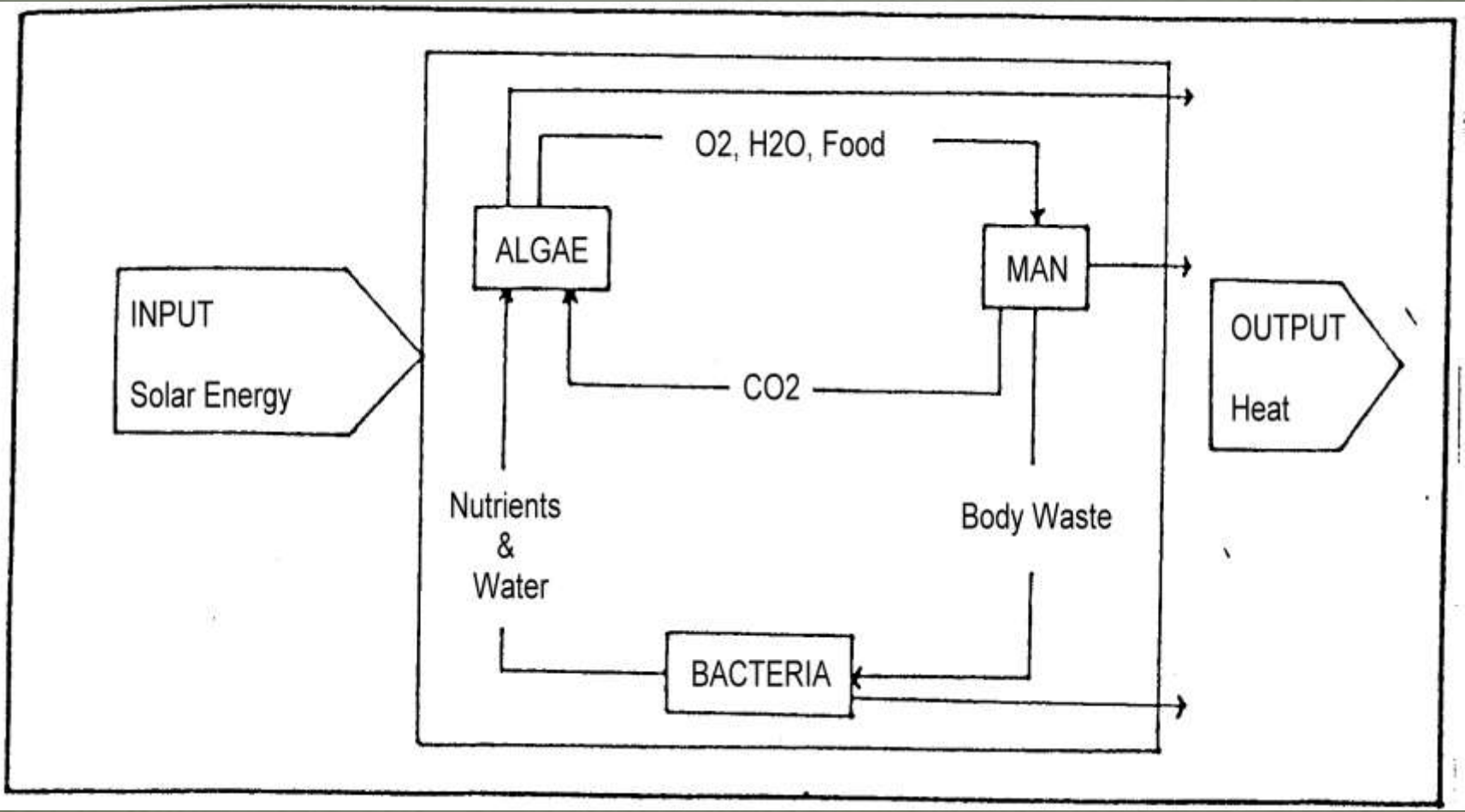

LIGHT ENERGY FROM THE SUN
rooted plants
zooplankton and
phytoplankton
herbivores
carnivores
decomposers
sediment
containing nutrients
bacteria and fungi
The water contains dissolved substances


Sun
Oxygen (O_2)
Producer
Carbon dioxide (CO_2)
Secondary consumer
(fox)
Primary consumer
(rabbit)
Precipitation
Falling leaves
and twigs
Producers
Soil decomposers
Water
Soluble mineral nutrients

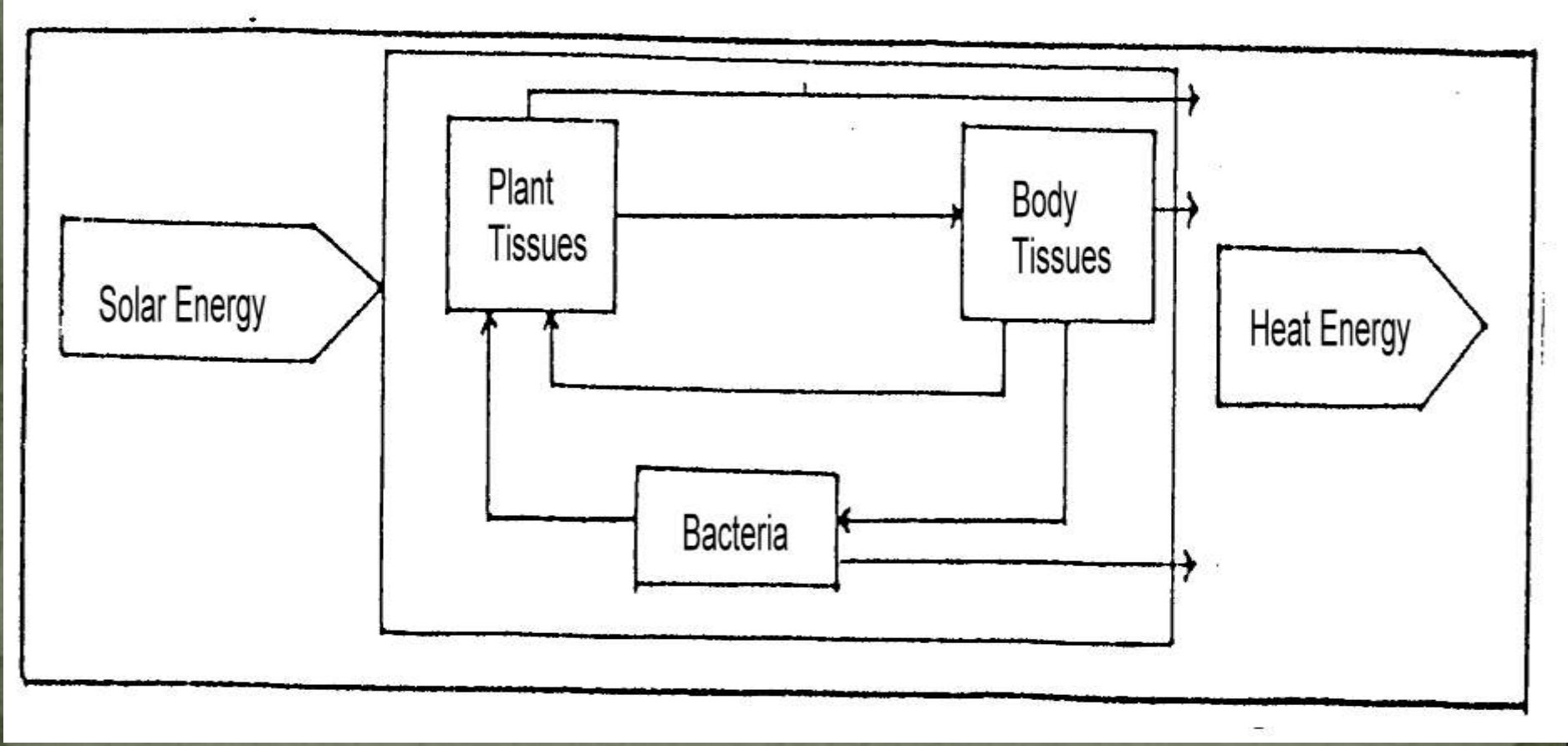
Three major principles of ecosystem

- Nutrient cycling:
  - Movement of chemical elements from the environment into living organisms and from them back into the environment through organisms live, grow, die and decompose.
- Energy flow:
  - Energy is required to transform inorganic nutrients into organic tissues of an organism.
  - Energy is the driving force to the work of ecosystem.
- Structure
  - It refers to the particular pattern of inter-relationships that exists between organisms in an ecosystem.

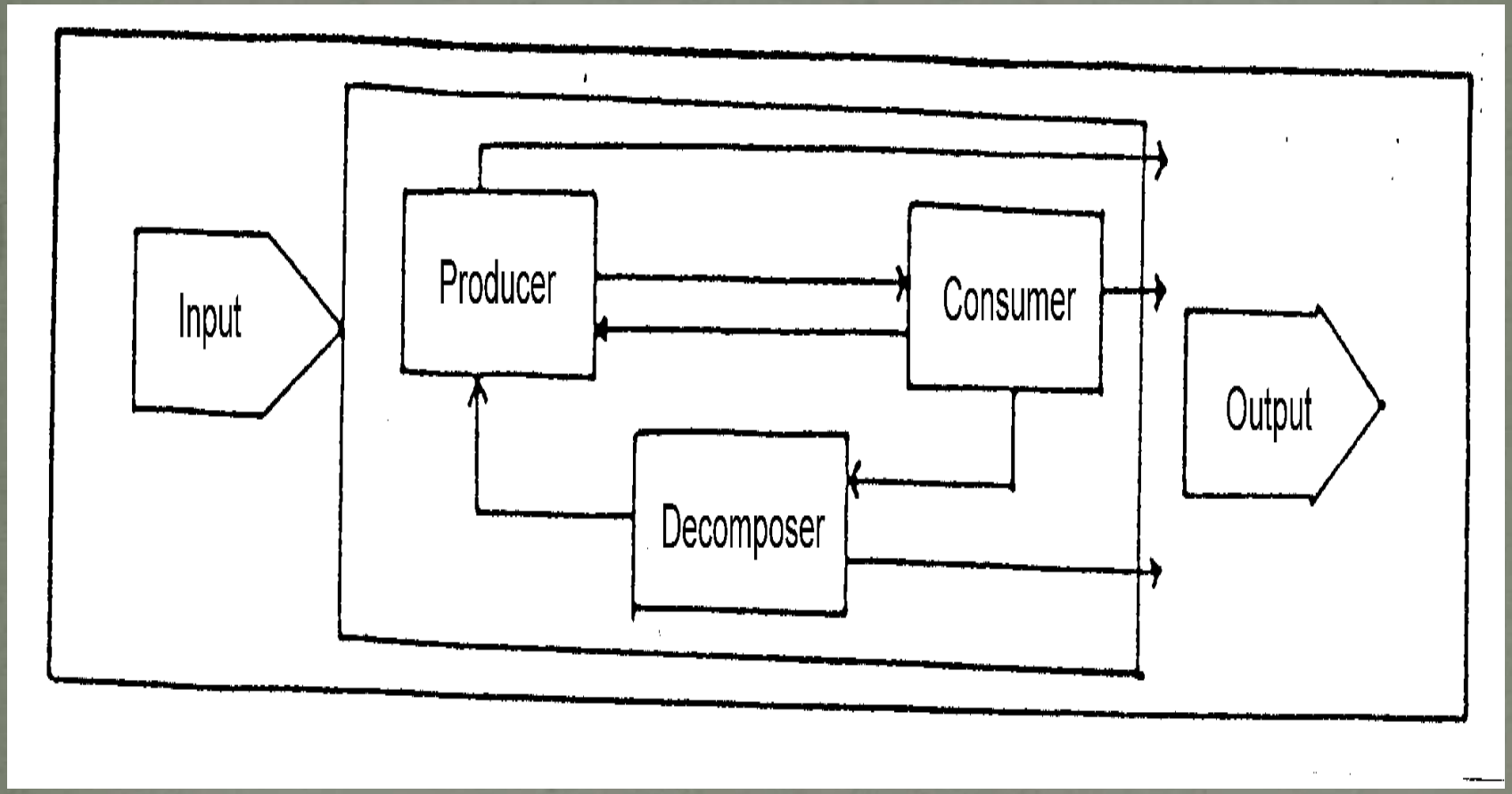
Nutrient cycling



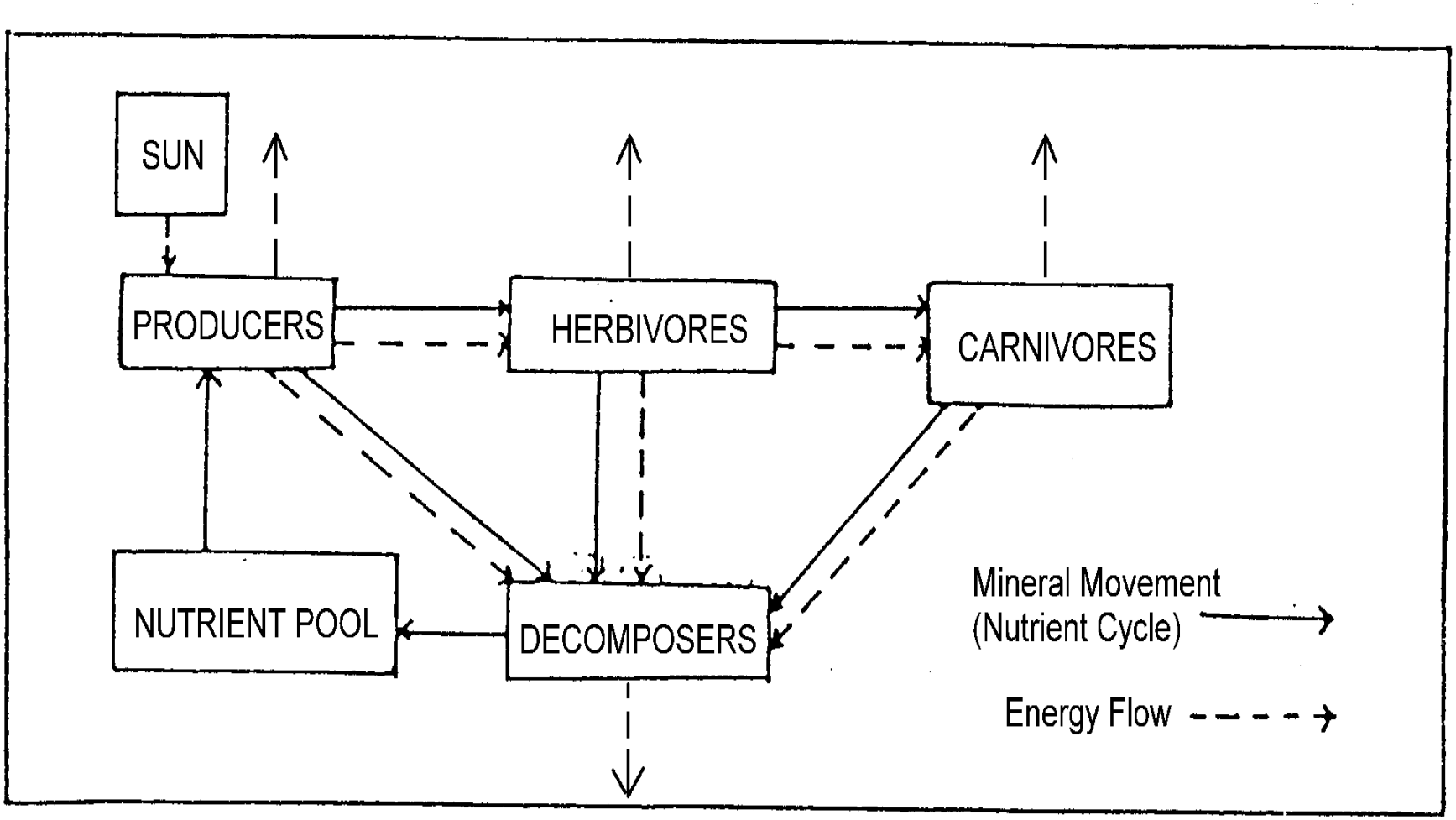
Energy flow


Solar Energy
Plant Tissues
Body Tissues
Heat Energy
Bacteria

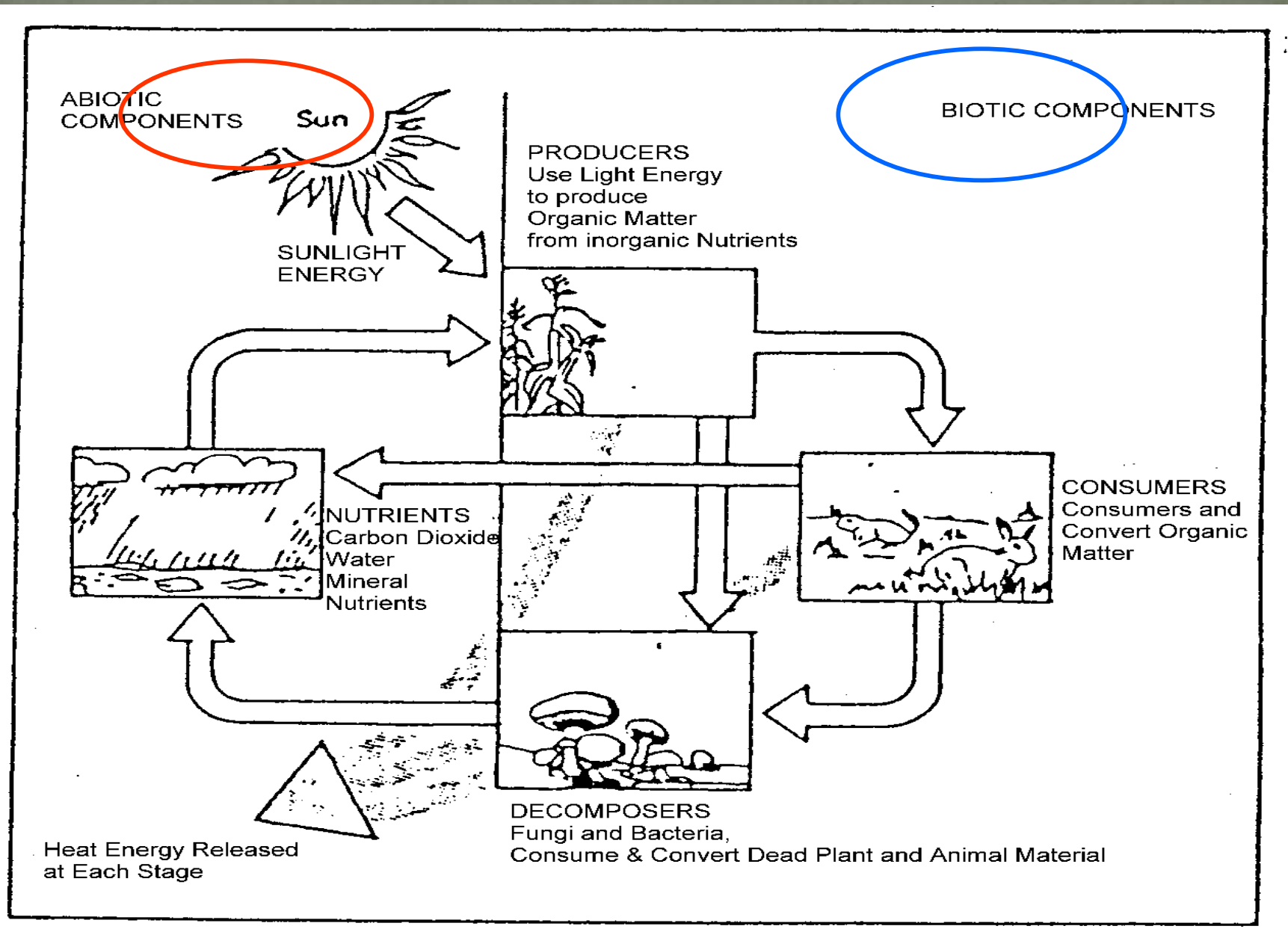
Structure



Ecosystem:
Nutrient cycling, energy flow and structure



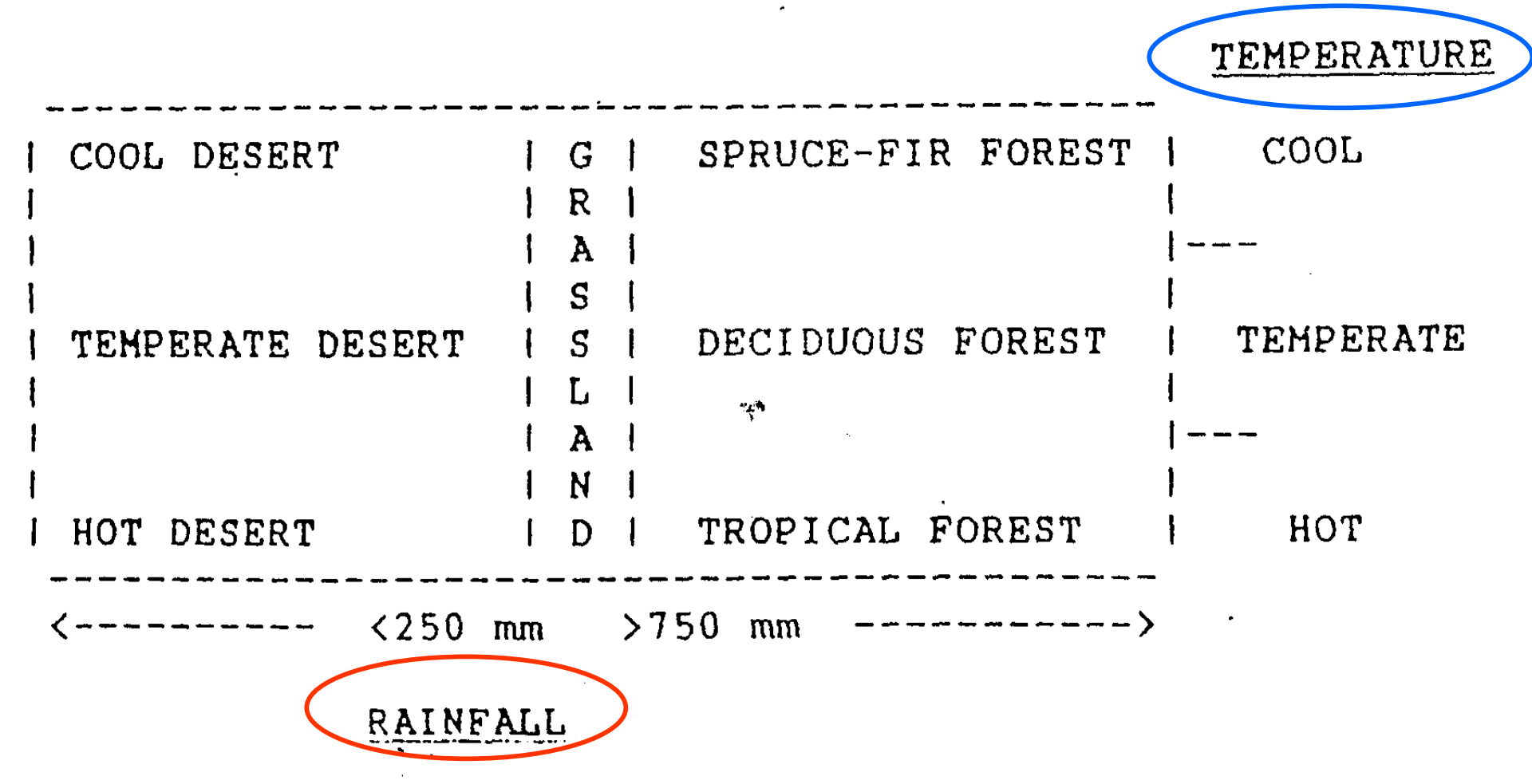
Components of an ecosystem



Abiotic components

- They form the environment and determine the type / structure of ecosystem.
  - Sunlight (temperature)
  - Nutrients
    - Rainfall, minerals, carbon, nitrogen,…..
- Type of ecosystems:
  - Tropical rainforest, Desert, Tundra, Grassland,…..

Distribution of vegetation / ecosystem

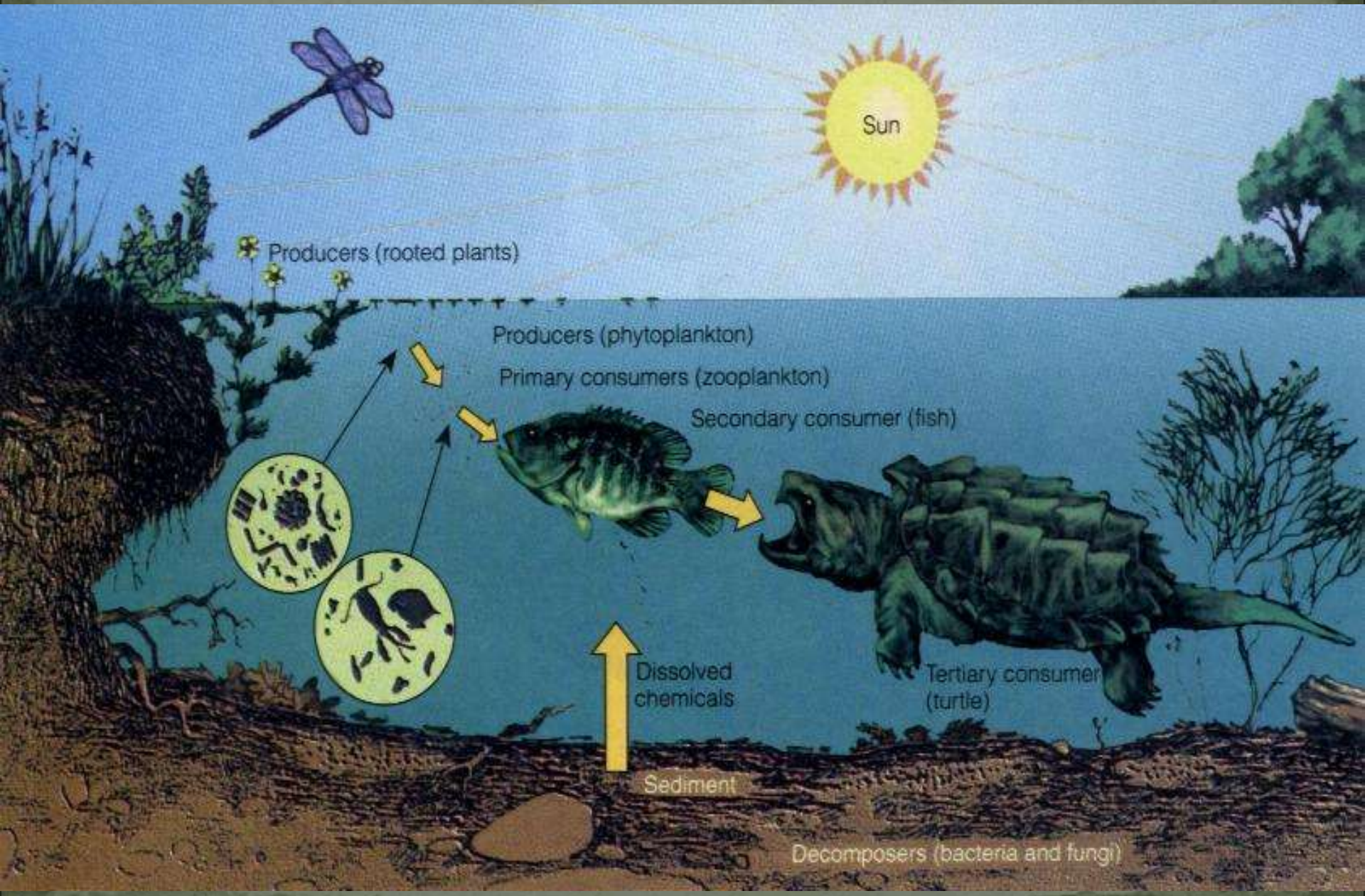


Biotic components

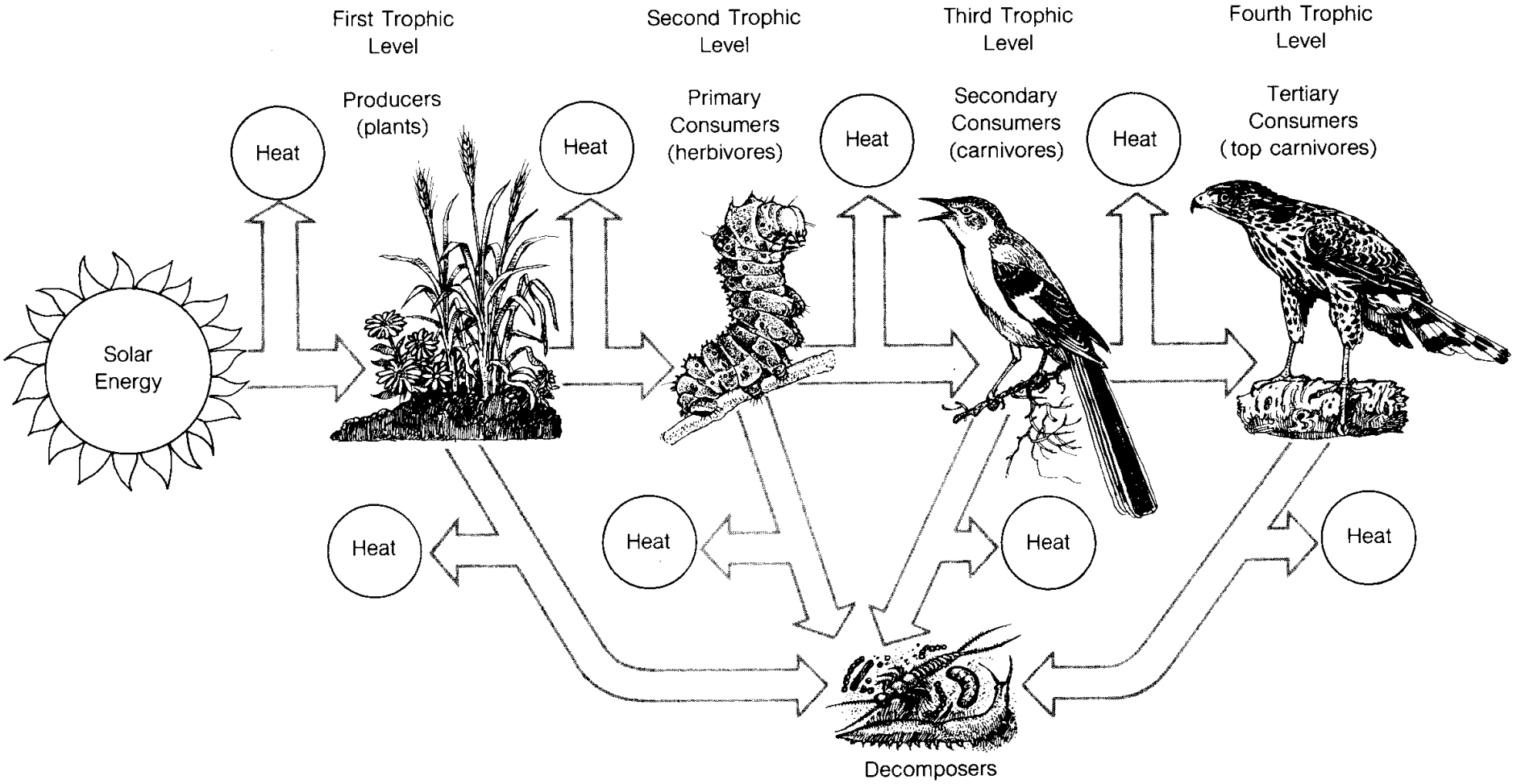
- Producers (Autotrophs):
  - All green plants. They use solar energy, chlorophyll, inorganic nutrients and water to produce their own food. (Photosynthesis)
- Consumers:
  - They consume the organic compounds in plant and animal tissues by eating.
    - Herbivores (plant feeders) — Primary consumers
    - Carnivores (meat eaters) — Secondary consumers
    - Omnivores (general feeders)

Biotic components

- Decomposers
  - They are tiny organisms includes bacteria and fungi, which turn organic compounds in dead plants and animals into inorganic materials.
  - They cause the continual recirculation of chemicals within ecosystem (nutrient cycle)


Sun
Producers (rooted plants)
Producers (phytoplankton)
Primary consumers (zooplankton)
Secondary consumer (fish)
Tertiary consumer (turtle)
Dissolved chemicals
Sediment
Decomposers (bacteria and fungi)

Biotic components and food chain

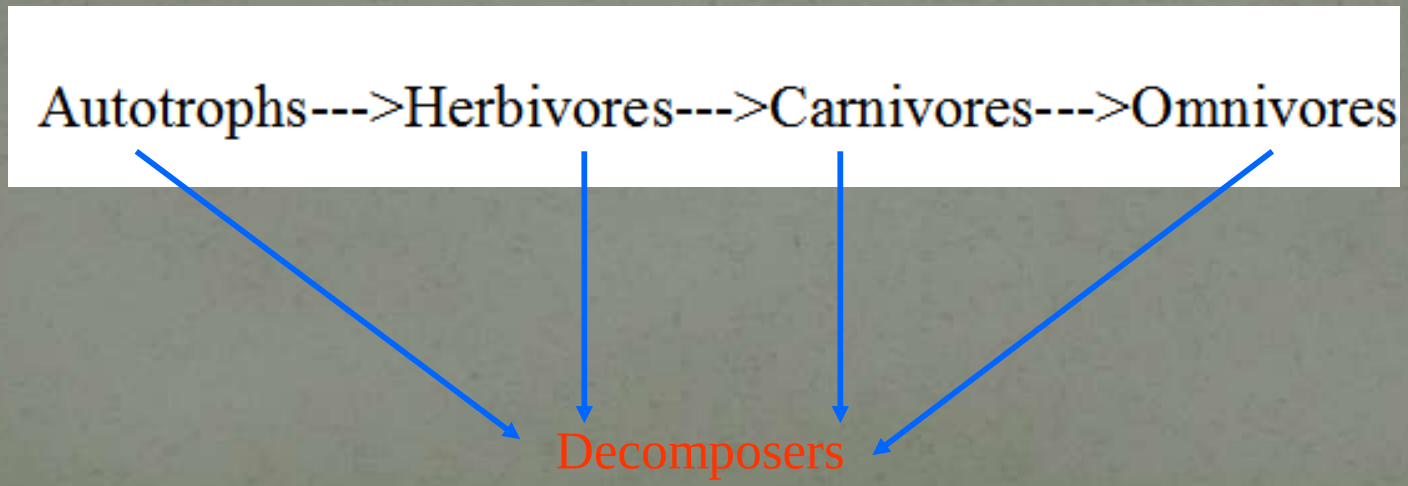


Movement of energy and nutrients

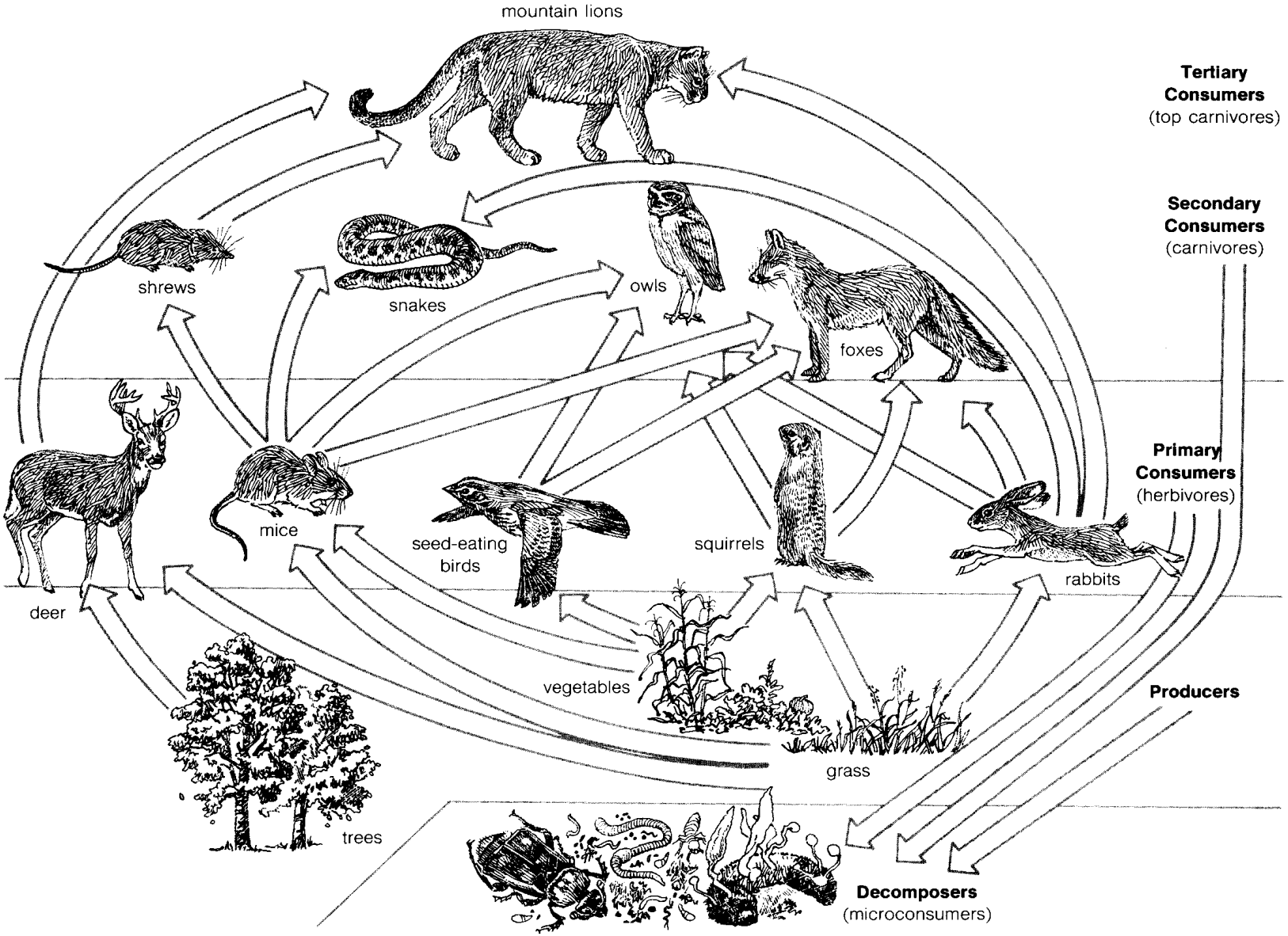
- Food chain
- Food webs
- Trophic level, biomass and biome

Food Chain

- The particular pathway of nutrient and energy movement depends on which organism feeds on anther.



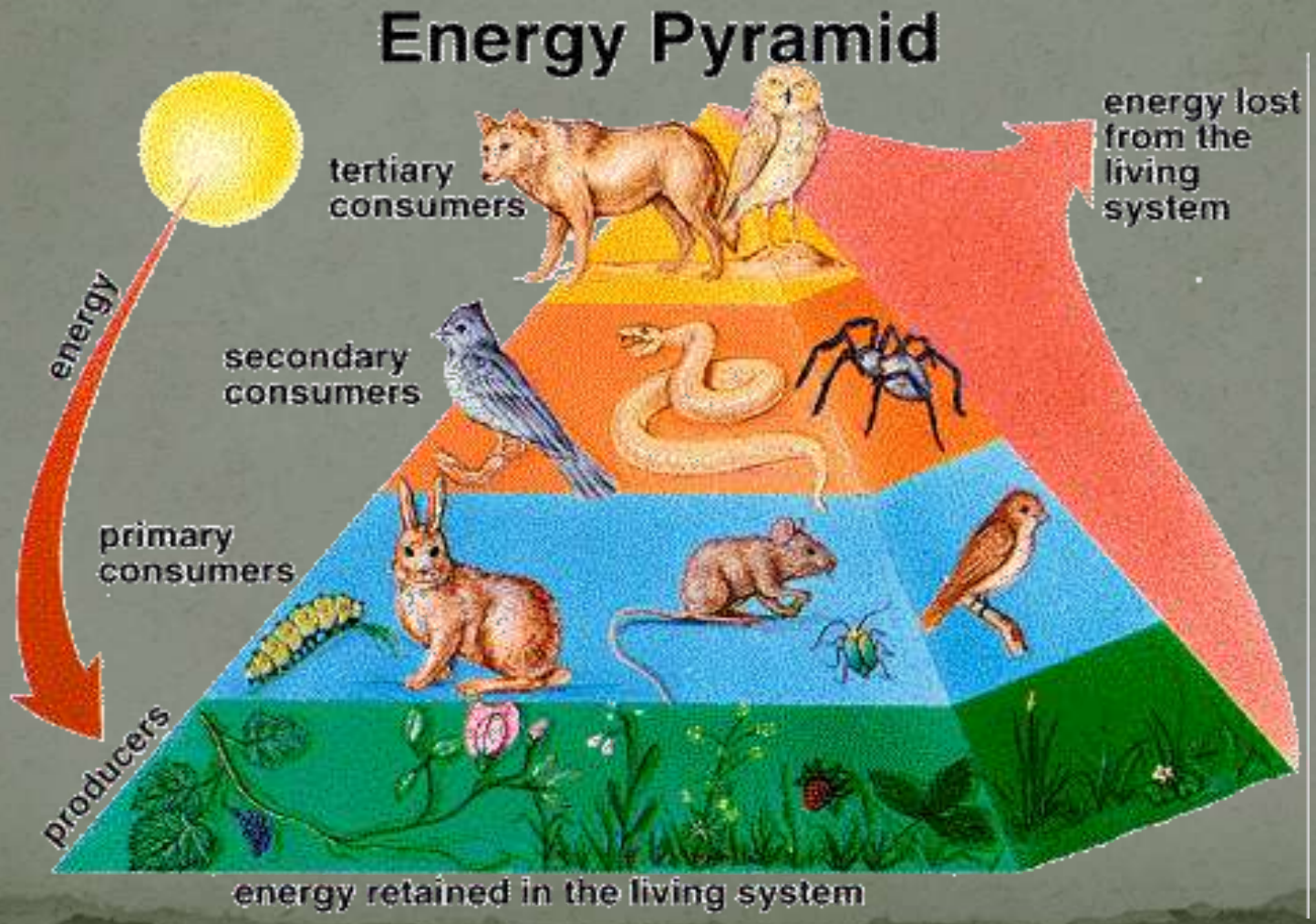
Food Webs


mountain lions
Tertiary Consumers (top carnivores)
Secondary Consumers (carnivores)
shrews
snakes
owls
foxes
Primary Consumers (herbivores)
mice
seed-eating birds
squirrels
rabbits
deer
vegetables
Producers
grass
trees
Decomposers (microconsumers)

Trophic Levels

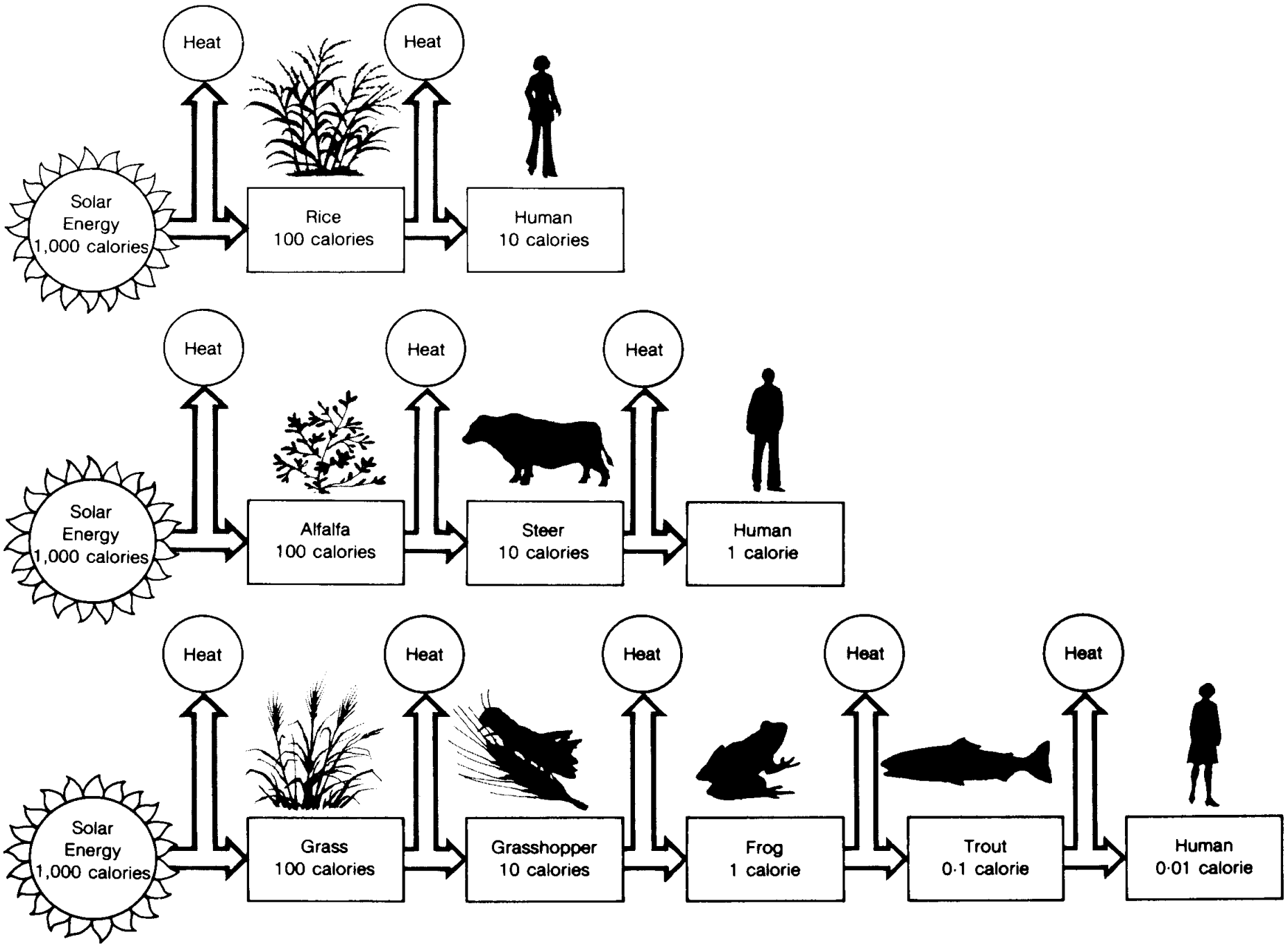
- A trophic level means a feeding level.
  - First level – all producers
  - Second level – all herbivores
  - Third level – first level carnivores
  - Fourth level – second level carnivores
  - So on……..

Trophic levels



Biomass

- Biomass means the total combined weight of any specified group of organisms.
- The biomass of the first trophic level is the total weight of all the producers in a given area.
- Biomass decreases at higher trophic levels.


Heat
Heat
Solar Energy 1,000 calories
Rice 100 calories
Human 10 calories
Heat
Heat
Heat
Solar Energy 1,000 calories
Alfalfa 100 calories
Steer 10 calories
Human 1 calorie
Heat
Heat
Heat
Heat
Heat
Solar Energy 1,000 calories
Grass 100 calories
Grasshopper 10 calories
Frog 1 calorie
Trout 0·1 calorie
Human 0·01 calorie

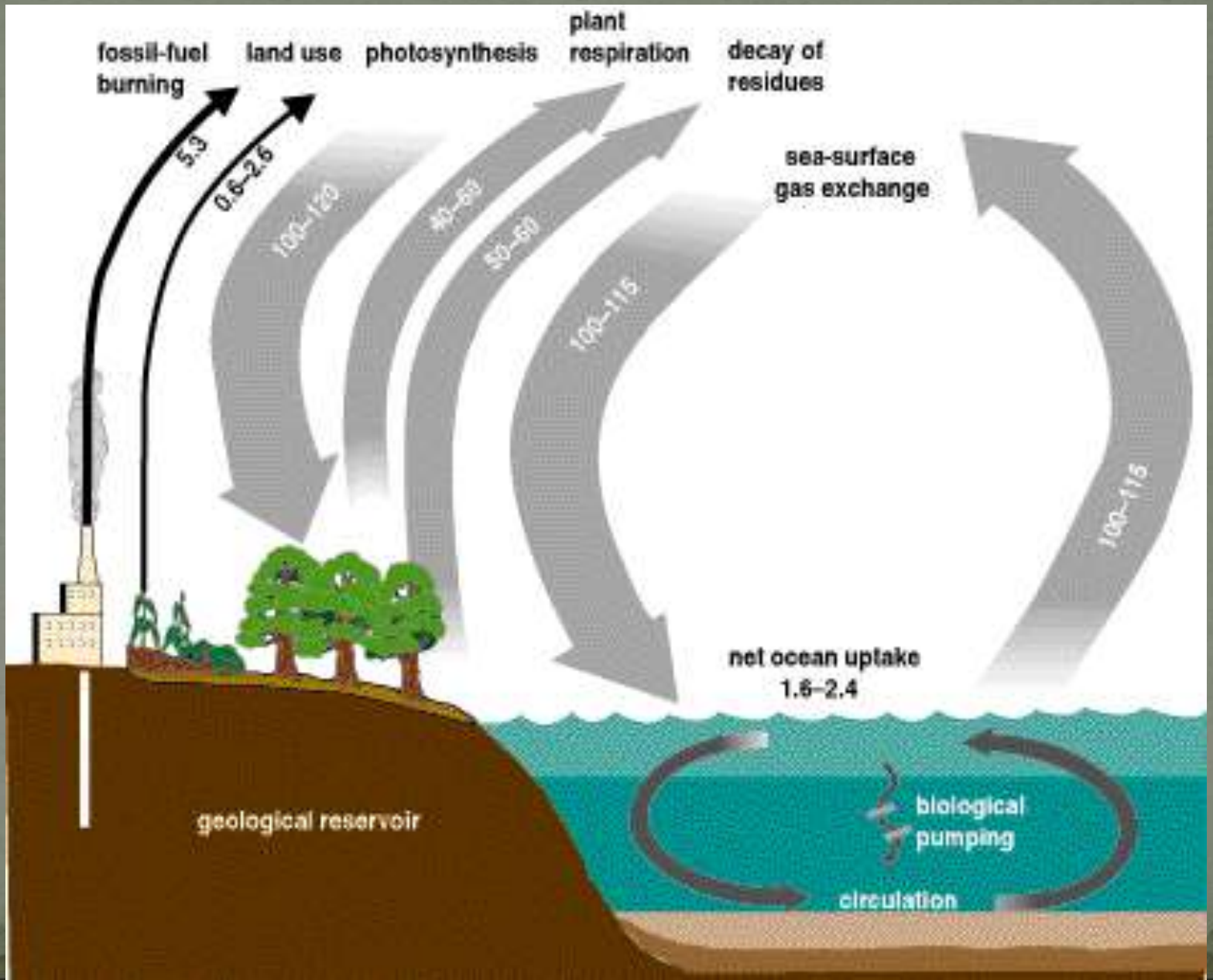
Biome

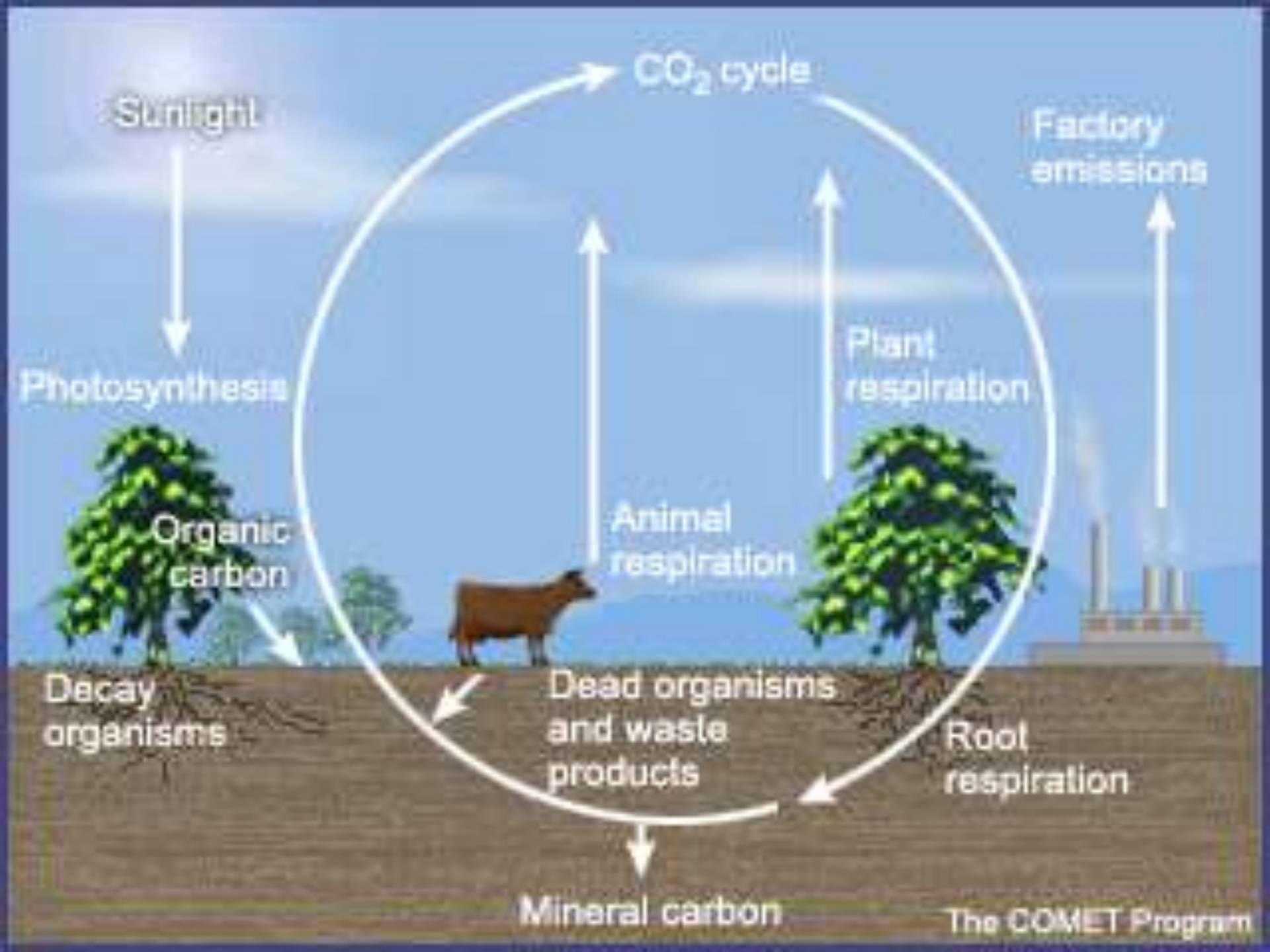
- This is a total different concept apart from Biomass.
- Biome are defined as
  - “the world’s major communities, classified according to the predominant vegetation and characterized by adaptations of organism to that particular environment.

Linkages and Interactions in an ecosystem

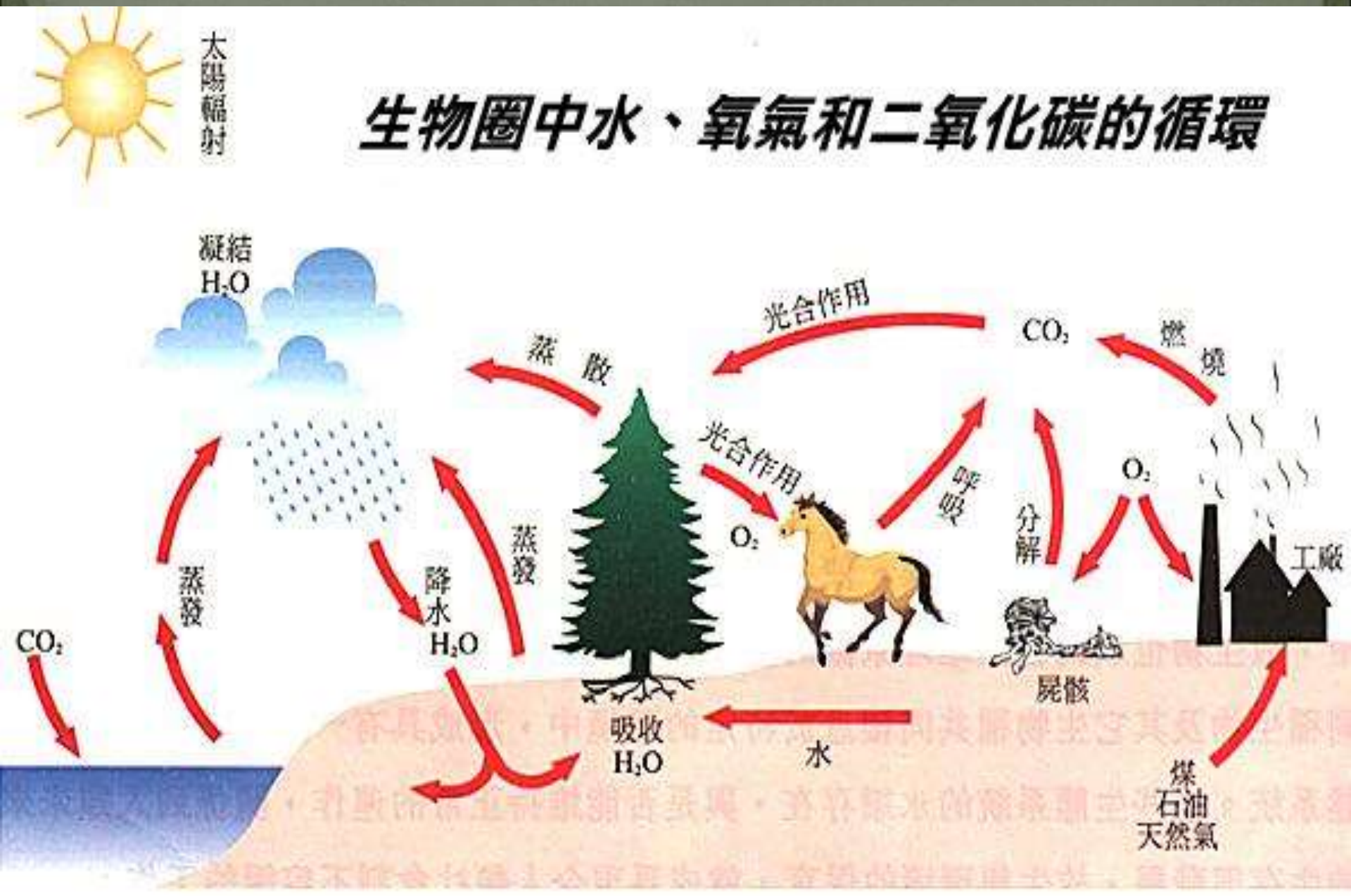
- Carbon and Oxygen cycle
- Nitrogen cycle
- A model of nutrient cycle

Carbon Cycle and Oxygen Cycle

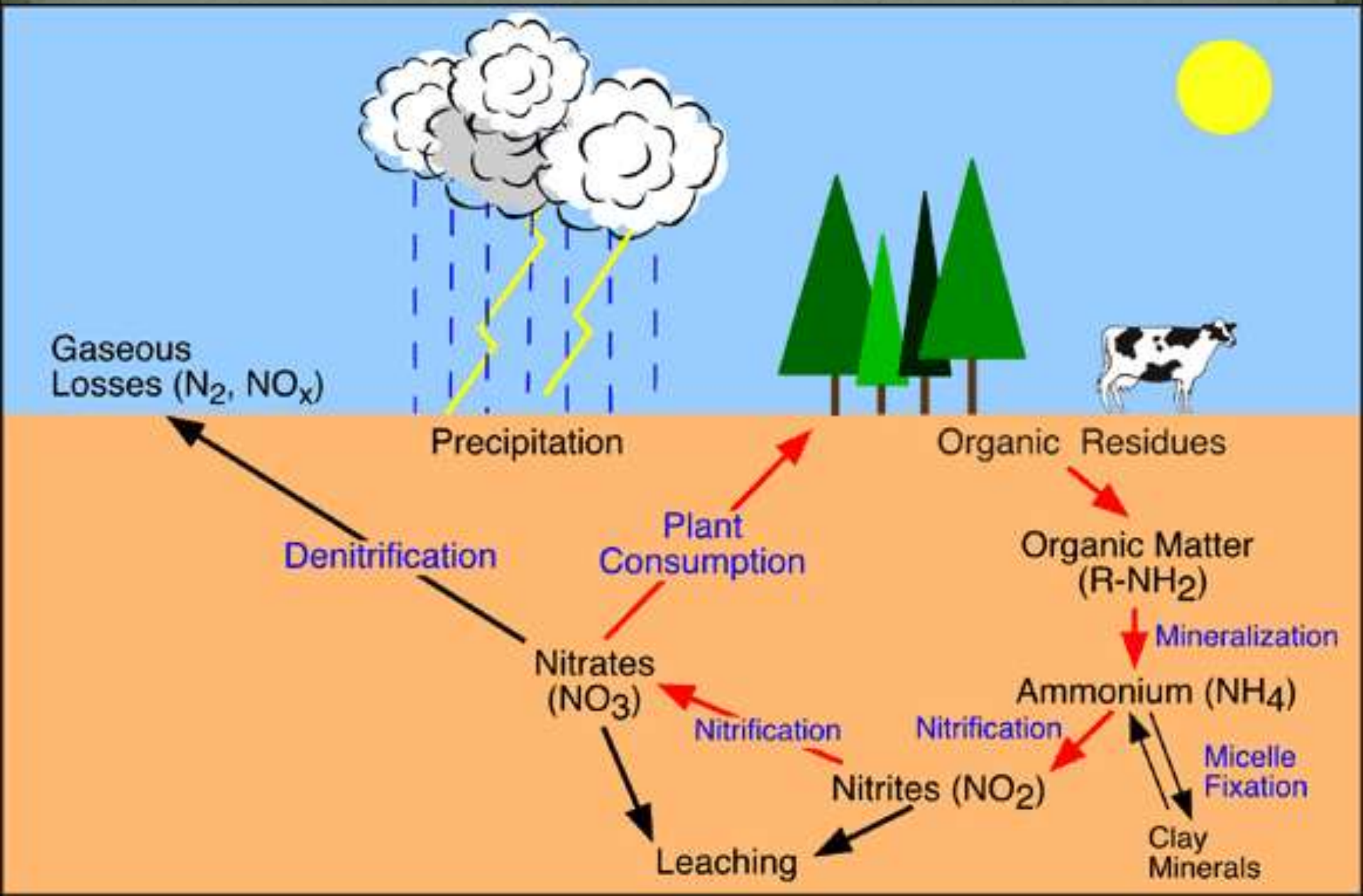



CO_2 cycle
Sunlight
Factory emissions
Photosynthesis
Plant respiration
Organic carbon
Animal respiration
Decay organisms
Dead organisms and waste products
Root respiration
Mineral carbon
The COMET Program

生物圈中水、氧氣和二氧化碳的循環



Nitrogen Cycle



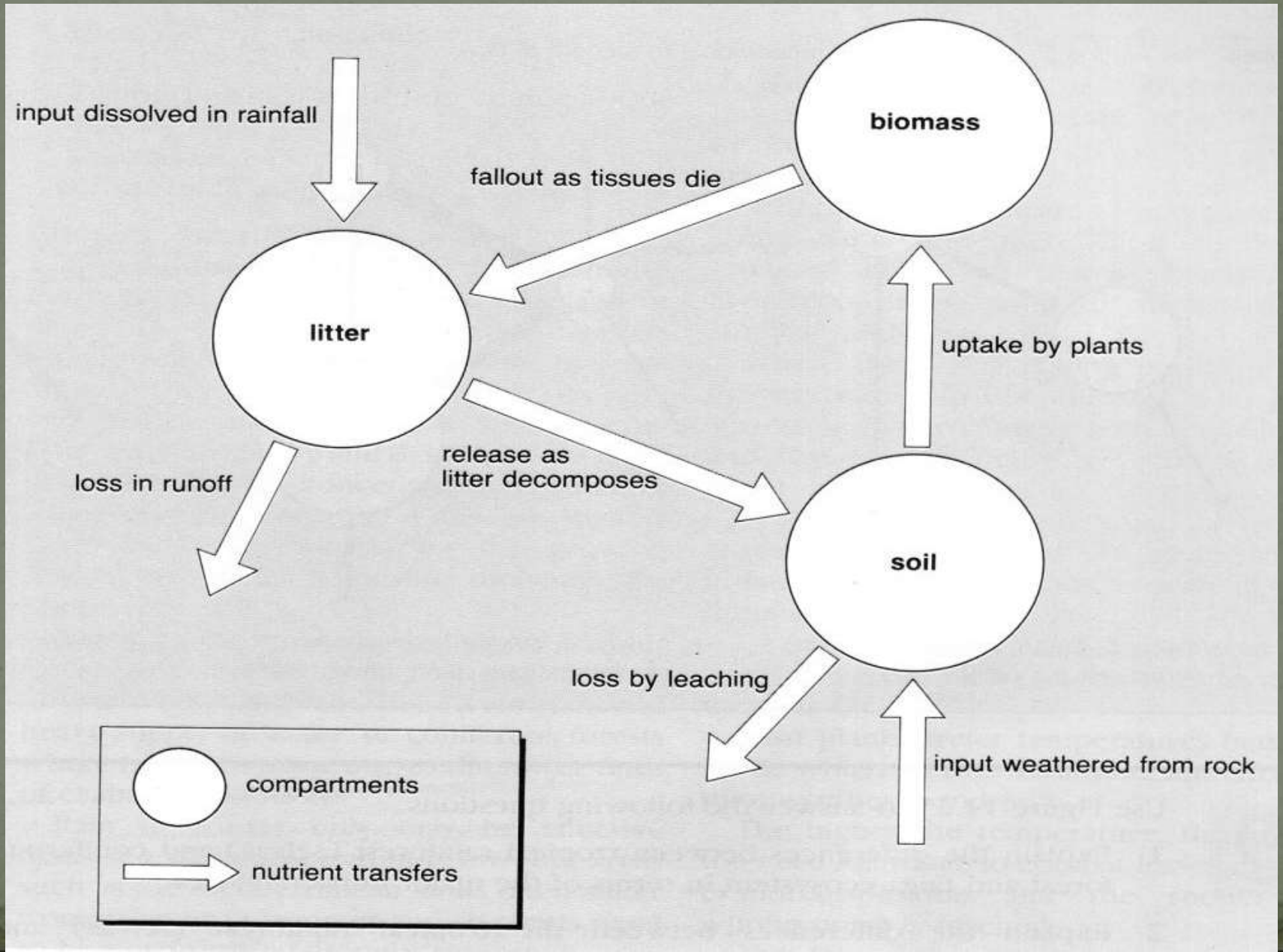
Nitrogen cycle

- Nitrogen cycle can be affected by man in five major ways:
  - Fertilizer production (mainly nitrates and ammonium salts) to grow more food by increasing yields, and replenishing lost nitrogen from the soil.
  - Burning of fossil fuels in cars, power plants, and heating which puts nitrogen dioxide into the atmosphere.
  - Increasing animals wastes (nitrates) from more people and from livestock and poultry grown in ranches.
  - Increased sewage flows from industry and urbanization.
  - Increased erosion of and runoff nearby streams, lakes and rivers from cultivation, irrigation, agricultural wastes, mining, urbanization and poor land use.

Model of Nutrient Cycle

- Nutrients (chemicals, minerals or elements) are circulated around the ecosystem and recycled continually.
- Gersmehl identified three storage compartments.
  - Litter: the surface layer of vegetation which may eventually become humus.
  - Biomass: the total mass of living organisms, per unit area.
  - Soil: the nutrients store in soil (weathered material) and semi-weathered material.

Model of Nutrient Cycle

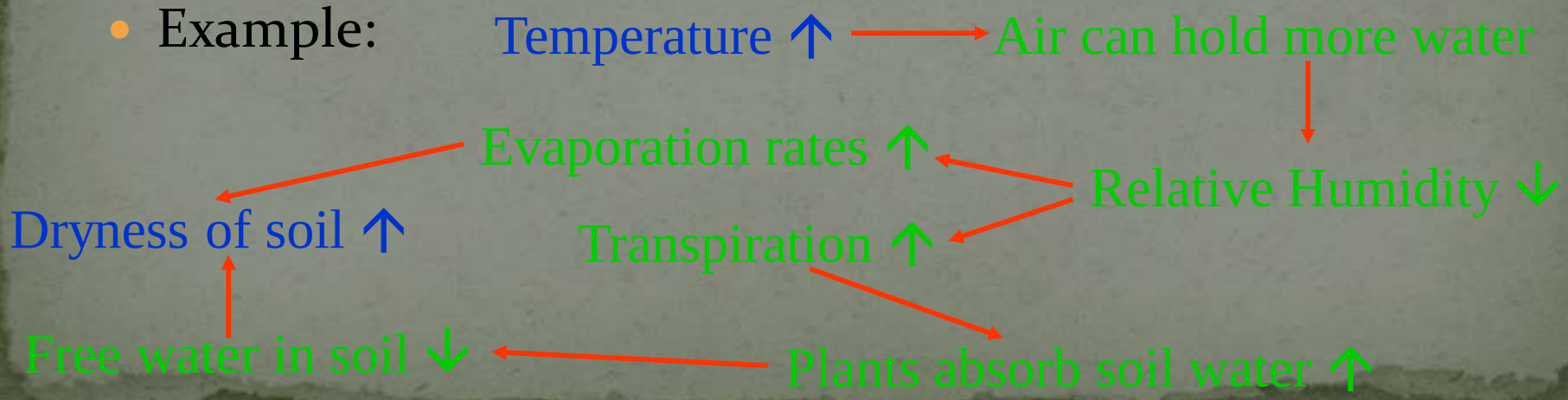


Environmental Limitation in ecosystem development

- Principles of limiting factors
  - Law of the maximum
  - Law of the minimum
- Principle of holocoenotic environment
- Limiting factors of an environment
  - Light
  - Temperature
  - Water
  - Wind
  - Topography
  - Soil
  - Biotic factors

Principle of holocoenotic environment

- A German ecologist Karl Friederich (1927) suggested that 'community-environmental relationship are holocoenotic'. This means that there are no 'walls' or barriers between the factors of an environment and the organism or biotic community.
- If one factor is changed, almost all will change eventually.
- Example:



Limiting factors of an environment

- Light
- Temperature
- Water
- Wind
- Topography
- Soil
- Biotic Factors

Light

- Light is an very important environment factor:
  - Source of energy for ecosystem
  - Control factor for reproduction and migration.

Light

- Quality of light:
  - Red and blue light: green plants (photosynthesis)
  - Green light: plants in woods or deep water
  - Ultraviolet light: retards plant growth
- Duration of light
  - Affect the behaviour of plants and animals (flowering, migration, mating….)
- Intensity of light:
  - Controlling factor for rate of photosynthesis
  - Net productivity is the function of photosynthesis and respiration.

Water

- Water restrict ecosystem development because ,most organisms need large amounts of water to survive.
- Water requirement for plants will vary both with environmental conditions and among different species.
- Actual rate of transpiration is the function of
  - relative humidity
  - Air movement
  - Size of leaves
  - Size of stomata

Water

- Plants classification by water requirement.
  - Xerophytes: plants can survive in extremely arid areas.
  - Halophytes: plants can survive in saline conditions
  - Hydrophytes: plants live in water or in moist soil.

Wind

- Wind can act as an environmental factor
  - Directly by causing mechanical damage to plants
  - Indirectly affecting relative humidity and evaporation rates.
- High wind speed increases the rate of transpiration.
- Mountain summits, coasts and open plains vegetation may be dwarfed as a result of wind action.

Topography

- Topography can influence ecosystem development in three major ways.
  - Direct effects of altitude on temperature
    - normal lapse rate (-6.5°C/km)
  - The combination of changes in temperature and relative humidity
    - an altitudinal zonation of ecosystems.
  - Slope orientation and angle
    - South-facing slopes (in the northern hemisphere) are warmer and drier than north-facing slopes.
    - Angle of slope will be a critical factor in soil formation and drainage.

Soil

- Attributes of soils, such as texture, pH, soil climate and organic content operate in a closely inter-related fashion to exert control on
  - rates of decomposition
  - nutrient cycling,
  - plant distribution
  - productivity.

Biotic Factors

- Biotic factors are the interactions that occur between living things.
- Some species are beneficial or even essential for the existence of others, whereas some may be harmful.
  - The dominant plants will grow tallest and modify the light conditions for the rest of the community.
  - Plants struggle for light will influence root development and the competition for water and nutrients in the soil.
  - Many plants rely on animals for pollination and seed dispersal.
  - Many animals are directly dependent on plants for food.

Biotic Factors

- Man is by far the most important biotic factor.
- Man modifies of ecosystems by fire, hunting and agriculture,……
- Industrialization and the intensification of agriculture, man has obliterated large areas of natural systems and caused pollution of both terrestrial and aquatic habitats.

- Thank You