# ECOLOGY

# ECOLOGY

- Ecology is the study of organisms and their interaction with the environment around them. This is the study of relationship between living things and their habitats.

# KEY CONCEPTS INCLUDE:

- interactions within and among populations
- nutrient cycling with energy flow through ecosystems
- the effects of natural events and human activities on ecosystems

# WHAT IS ECOLOGY?

Ecology- the scientific study of interactions between organisms and their environments, focusing on energy transfer

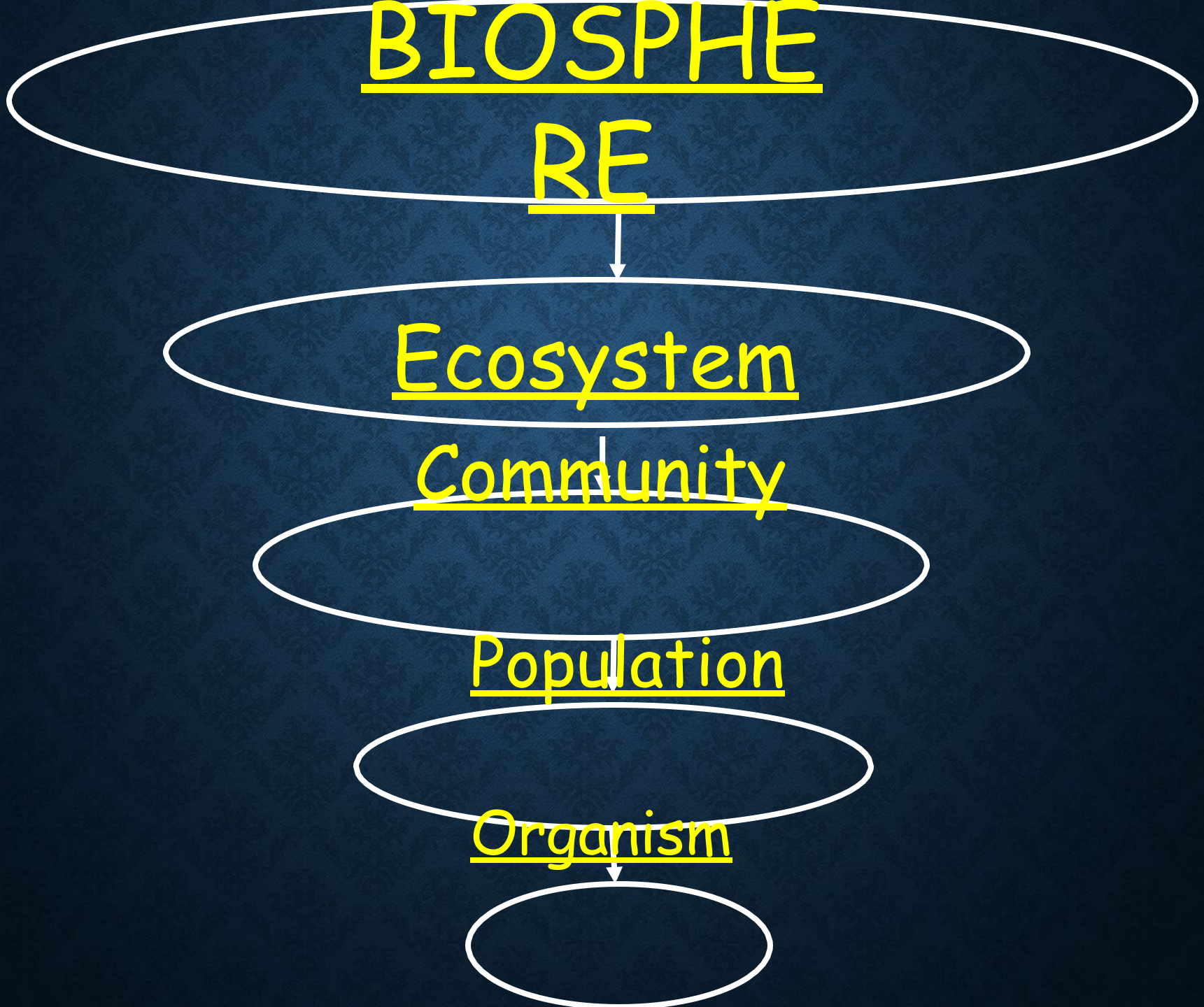
- It is a science of relationships.

# WHAT DO YOU MEAN BY ENVIRONMENT?

The environment is made up of two factors:

**Biotic factors**- all living organisms inhabiting the Earth

**Abiotic factors**- nonliving parts of the environment (i.e. temperature, soil, light, moisture, air currents)


BIOSPHERE
Ecosystem
Community
Population
Organism

# **ORGANISM**- ANY UNICELLULAR OR MULTICELLULAR FORM EXHIBITING ALL OF THE CHARACTERISTICS OF LIFE, AN INDIVIDUAL.

- The lowest level of organization


**Population**-a group of organisms **of one species** living in the same place at the same time that interbreed and compete with each other for resources (ex. food, mates, shelter)

**COMMUNITY- SEVERAL INTERACTING POPULATIONS THAT INHABIT A COMMON ENVIRONMENT AND ARE INTERDEPENDENT.**

**ECOSYSTEM**- POPULATIONS IN A COMMUNITY AND THE ABIOTIC FACTORS WITH WHICH THEY INTERACT (EX

RI

**BIOSPHERE**- LIFE SUPPORTING PORTIONS OF EARTH COMPOSED OF AIR, LAND, FRESH WATER, AND SALT WATER.

- The highest level of organization

"The ecological niche of an organism depends not only on where it lives but also on what it does. By analogy, it may be said that the habitat is the organism's 'address', and the niche is its 'profession', biologically speaking."

Reference ;

Odum - Fundamentals of Ecology

# HABITAT VS. NICHE

- Niche - the role a species plays in  a community (job)

- Habitat- the place in which an  organism lives out its life

(address)

# HABITAT VS. NICHE

A niche is determined by the tolerance limitations of an organism, or a limiting factor.

Limiting factor- any biotic or abiotic factor that restricts the existence of organisms in a specific environment.

# FEEDING RELATIONSHIPS

- There are 3 main types of feeding relationships

1. Producer- Consumer
2. Predator- Prey
3. Parasite- Host

# WHY SHOULD WE STUDY ECOLGY ?

- With the knowledge of ecology, we are able to know which resources are necessary for the survival of different organisms. Lack of ecological knowledge has led to scarcity and deprivation of these resources, leading to competition.
- The many specialties within ecology, such as marine, vegetation, and statistical ecology, provide us with information to better understand the world around us. This information also can help us improve our environment, manage our natural resources, and protect human health and our own lives and those around us.

# IMPLEMENTATION OF ECOLOGICAL ENGINEERING

- **Implementation of ecological engineering has focused on the creation or restoration of ecosystems, from degraded wetlands to multi-celled tubs and greenhouses that integrate microbial, fish, and plant services to process human wastewater into products such as fertilizers, flowers, and drinking water.**
- **Saprophytes are organisms that feed on dead or decaying matter. Fungi, bacteria generally come under the category of saprophytes. Saprophytes are also referred to as nature's scavengers because they feed on dead and decaying substances thus, cleaning our earth.**

# ARE HUMANS NATURALLY SCAVENGERS?

- Some land scavengers include bears, hyenas, jackals, and wolves. Scavengers such as vultures, crows, ravens, and condors are found in the air. In water, lobsters, crabs, and some species of shark are considered scavengers. Vulture, white shark, Jungle Crow, polar bear are other scavangers.
- Biologically, the best sense is that we started out as scavengers. We definely were omnivores, and, before we had tools, we were not really strong enough to take down live prey of any size.

- **Ecology helps in maintaining the world rich in resources with assuring the balance through natural interaction of different organisms. Some of the importance of ecology is maintaining a clean environment, ensuring resources like land and water, and helping the ecosystem adapt to climate change.**
- **Engineers need to know about biological principles in the same way that they know about transport processes, mechanical principles, electrical principles, chemical principles, and materials principles. These principles form the basis of engineering applications.**

- **The field of biological sciences has grown multitude in the past decade to address real-life challenges and industrial innovations to cater to the needs of society. Different biological phenomena can be approximated in terms of physical processes of mechanical work, electrical signals, and chemical energy.**
- **Ecological benefits include healthier water temperatures for aquatic life, improved floodplain management, vital connectivity for bird and animal populations, resiliency in the face of changing weather patterns, and improved water quality for wildlife and humans alike.**

# Feeding Relationships

**Producer-** all autotrophs (plants), they trap energy from the sun

- Bottom of the food chain

# Feeding Relationships

**Consumer-** all heterotrophs: they ingest food containing the sun's energy

- Herbivores
- Carnivores
- Omnivores
- Decomposers

# FEEDING RELATIONSHIPS

## CONSUMER-

Herbivores

- Eat plants

- **Primary consumers**
- Prey animals

# RELATIONSHIPS

## CONSUMER-CARNIVORES-EAT MEA

- Predators
  - Hunt prey animals for food.

# FEEDING

# RELATIONSHIPS CONSUMER-

## CARNIVORES- EAT MEAT

- Scavengers
  - Feed on carrion ( decaying animals ), dead animals

# FEEDING RELATIONSHIPS

Consumer- Omnivores -eat both plants and animals

# FEEDING RELATIONSHIPS

## Consumer- Decomposers

- Breakdown the complex compounds of dead and decaying plants and animals into simpler molecules that can be absorbed

# SYMBIOTIC RELATIONSHIPS

Symbiosis- two species living together

3 Types of symbiosis:

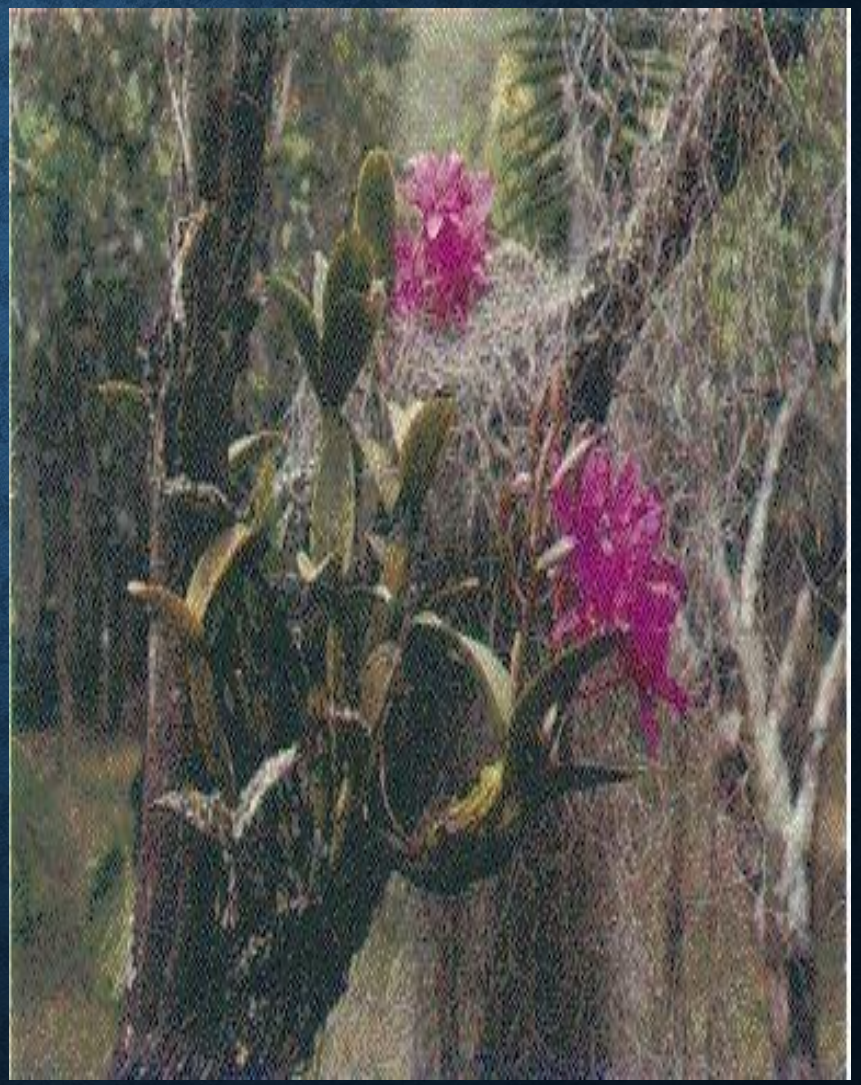
1. Commensalism
2. Parasitism
3. Mutualism

# SYMBIOTIC RELATIONSHIPS

**Commensalism-**

one species benefits and the other is neither harmed nor helped

**Ex. orchids / plants on a tree**



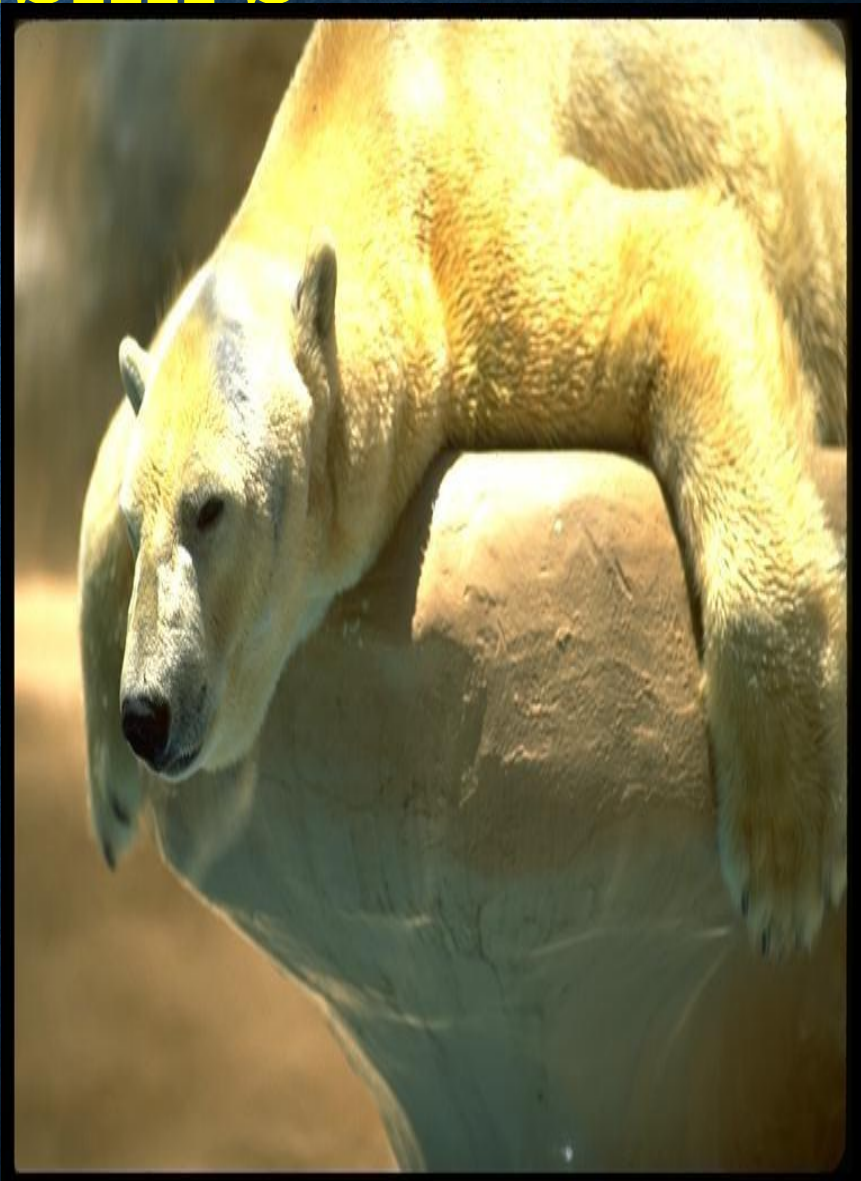
**Epiphytes:** A plant, such as a tropical orchid or a bromeliad, that grows on another plant upon which it depends for mechanical support but not for nutrients. Also called

# SYMBIOTIC RELATIONSHIPS

**Commensalism-**

one species benefits and the other is neither harmed nor helped

Ex. Cyanobacteria grow on the fur of polar bears without harming it.



# Symbiotic Relationships

## Parasitism-

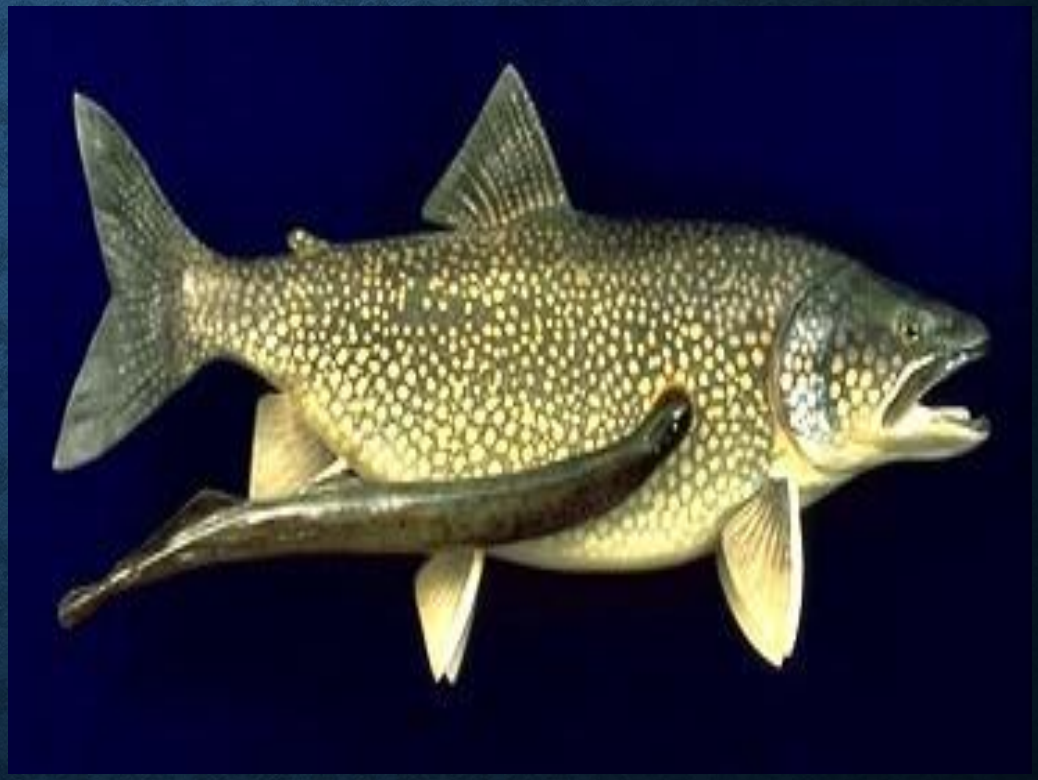
one species benefits (parasite) and the other is harmed (host)

- Parasite-Host relationship

# Symbiotic Relationships

**Parasitism-** parasite-host

Ex. lampreys, leeches, fleas, ticks, tapeworm



**Cuscuta (/kʌsˈkjuːtə/), commonly known as dodder or amarbel, is a genus of over 201 species of yellow, orange, or red (rarely green) parasitic plants.**

Hindustan Times | By
Ipsita Pati, Gurgaon Dec 22, 2016 11:45 PM IST

# Parasitic vine in trees threatens Gurgaon's green cover

**The creeper Amar Bel (Cuscuta) is spreading to several trees, predominantly along the road from Huda Metro station to Sushant Lok.**

Trees in the city are being threatened by Amar Bel (Cuscuta) — a parasitic vine that is spreading to several trees, predominantly along the road from Huda Metro station to Sushant Lok. This creeper grows on the host plant and draws nutrition, causing the death of the host.

https://www.google.com/search?q=cusduta+amarbel+ruining+trees&rlz=1C1YTUH_e
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EEUYOTIJCAEQIRgKGKABMgkIAhAhGAoYoAEyCQgDECEYChigATIJCAQQIRgKGKAB
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state=ive&vld=cid:9d9e19f5,vid:Y4-5gxOqw08,st:0

TRADITIONAL MEDICINE
Cuscuta seeds have long been used for osteoporosis in China and some other Asian countries.
Cuscuta is a commonly used traditional Chinese medicine which is believed to strengthen the
liver and kidneys.

Improves Hair Health: The plant prevents hair fall and dandruff. Its sap is obtained from the stem and can be used as a hair conditioner and shampoo. It is useful remedy for baldness.

# Symbiotic Relationships

**Mutualism-**

beneficial to both species

Ex. cleaning birds and cleaner shrimp

**Cleaner shrimp are so called because they exhibit a cleaning symbiosis with client fish where the shrimp clean parasites from the fish. The fish benefit by having parasites removed from them, and the shrimp gain the nutritional value of the parasites.**

# SYMBIOTIC RELATIONSHIPS

**Mutualism-**

beneficial to both species

**Ex. lichen**


Lichen

| Type of relationship | Species harmed | Species benefits | Species neutral |
| --- | --- | --- | --- |
| Commensalism | | ● | ● |
| Parasitism | ● | ● | |
| Mutualism | | ● ● | |

● = 1 species

# TROPHIC LEVELS

- Each link in a food chain is known as a trophic level.
- Trophic levels represent a feeding step in the transfer of energy and matter in an ecosystem.

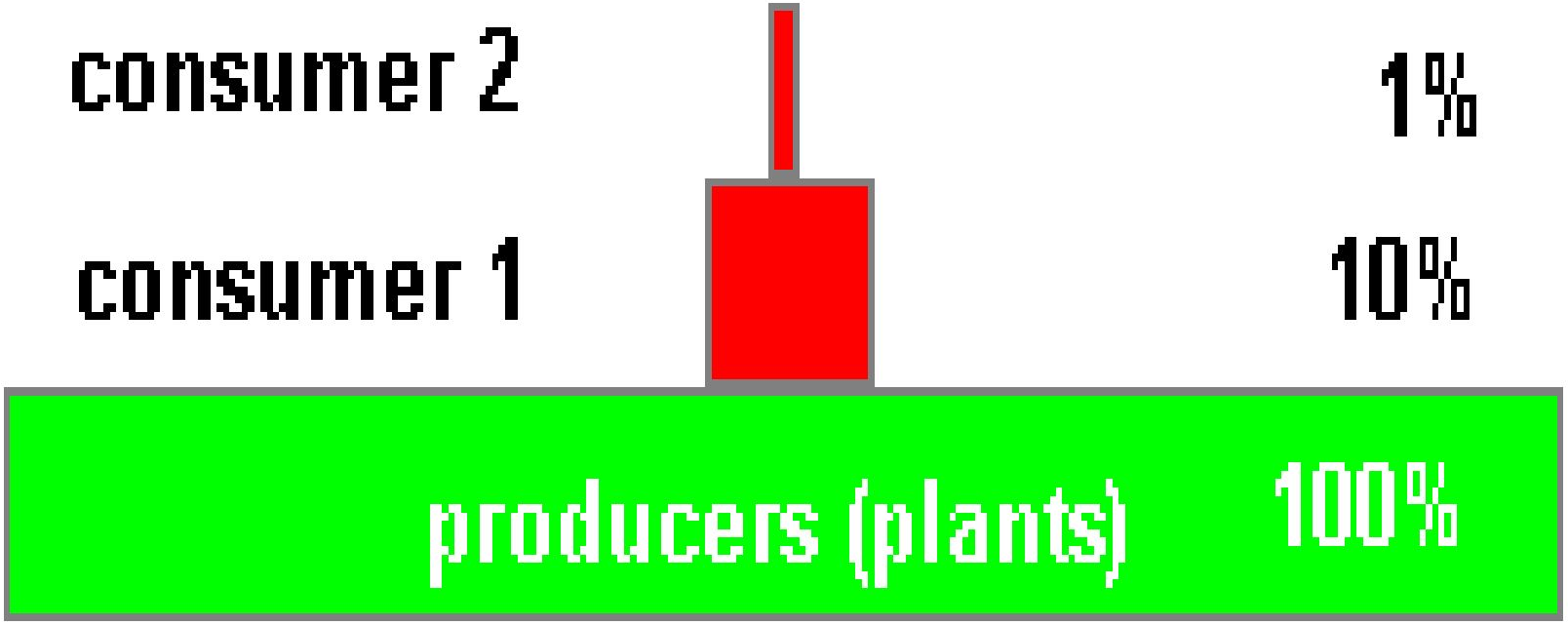
# TROPHIC LEVELS

**Biomass-** the amount of organic matter comprising a group of organisms in a habitat.

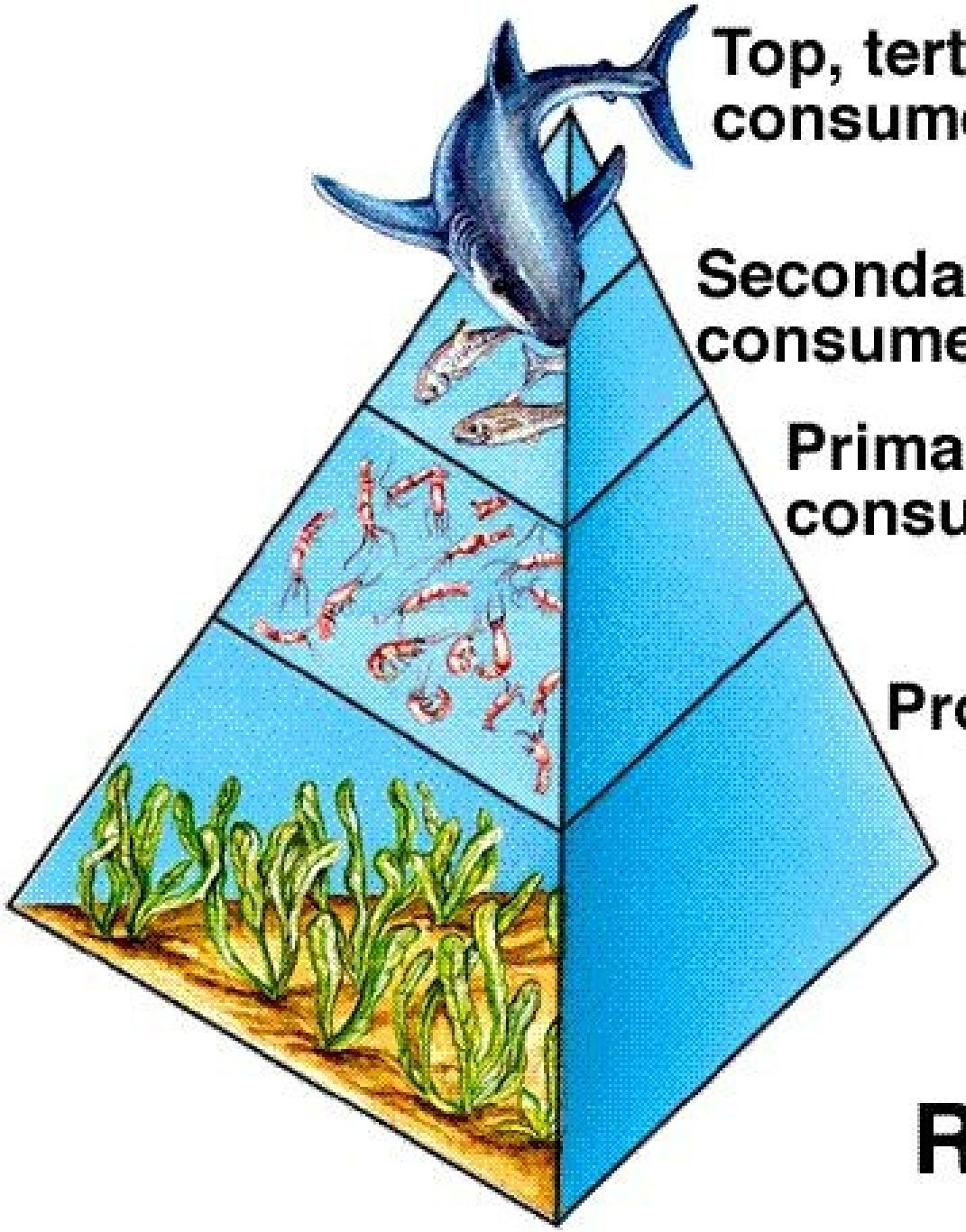
- As you move up a food chain, both available energy and biomass decrease.
- Energy is transferred upwards but is diminished with each transfer.

# TROPHIC LEVELS

# Typical ecosystem



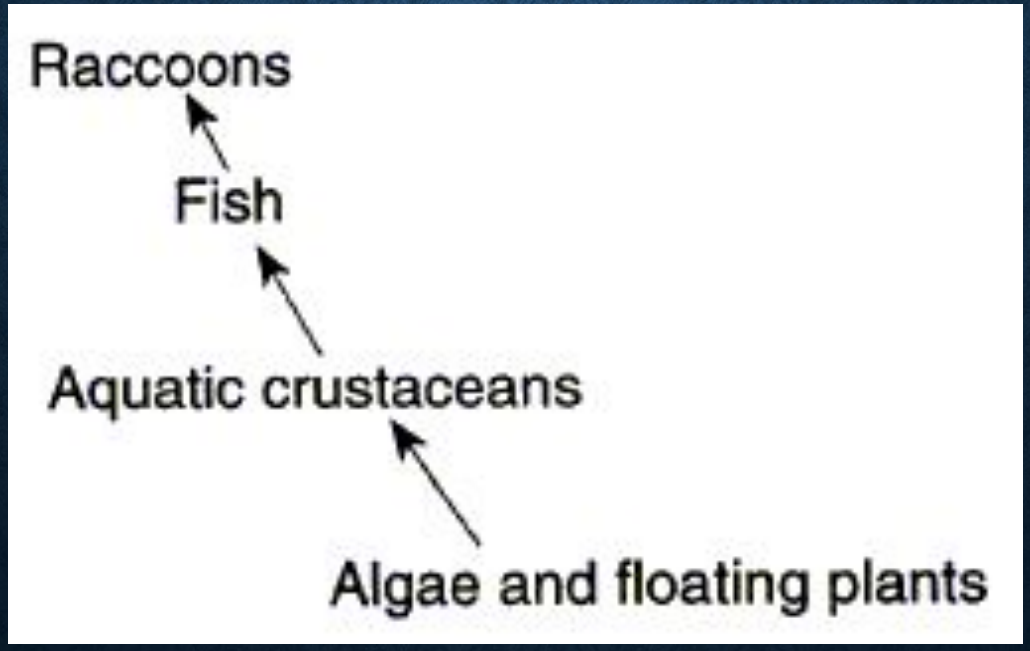

energy/biomass

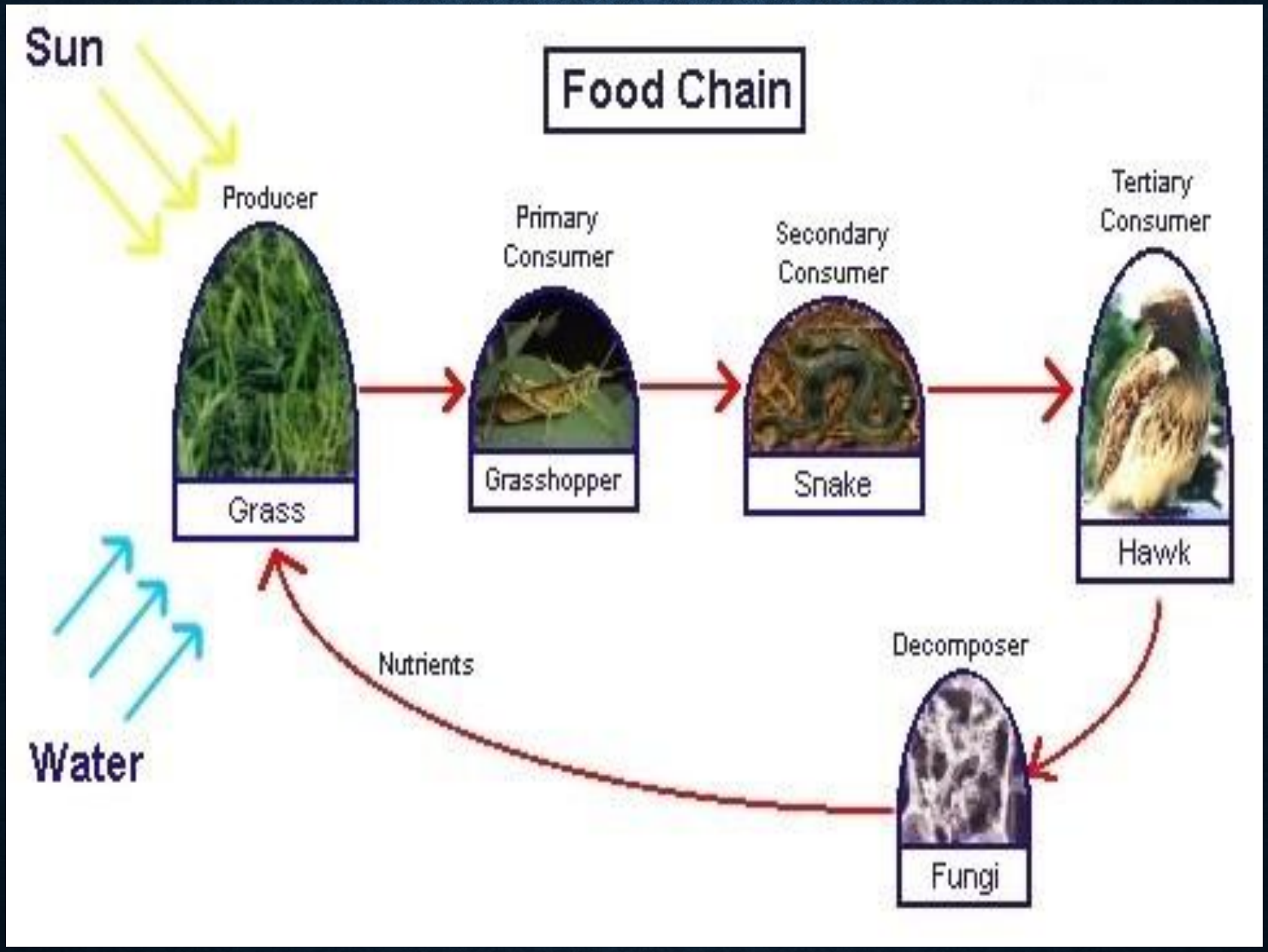



# Food Web Energy Requirements

# Trophic Levels

**Food chain**- simple model that shows how matter and energy move through an ecosystem




Sun
Food Chain
Producer
Primary Consumer
Secondary Consumer
Tertiary Consumer
Grass
Grasshopper
Snake
Hawk
Nutrients
Decomposer
Fungi
Water

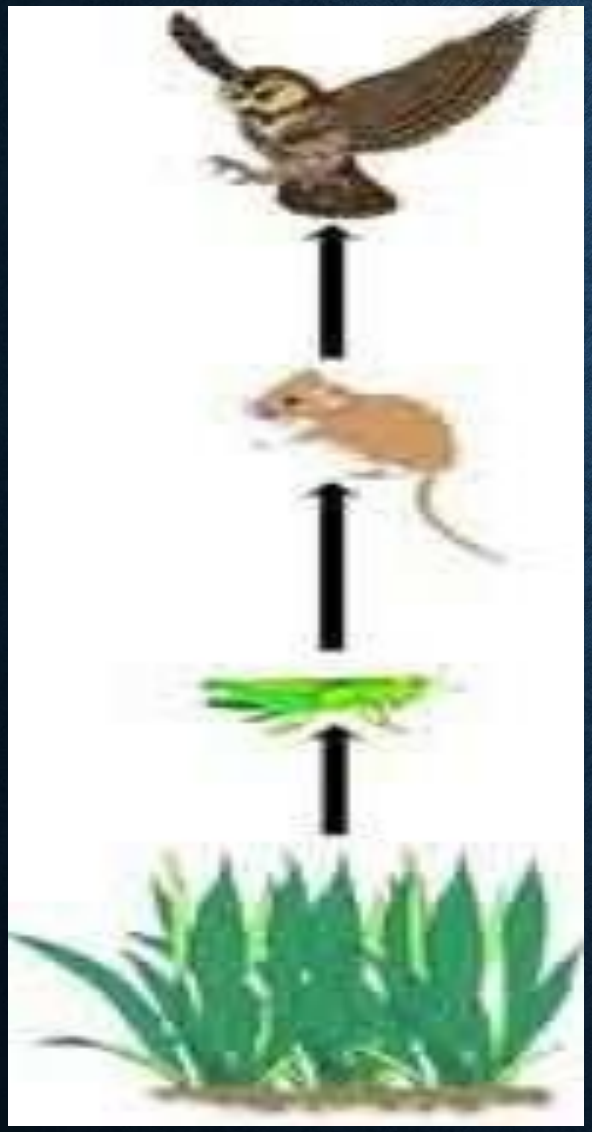
# TROPHIC LEVELS

**Food web**- shows all possible feeding relationships in a community at each trophic level

- Represents a network of interconnected food chains

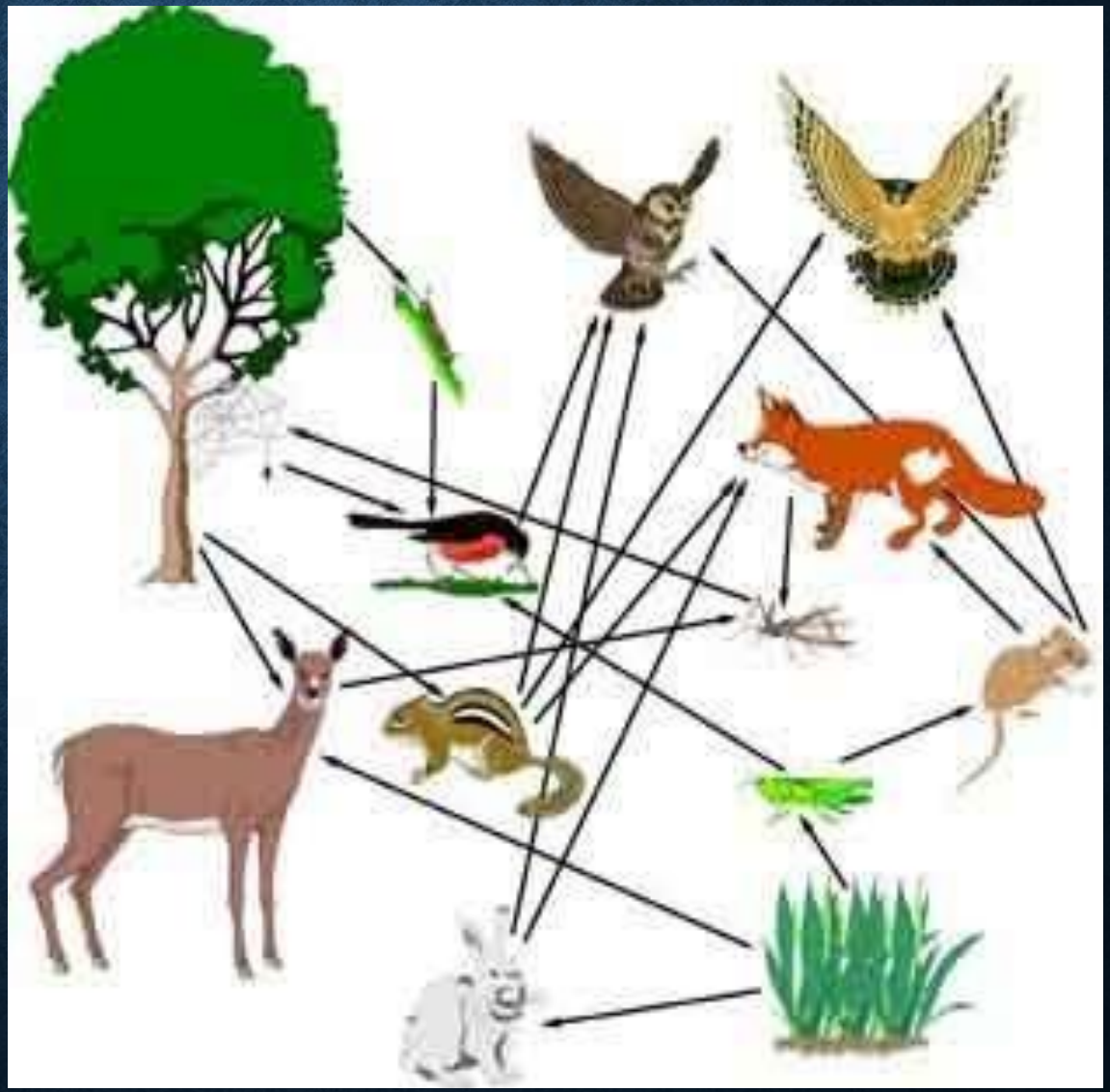
# FOOD CHAIN

## (JUST 1 PATH OF ENERGY)

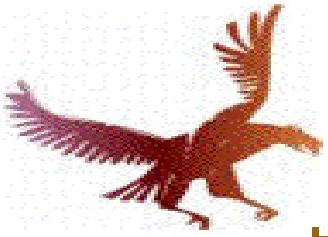


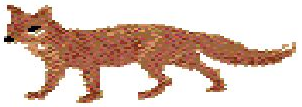
# Food web

## (all possible energy paths)



# A Food Web in the Desert Biome





Larger Predators

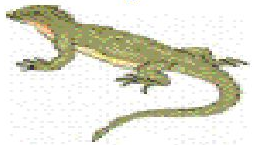
Hawk

Kit Fox

Small Predators
Carnivores,
Insectivores

Tarantulas

Scorpions



Lizards

Snakes

Plant Eaters
Primary Consumers

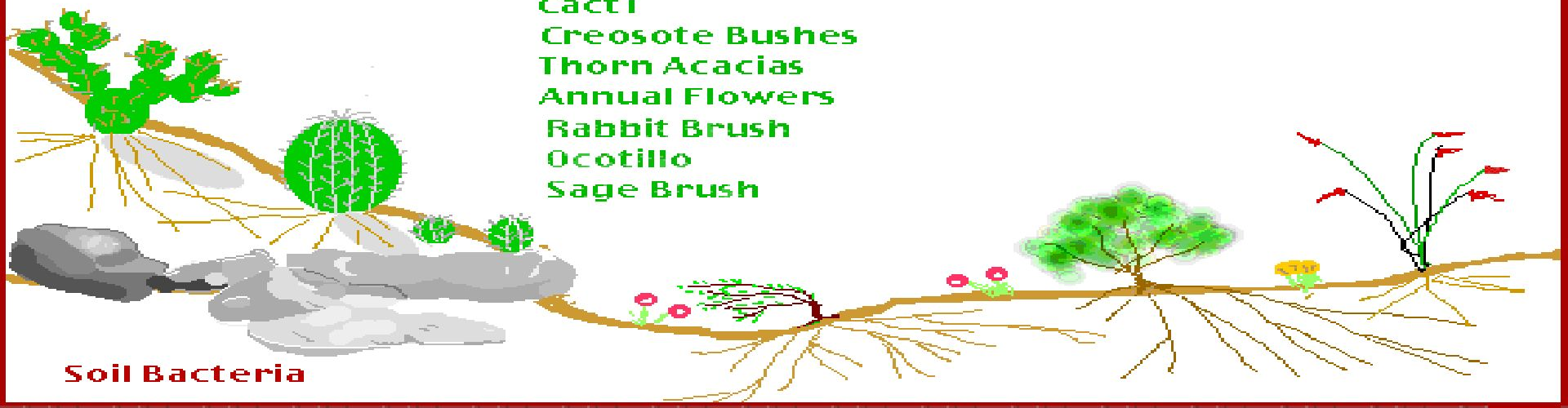
Insects

Lizards

Rodents
Kangaroo Rats

Primary Producers

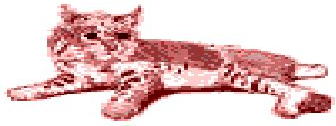
Cacti
Creosote Bushes
Thorn Acacias
Annual Flowers
Rabbit Brush
Ocotillo
Sage Brush



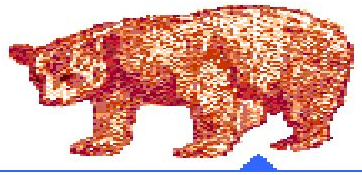
Soil Bacteria

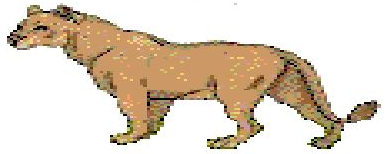
# A Food Chain in the Temperate Rain Forest Biome

## Tertiary Consumers


Lynx


Wolf


Bear


Cougar

## Secondary Consumers

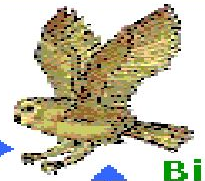

Shrew


Amphibians


Weasel


Racoon

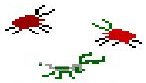

Insects


Birds

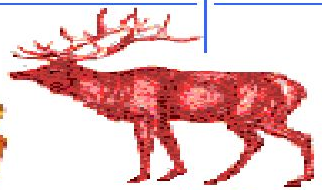
## Primary Consumers


Small Mammals


Salmon


Insects


Deer


Elk

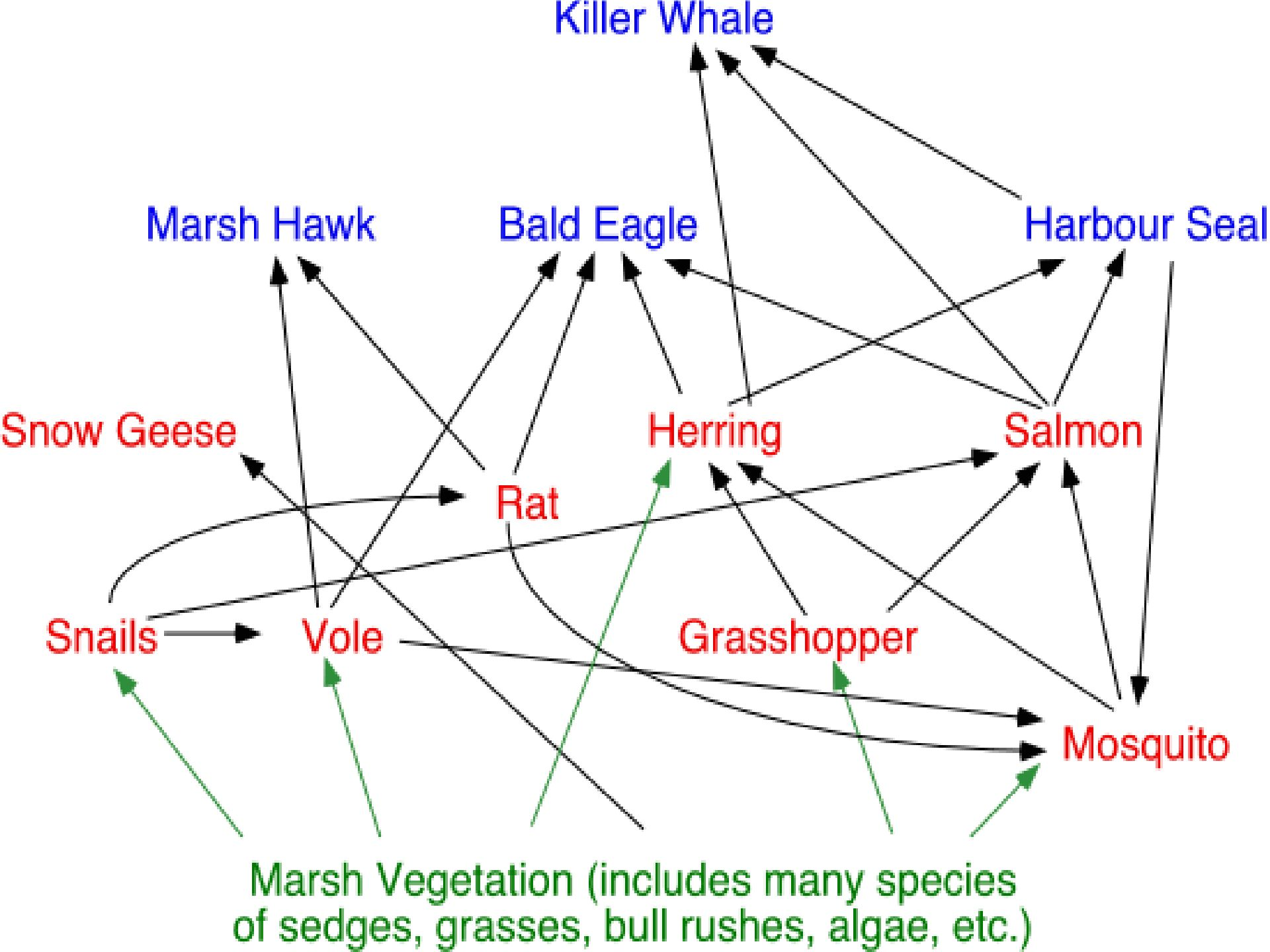

Birds

## Primary Producers

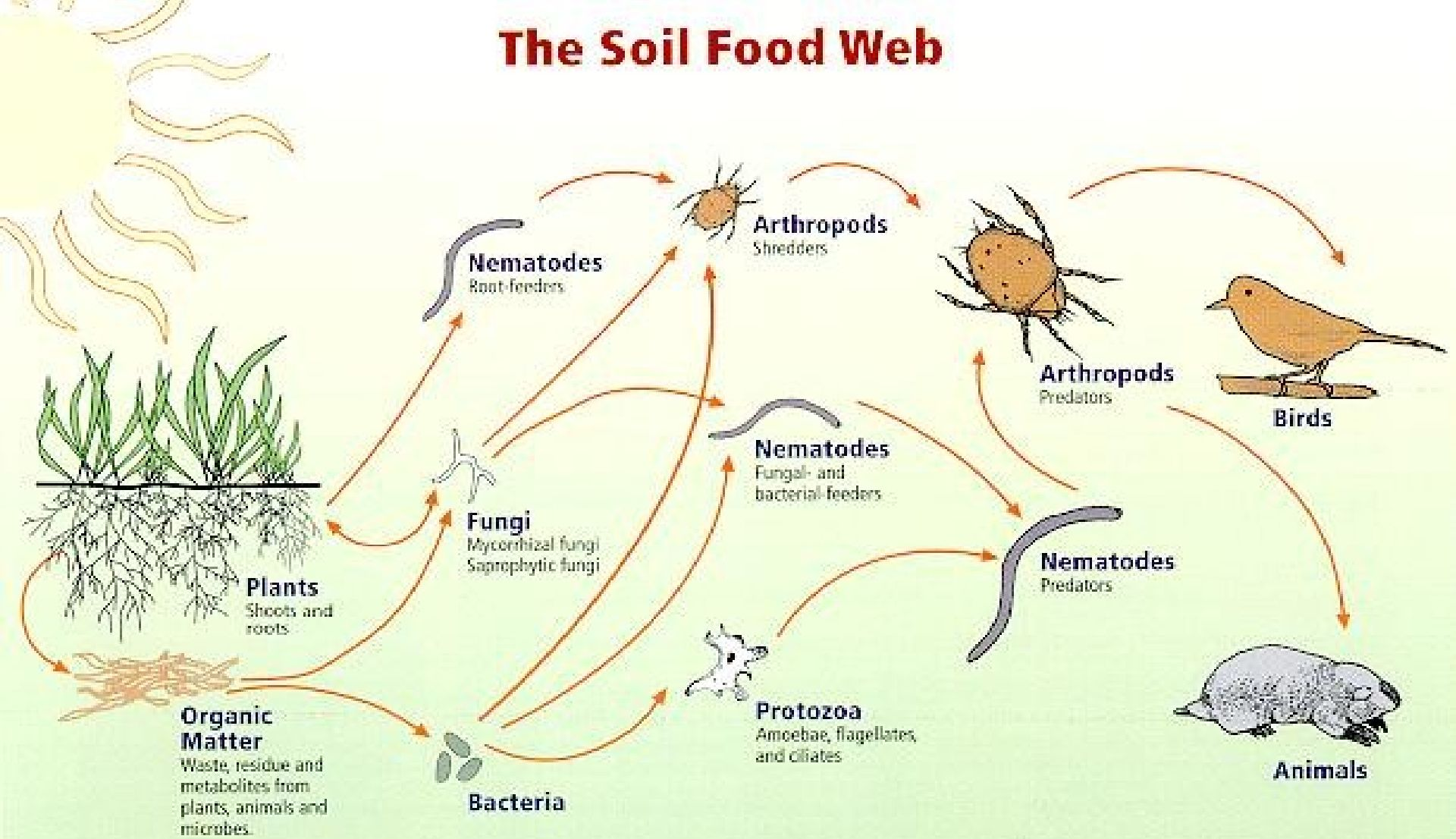
Ferns Mosses Shrubs
Shrubs Flowers

Canopy level trees: Conifers: Fir Hemlock Cedar Spruce
Understory trees : Vine Maples Dogwood


Ferns, grasses, moss, small flowering plants, fungi, small leafy plants.
Bacteria, protozoans, fungi, detritivores digest dead matter.


Killer Whale
Marsh Hawk
Bald Eagle
Harbour Seal
Snow Geese
Herring
Salmon
Rat
Snails
Vole
Grasshopper
Mosquito
Marsh Vegetation (includes many species
of sedges, grasses, bull rushes, algae, etc.)

# The Soil Food Web




**First trophic level:**
Photosynthesizers

**Second trophic level:**
Decomposers
Mutualists
Pathogens, parasites
Root-feeders

**Third trophic level:**
Shredders
Predators
Grazers

**Fourth trophic level:**
Higher level predators

**Fifth and higher trophic levels:**
Higher level predators

# Nutrient Cycles

Cycling maintains homeostasis (balance) in the environment.

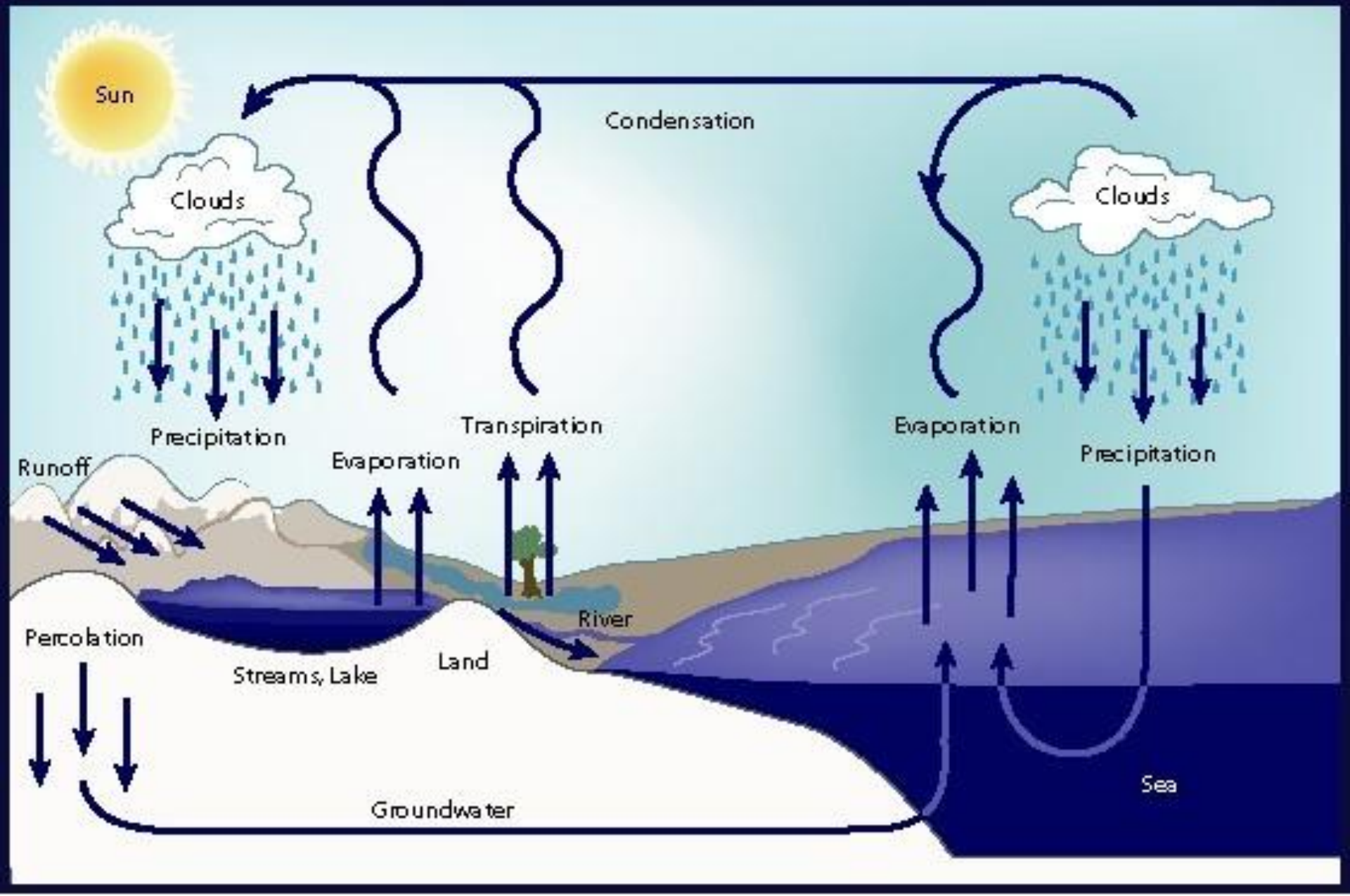
- 3 cycles to investigate:

1. Water cycle
2. Carbon cycle
3. Nitrogen cycle

# WATER CYCLE-

- Evaporation, transpiration, condensation, precipitation

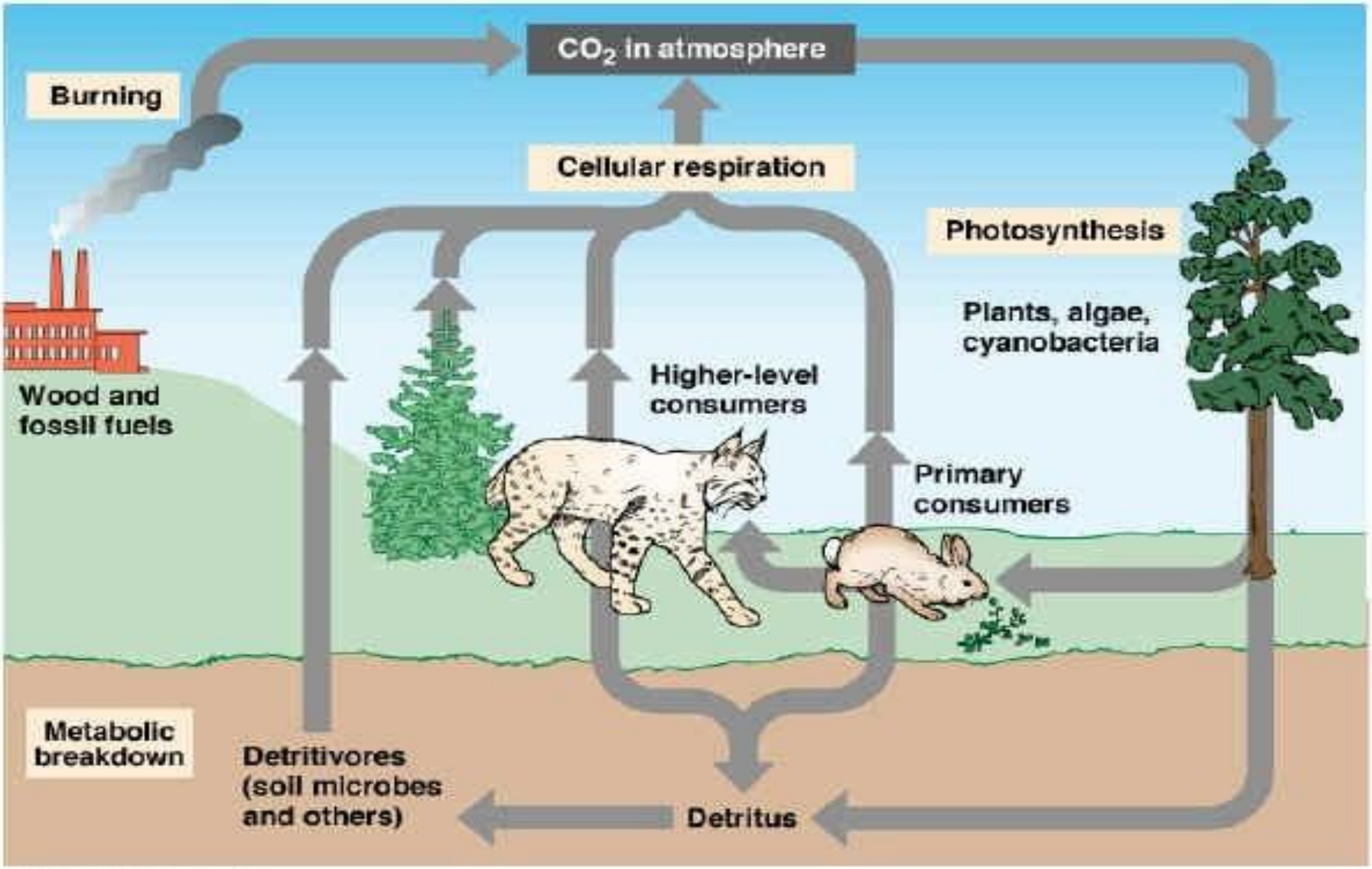
# WATER CYCLE-


Sun
Condensation
Clouds
Clouds
Precipitation
Transpiration
Evaporation
Evaporation
Precipitation
Runoff
River
Percolation
Land
Streams, Lake
Sea
Groundwater

# CARBON CYCLE-

- Photosynthesis and respiration cycle carbon and oxygen through the environment.

# CARBON CYCLE-



# NITROGEN CYCLE-

Atmospheric nitrogen ($N_2$) makes up nearly 78%-80% of air.

Organisms can not use it in that form.

Lightning and bacteria convert nitrogen into usable forms.

# NITROGEN CYCLE-

Only in certain bacteria and industrial technologies can fix nitrogen.

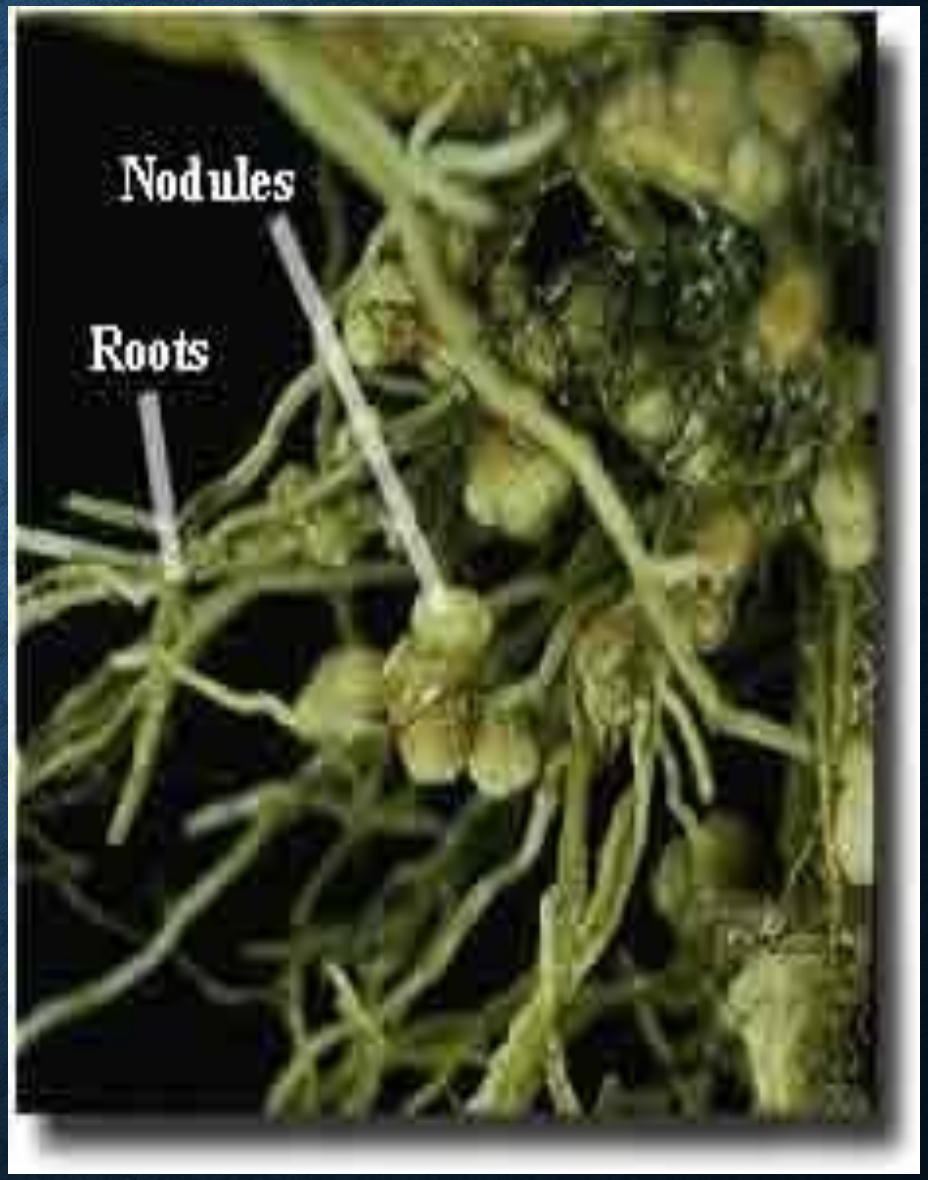
**Nitrogen fixation**-convert atmospheric nitrogen ($N_2$) into ammonium ($NH_4^+$) which can be used to make organic compounds like amino acids.

$$N_2 \longrightarrow NH_{4+}$$

# NITROGEN CYCLE-

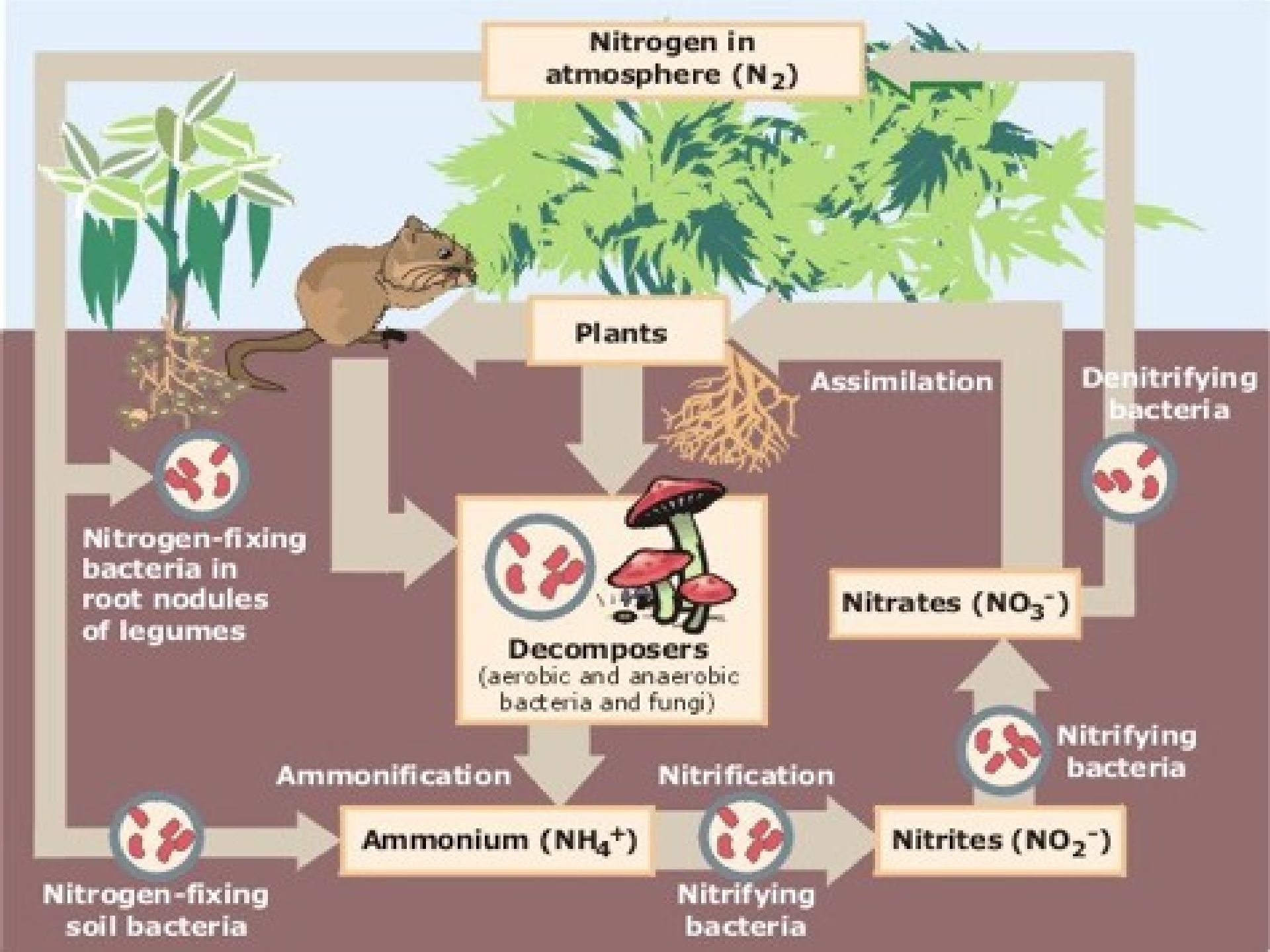
Nitrogen-fixing bacteria:

Some live in a symbiotic relationship with plants of the legume family (e.g., soybeans, clover, peanuts).

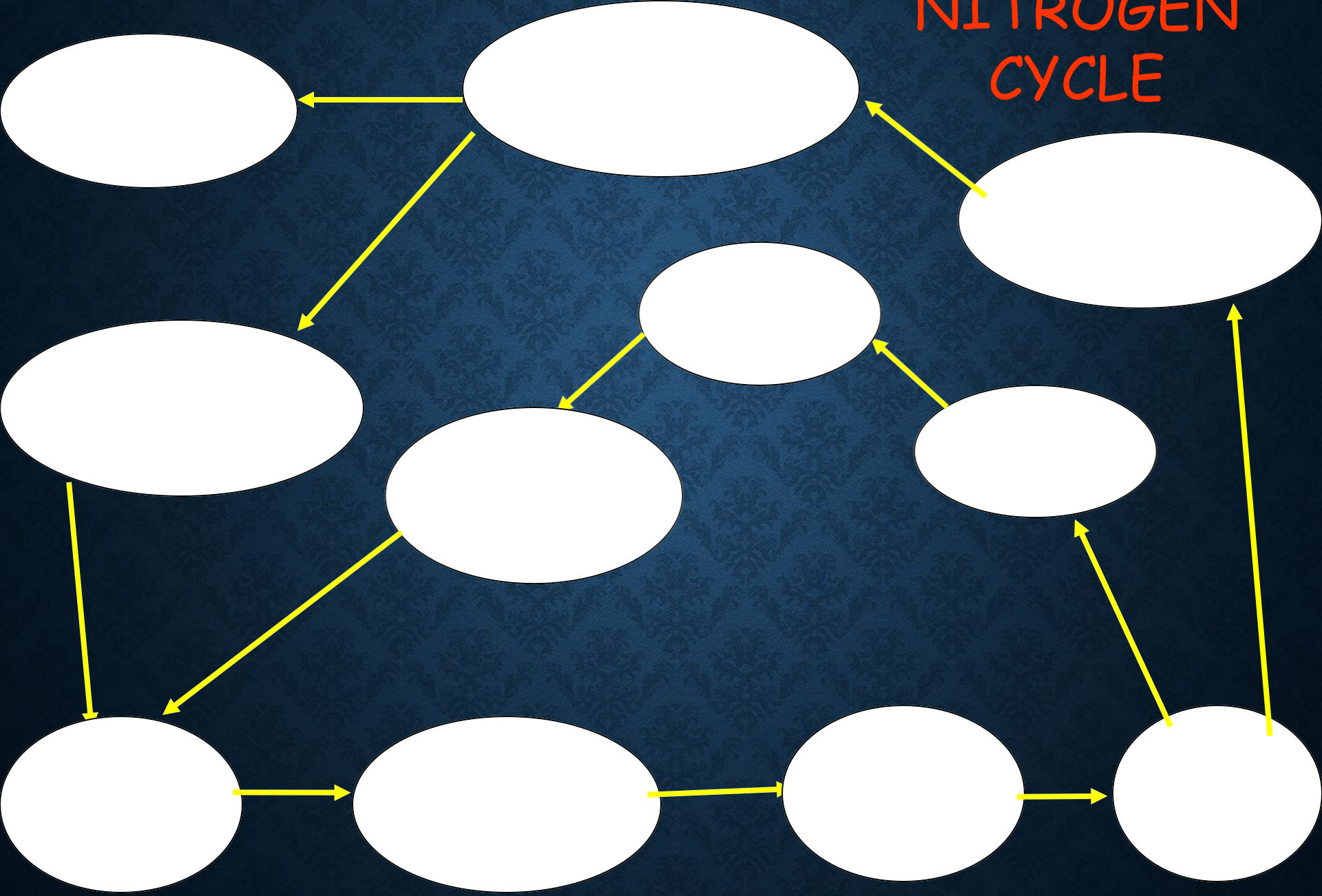


## Nitrogen cycle-

- Some nitrogen-fixing bacteria live free in the soil.
- Nitrogen-fixing cyanobacteria are essential to maintaining the fertility of semi-aquatic environments like rice paddies.


Nitrogen in atmosphere ($N_2$)
Plants
Assimilation
Denitrifying bacteria
Nitrogen-fixing bacteria in root nodules of legumes
Decomposers
(aerobic and anaerobic bacteria and fungi)
Nitrates ($NO_3^-$)
Nitrifying bacteria
Ammonification
Nitrification
Ammonium ($NH_4^+$)
Nitrites ($NO_2^-$)
Nitrogen-fixing soil bacteria
Nitrifying bacteria

# NITROGEN CYCLE



# TOXINS IN FOOD CHAINS-

While energy decreases as it moves up the food chain, toxins increase in potency.

- This is called biological magnification

Ex: DDT & Bald Eagles

# SLIDE COUNT ?

- Please note that after taking into account the figures and much bigger font size used, the number of slides would be much lesser , may not even be half.

# VIDEO

- https://www.youtube.com/watch?v=_NEIq-uoBb8

# ASSIGNMENT
# ( NOT TO BE SUBMITTED )

- What are essential amino acids?
- What is biofertilizer ?
- What is cloning ?
- What is organic food?
- What are Gentically Modified crops?
- Just self reading.

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