12/29/2021

The Ecosystem

An Introduction

What is an ecosystem?

- SYSTEM = regularly interacting and interdependent components forming a unified whole.

- ECOSYSTEM = **an ecological system;**

  = a community and its physical environment treated together as a functional system.

- **An ecosystem is composed of the organisms and physical environment of a specified area.**

It can be MICRO TO MACRO

ECOSYSTEM

- A community of interdependent organisms and the interactions with the physical environment in which they live.
- It can also be defined as the abiotic and biotic factors and the interactions between them.
- The interaction between organisms and the environment is the key!

ATTRIBUTES OF ECOSYSTEMS

- Order
- **Development**
- Metabolism (energy flow)
- Material cycles
- Response to the environment
- Porous boundaries
- Emphasis on function, not species

Contd….

BIOTIC

The biotic components of an ecosystem can be classified according to their **mode of energy acquisition.**

These are:

AUTOTROPH (PLANT
and
HETEROTROPHS (ANIMALS)

- **AUTOTROPHS: Producing food on its own**
- **HETEROTROPH – feed on other**
  - Primary consumers (herbivores)
  - Secondary consumers(carnivores)
  - Tertiary consumers (top carnivores)

CONSUMERS

- The role of the consumer is to transfer energy from one trophic level to the next.

Consumers have different names, depending on what they eat:

- **HERBIVORES: plant eaters**
- **CARNIVORES: meat eaters**
- **OMNIVORES: eat plants and animals**

Biotic and Abiotic factors

- Biotic Factor: A living, biological factor that may influence an organism or a system.

Example: disease, competition

Abiotic factor: A non-living, physical factor that may influence an organism or a system.

Examples: Temperature, salinity, pH, light

ECOSYSTEMS: FUNDAMENTAL CHARACTERISTICS

STRUCTURE:

- **Living (biotic)**
- **Nonliving (abiotic)**

PROCESS:

- Energy flow
- Cycling of matter (chemicals)

CHANGE:

- Dynamic (not static)
- Succession, etc.

ENERGY FLOW IN ECOSYSTEMS

- All organisms require energy, for growth, maintenance, reproduction, locomotion, etc.

TYPES OF ENERGY

- HEAT ENERGY
- MECHANICAL ENERGY (+GRAVITATIONAL ENERGY, ETC.)
- **CHEMICAL ENERGY** =

ENERGY STORED IN MOLECULAR BONDS i.e. CARBOHYDRATES

LAWS of THERMODYNAMICS

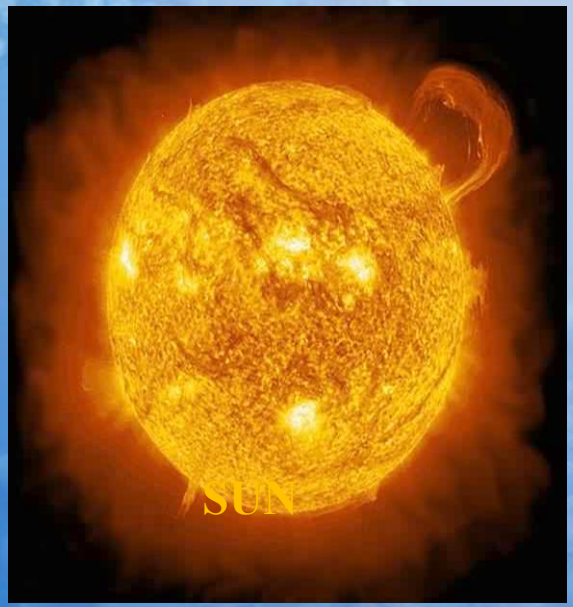
FIRST LAW of THERMODYNAMICS:

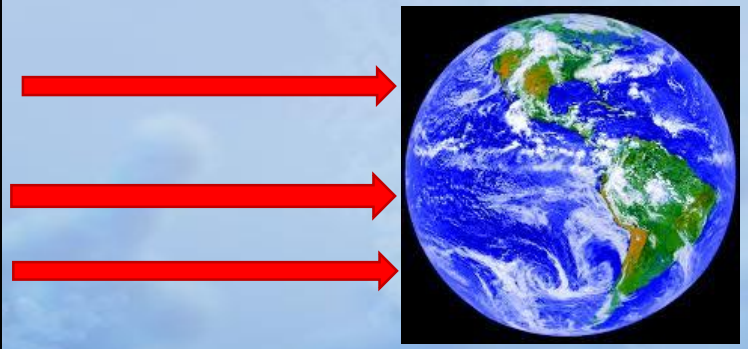
- Energy can be converted from one form to another, but cannot be created or destroyed.

SECOND LAW of THERMODYNAMICS

- **Transformations of energy always result in some loss or dissipation of energy**

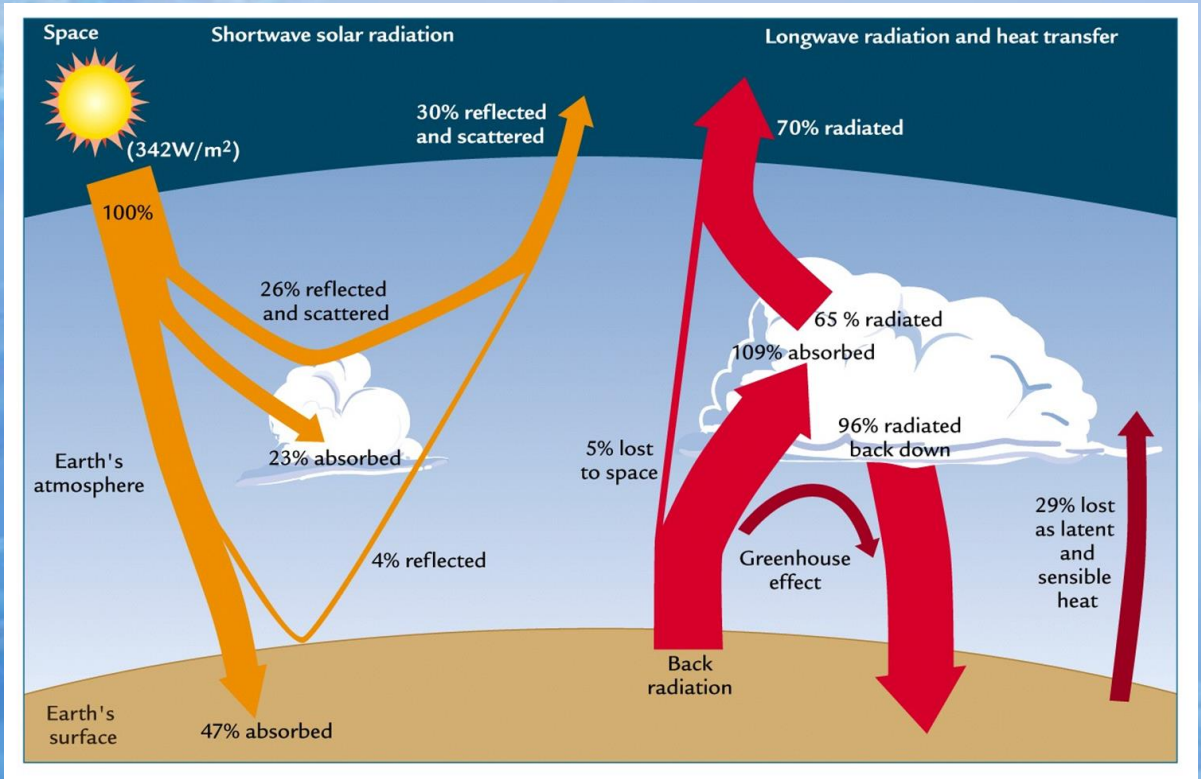
INCOMING SOLAR RADIATION

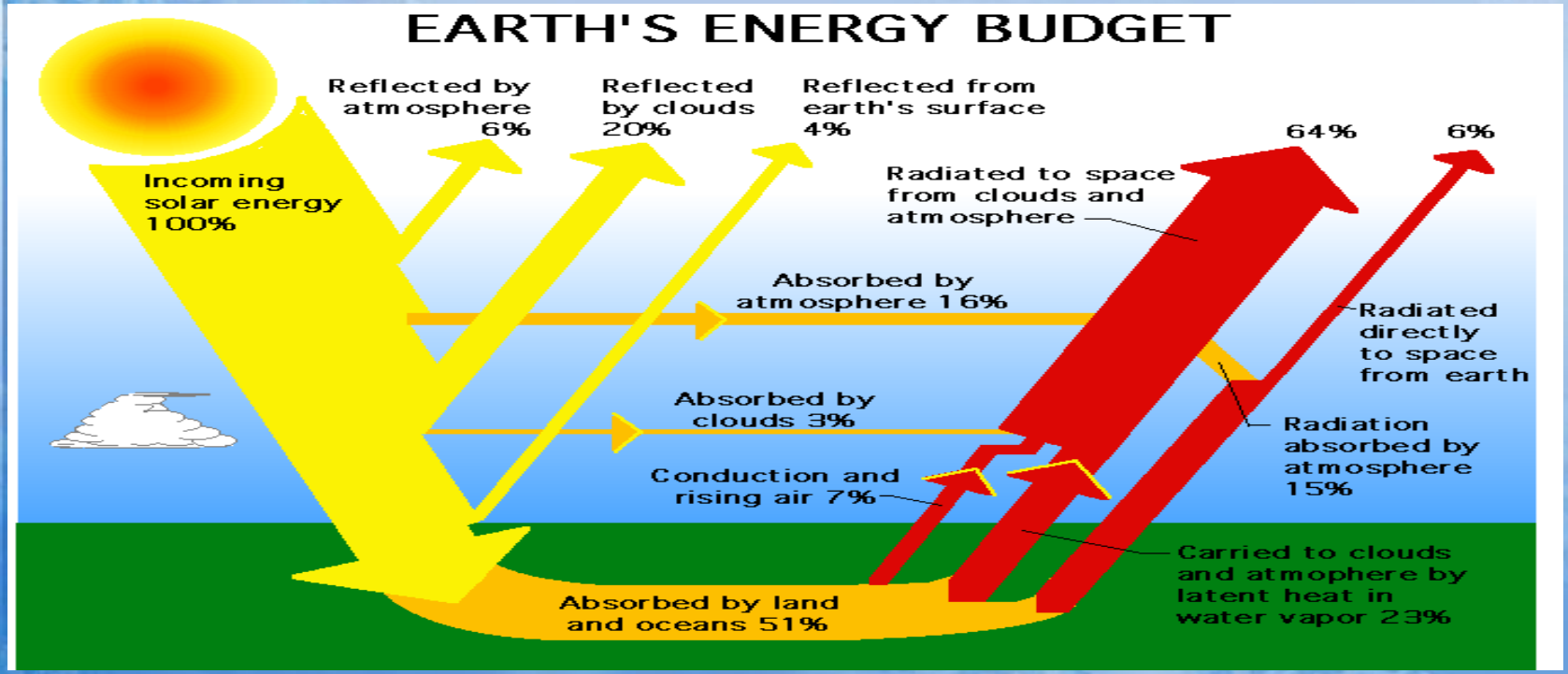




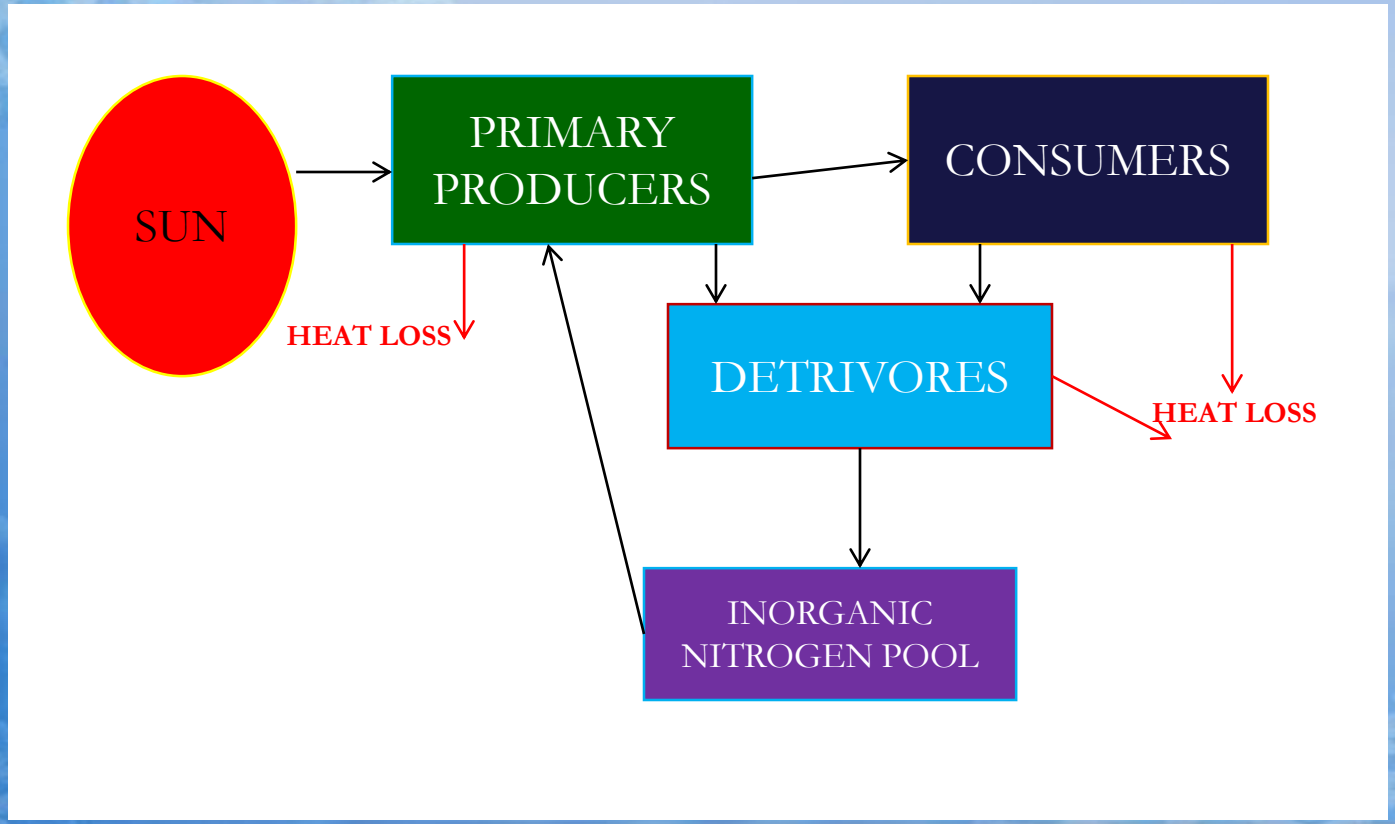
DISTANCE between Sun and the Earth is 150 million Kms

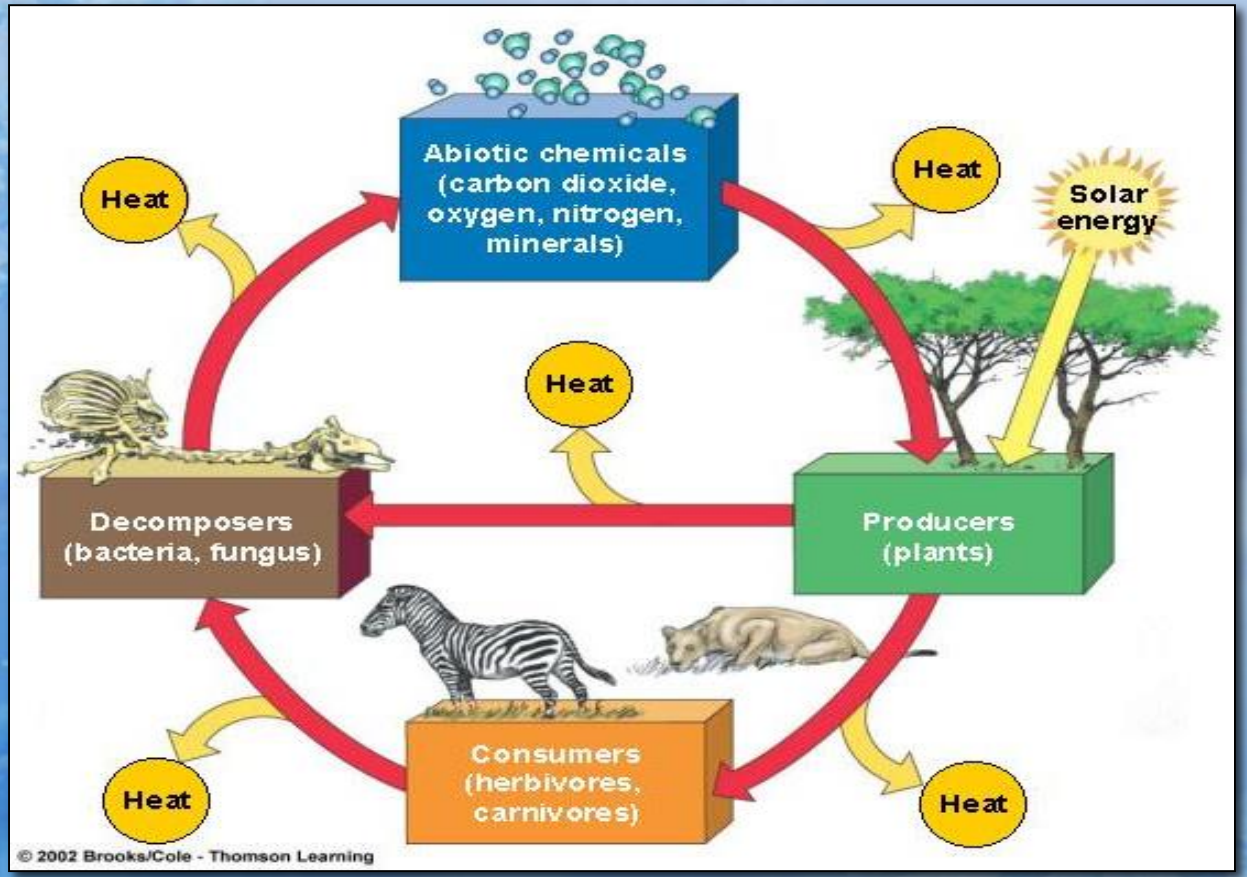
DISTRIBUTION of INCOMING and OUTGOING SOLAR ENERGY




EARTH'S ENERGY BUDGET
Reflected by atmosphere 6%
Reflected by clouds 20%
Reflected from earth's surface 4%
64%
6%
Incoming solar energy 100%
Radiated to space from clouds and atmosphere
Absorbed by atmosphere 16%
Radiated directly to space from earth
Absorbed by clouds 3%
Radiation absorbed by atmosphere 15%
Conduction and rising air 7%
Carried to clouds and atmophere by latent heat in water vapor 23%
Absorbed by land and oceans 51%

ENERGY FLOW IN THE ECOSYSTEM

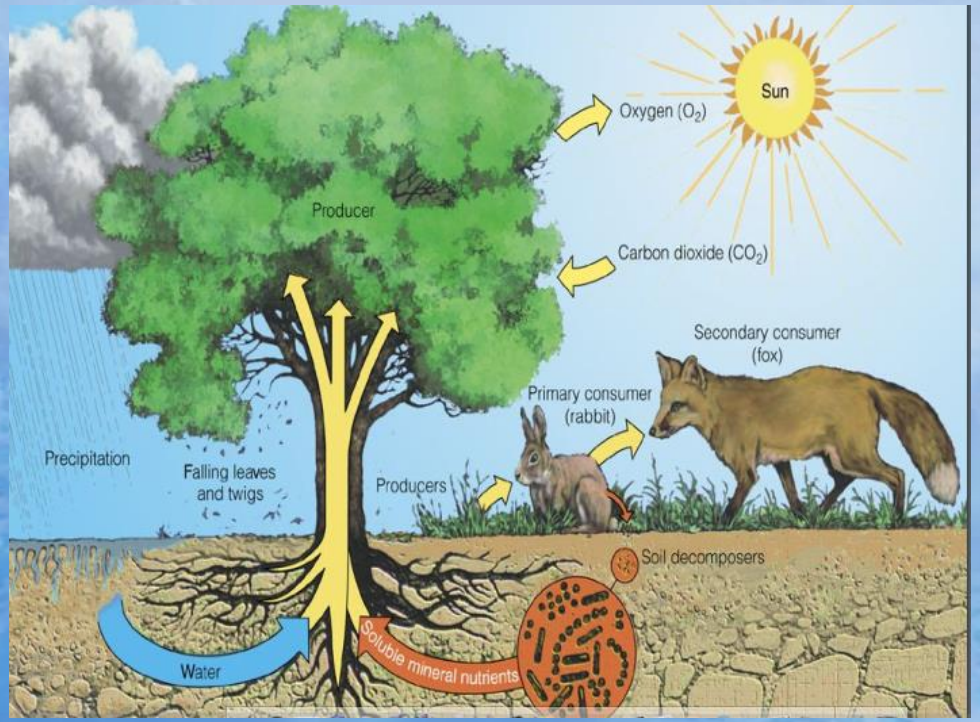



Abiotic chemicals
(carbon dioxide,
oxygen, nitrogen,
minerals)
Heat
Heat
Solar
energy
Heat
Decomposers
(bacteria, fungus)
Producers
(plants)
Consumers
(herbivores,
carnivores)
Heat
Heat
© 2002 Brooks/Cole - Thomson Learning

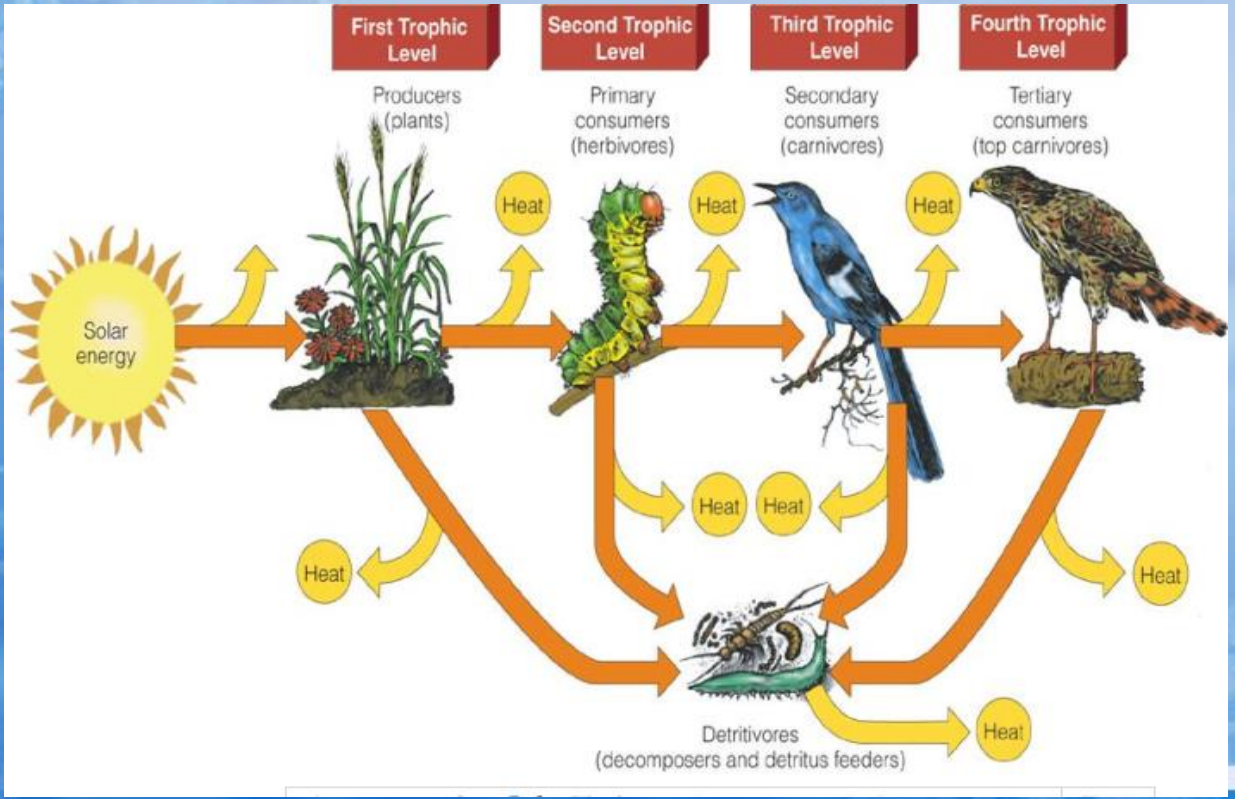
TROPHIC LEVELS

- TROPHIC LEVEL: FEEDING LEVEL. LEVEL at which energy consumed and Distributed.

ENERGY FLOW AND MATERIAL CYCLE



Energy transfer in a food chain: First law of thermodynamics



DECOMPOSER

- An organism that obtains energy by breaking down dead organic matter, including dead plants, dead animals and animal waste, into more simple substances.
- Examples include: bacteria and fungi.

- **Role of decomposers is to return valuable nutrients to the system so they can be used again and again**.

FOOD CHAIN AND FOOD WEB

A simple process by which food is transferred from one organism to the other is called food chain.

A complex process by which food is transferred from one organism to the other is called food web.

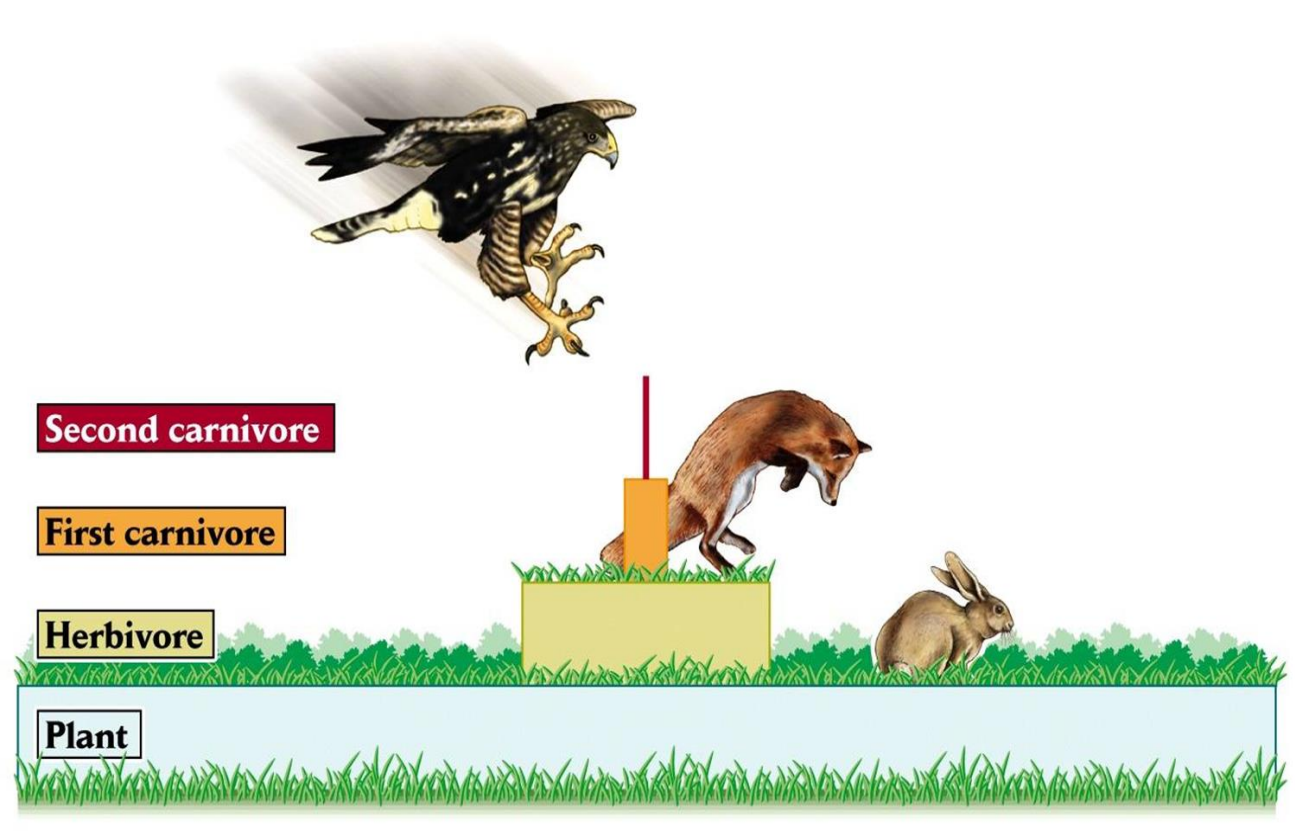
FOOD CHAIN

CARNIVORE

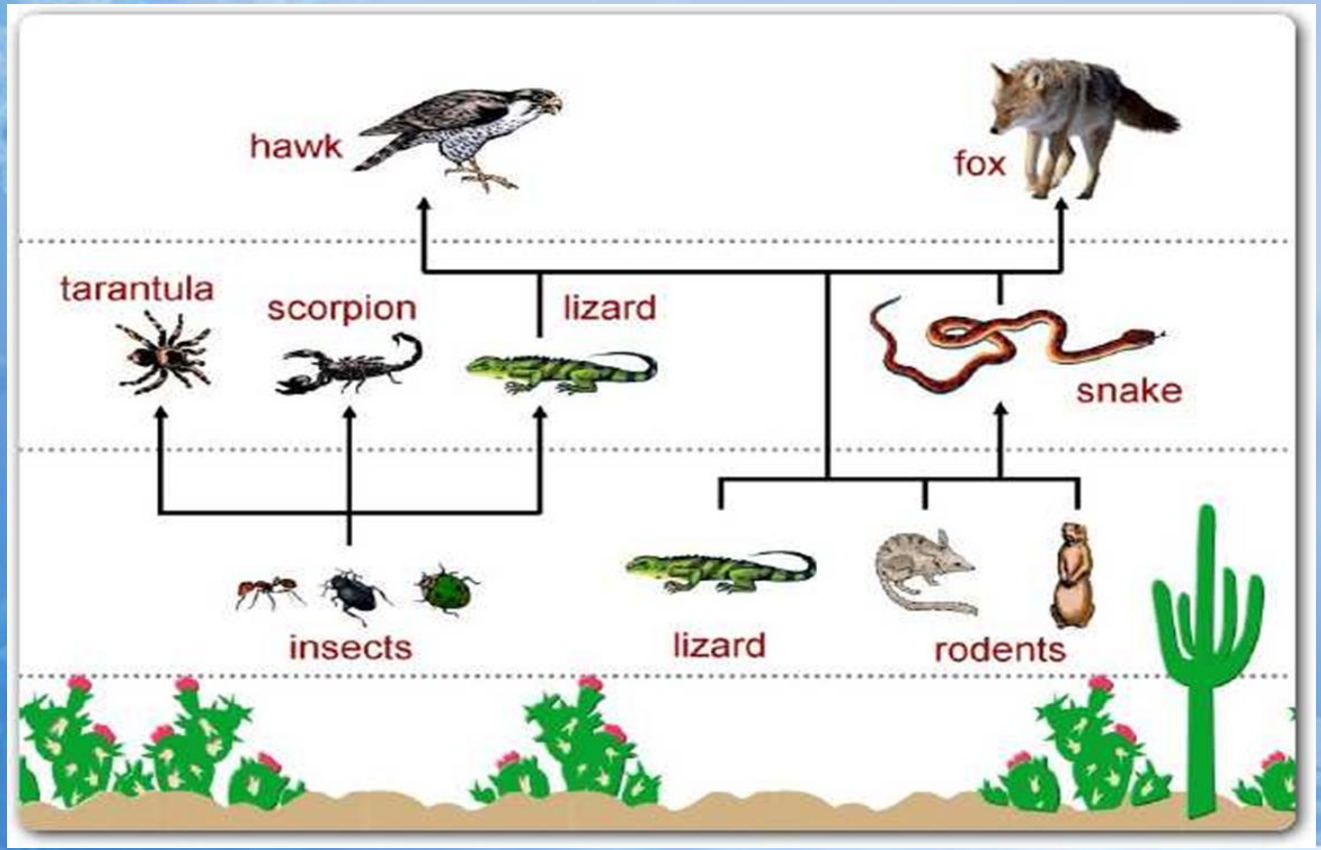
HERBIVORE

PRODUCER

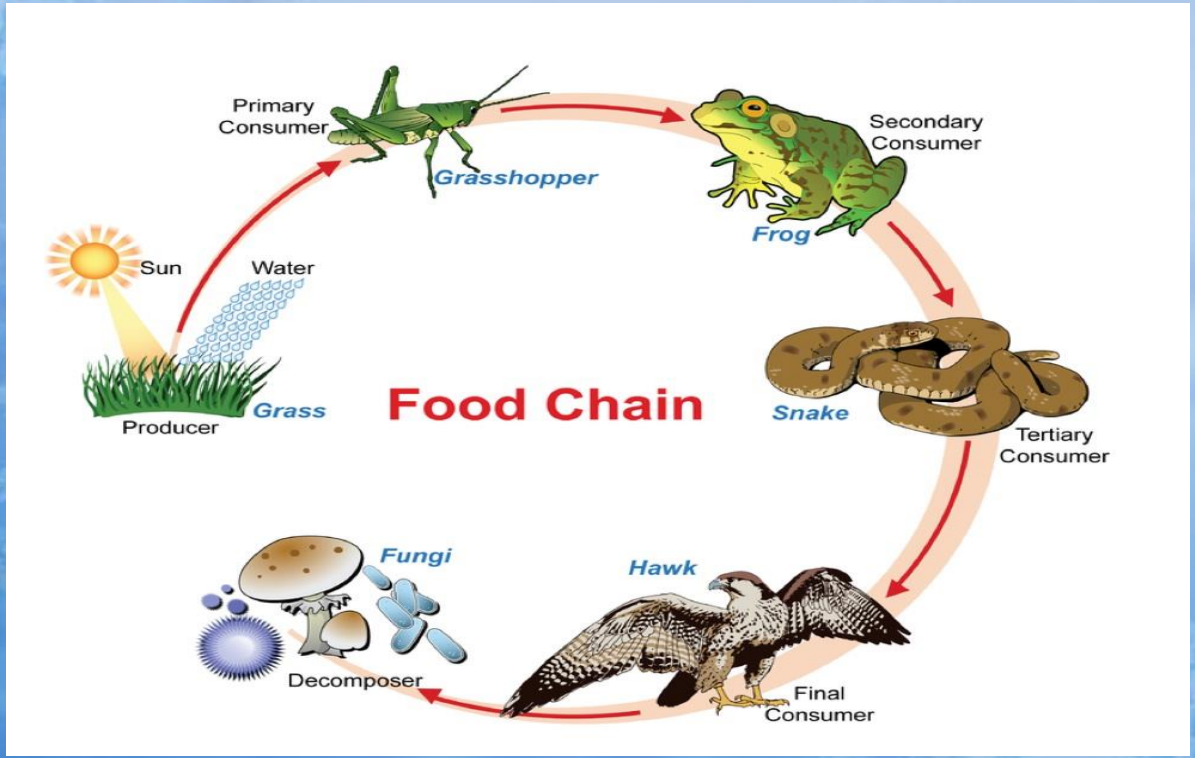
FOOD CHAIN



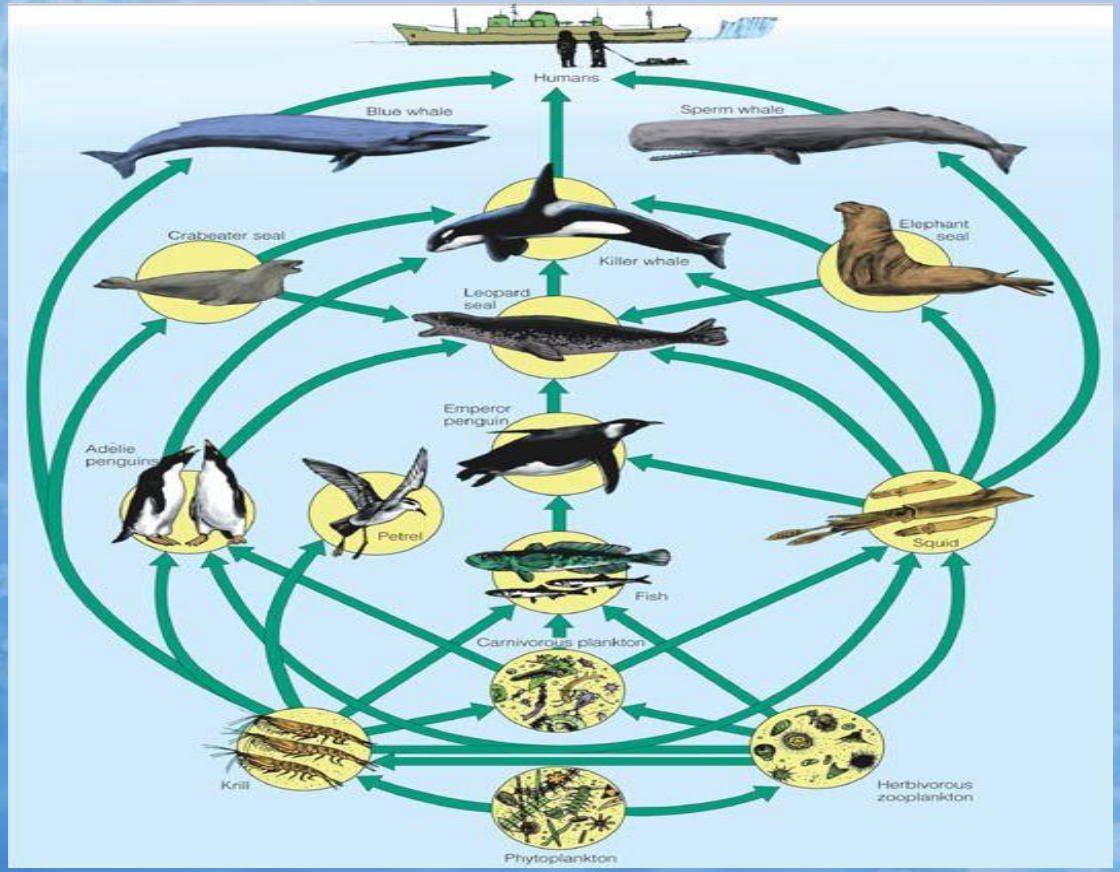
FOOD WEB


hawk
fox
tarantula
scorpion
lizard
snake
insects
lizard
rodents

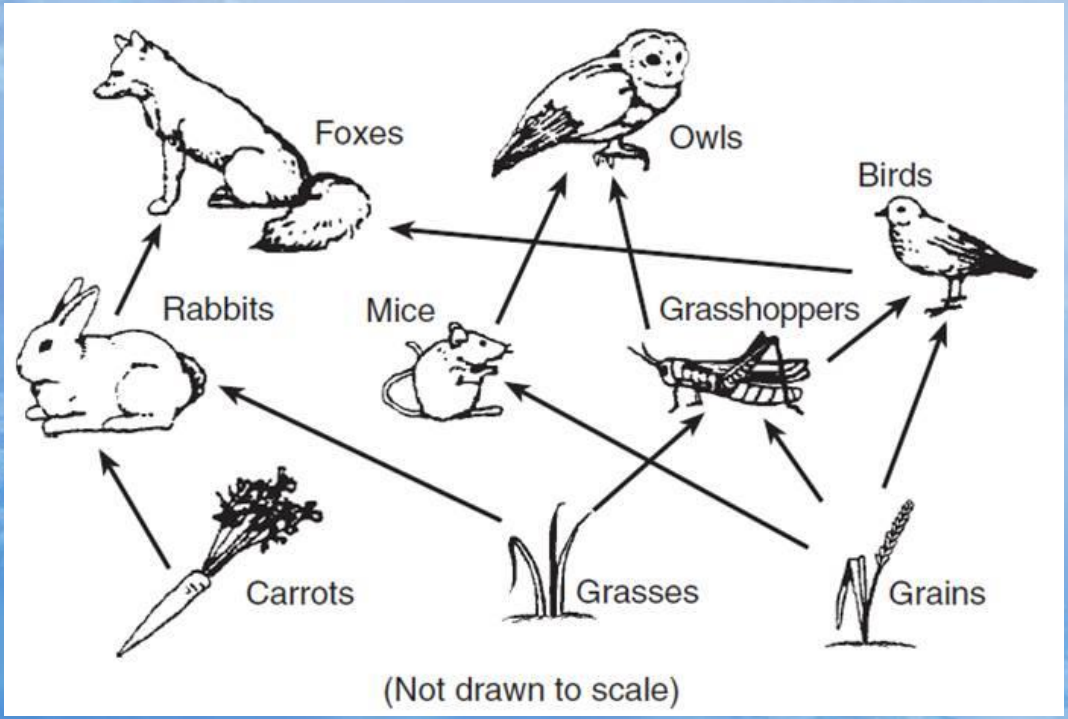
FOOD CHAIN


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

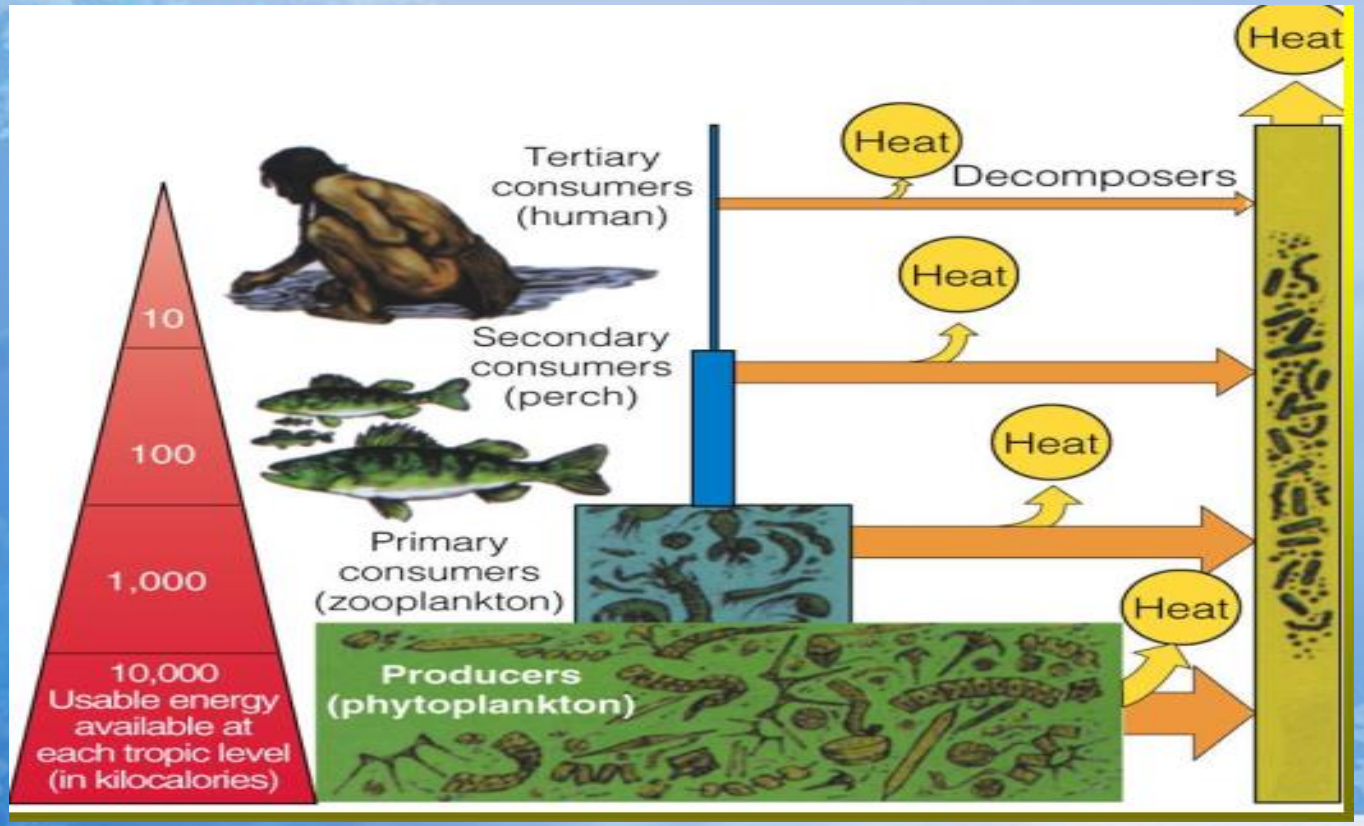
FOOD WEB


Humans
Blue whale
Sperm whale
Crabeater seal
Killer whale
Elephant seal
Leopard seal
Emperor penguin
Adélie penguins
Petrel
Squid
Fish
Carnivorous plankton
Krill
Herbivorous zooplankton
Phytoplankton

FOOD WEB


Foxes
Owls
Birds
Rabbits
Mice
Grasshoppers
Carrots
Grasses
Grains
(Not drawn to scale)

FOOD PYRAMID



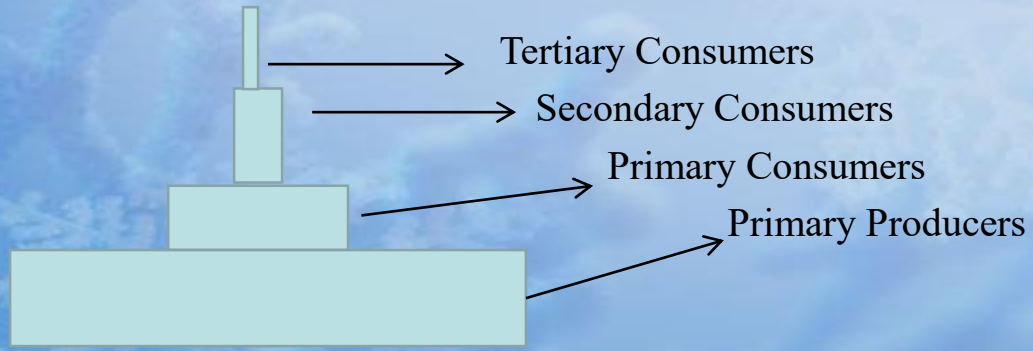
FOOD CHAINS AND PYRAMIDS

Pyramid diagrams give information about the organisms in a food chain. There are three types of pyramids:

Pyramid of numbers
Pyramid of biomass: **Biomass** is biological material
Pyramid of productivity

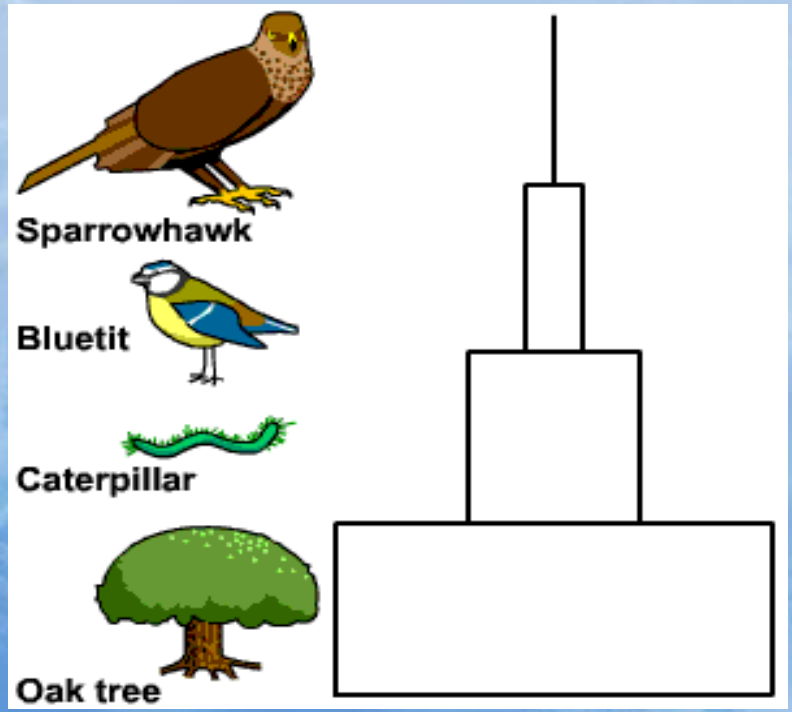
PYRAMID OF NUMBER

This show numbers of organisms at different trophic levels, which depend on



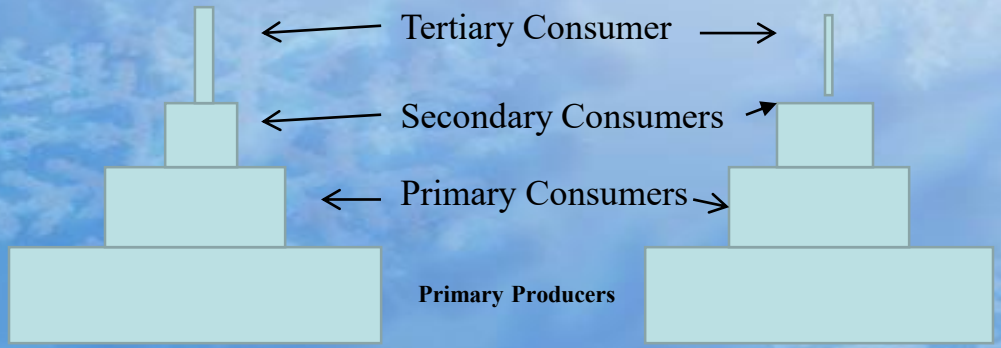
A graphical representation of the numbers of individual in each population in a food chain.

PYRAMID OF NUMBER



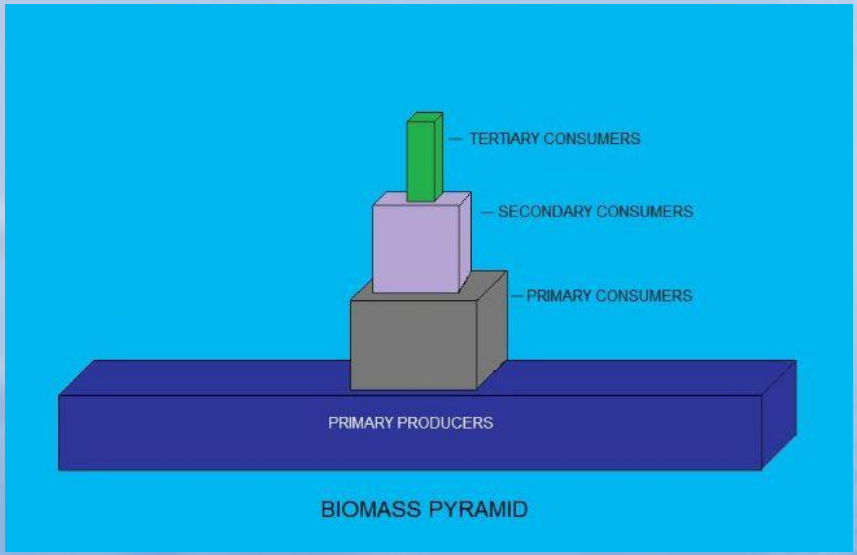
PYRAMID OF BIOMASS

PYRAMID OF PRODUCTIVITY



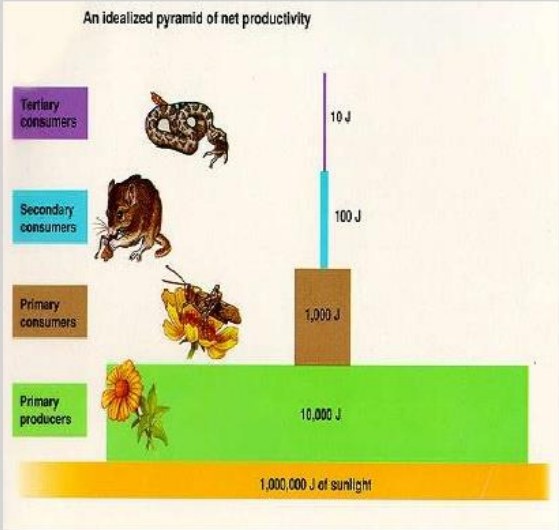
PYRAMID OF BIOMASS

- is a graphical representation designed to show the **biomass** or bio productivity at each trophic level in a given ecosystem.

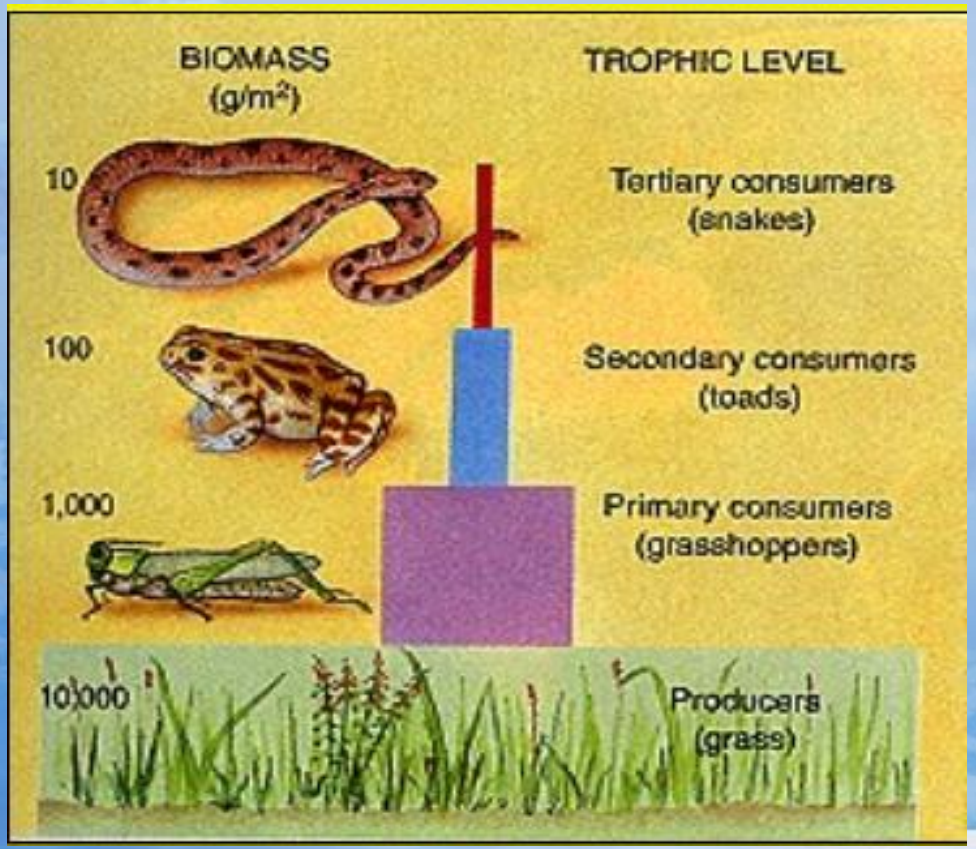


PYRAMID OF PRODUCTIVITY

A pyramid of productivity has trophic levels stacked in blocks proportional in size to the energy acquired from the level below. Food chains are usually bottom heavy since only 10% of energy is transferred.



PYRAMID OF BIOMASS



BIO GEOCHEMICAL CYCLES

Is a pathway by which a chemical substance moves through both biotic (biosphere) and abiotic (lithosphere, atmosphere, and hydrosphere) compartments of Earth.

BIOGEOCHEMICAL CYCLES

WATER CYCLE

CARBON CYCLE

NITROGEN CYCLE

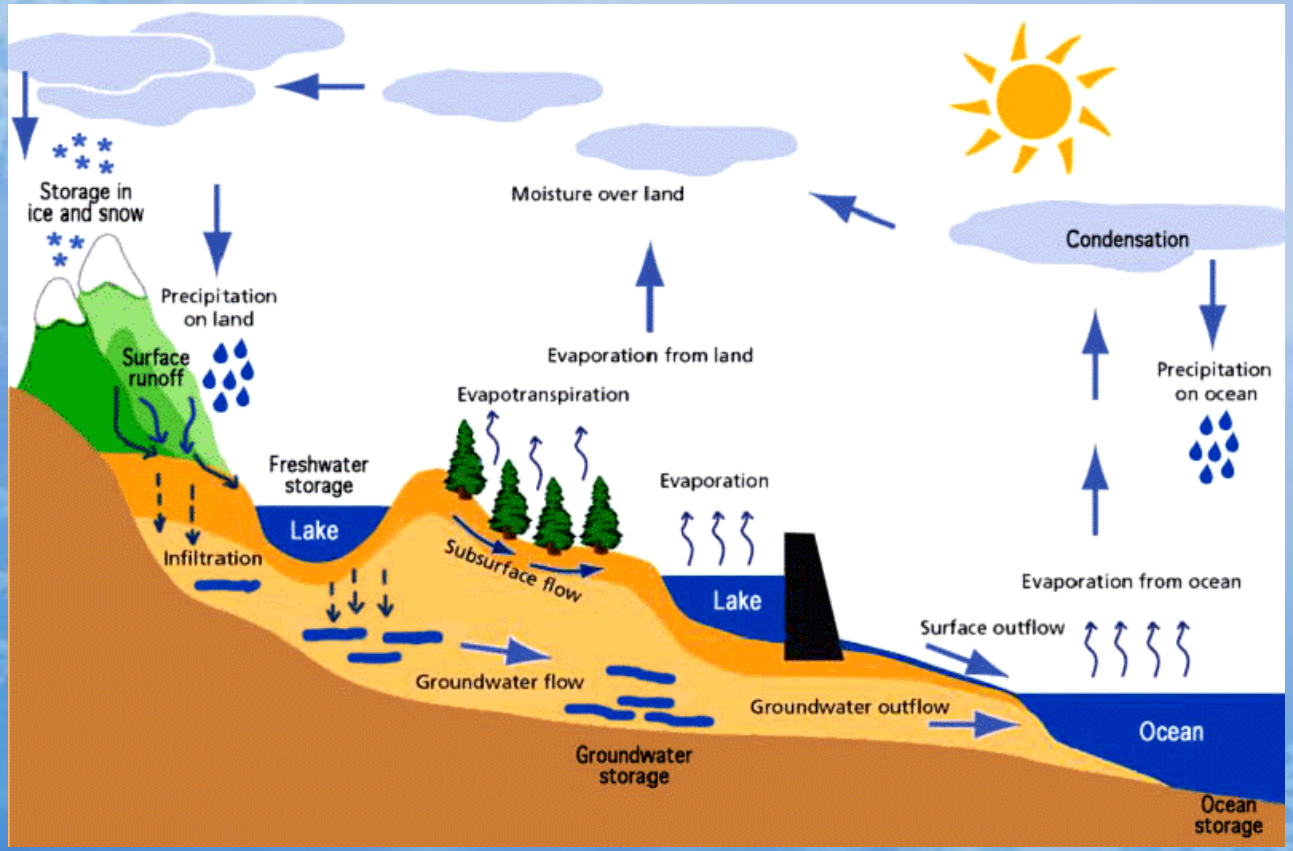
OXYGEN CYCLE

PHOSPEROUS CYCLE

NUTIENT CYCLE

- **A SUBSTANCE THAT PROVIDES NOURISHMENT ESSENTIAL FOR THE MAINTENANCE OF LIFE AND FOR GROWTH.**
- **Nutrient cycles:**
- **Nutrients derived from the environment move through the food chain and are converted from dead organic matter back into inorganic substance by microbial decomposition that is then readily used up by the primary producers from the nutrient pool.**

WATER CYCLE


Storage in ice and snow
Precipitation on land
Surface runoff
Infiltration
Freshwater storage
Lake
Evapotranspiration
Subsurface flow
Groundwater flow
Groundwater storage
Moisture over land
Evaporation from land
Evaporation
Lake
Condensation
Precipitation on ocean
Evaporation from ocean
Surface outflow
Groundwater outflow
Ocean
Ocean storage

WATER ON THE EARTH

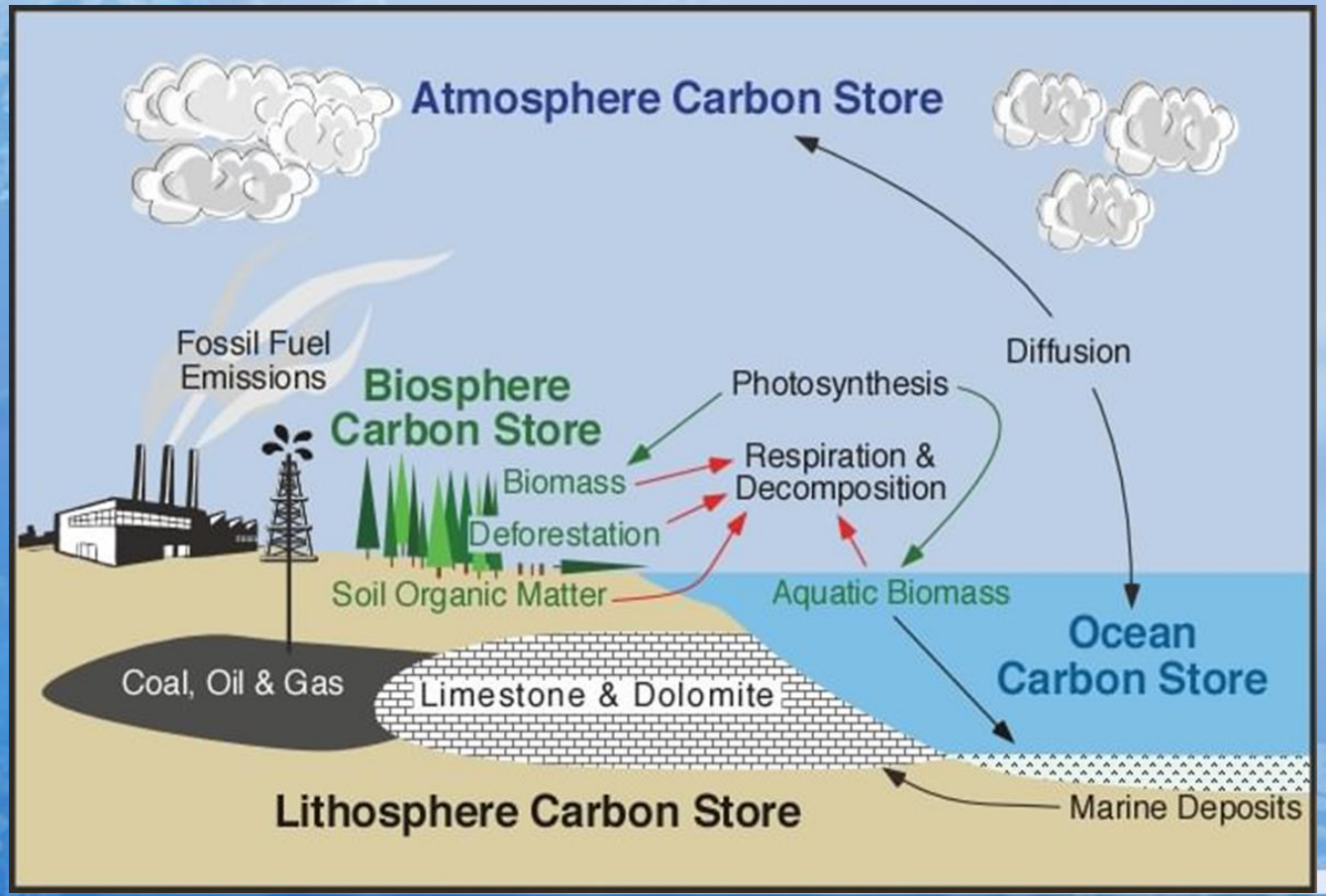
- Although 79% of the earth is covered in water with 97.5% of it is salt water.
- ONLY 3% OF THE WATER IS FRESHWATER.
- Most of the freshwater is in glaciers and ice caps.
- Less than 1% of the freshwater on the earth is readily available.

HUMAN IMPACT ON WATER CYCLE

- Chemical fertilizers and pesticides mix with water can pollute surface water or seep into the ground to contaminate groundwater
- Clear-cutting forests reduces the amount of water plants return to the atmosphere by transpiration.

- Sediment (soil/ silt) thicken the water and make it difficult for aquatic plants to grow.
- Excess nutrients can cause growth of excess algae. When they die, they decompose in a process that reduces the oxygen level in the water.
- Debris such as plastic bags, plastic bottles etc. can wash into water bodies and choke, suffocate, or disable ducks, fish, turtles, and birds.
- Household hazardous wastes like insecticides, pesticides, paint, solvents, and used motor oil can poison aquatic life.

CARBON CYCLE



SEVERAL WAYS IN WHICH CARBON IS RELEASED INTO THE ATMOSPHERE

- Respiration by plants and animals.
- Decay of animal and plant matter.
- Combustion of organic material
- Production of cement.
- The ocean releases CO2 into the atmosphere.
- Volcanic eruptions .

HUMAN IMPACTS ON THE CARBON CYCLE

Burning fossil fuels have serious impact on the carbon cycle.

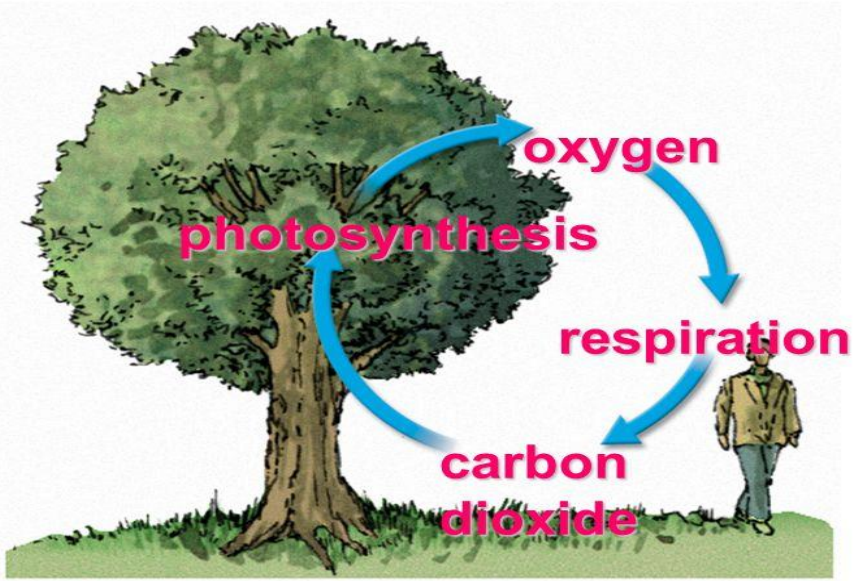
BURNING OF FOSSIL FUELS

About 90% of energy comes from burning of fossil fuels like Coal, Petrol and Diesel

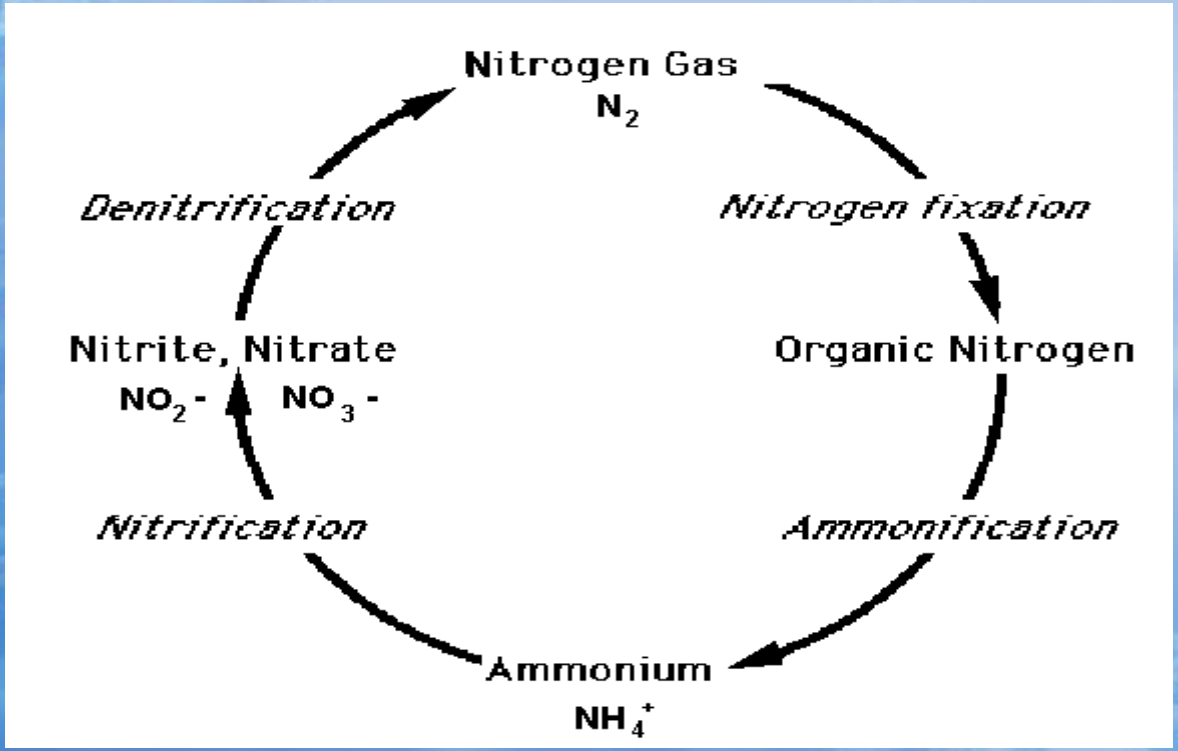
OXYGEN CYCLE

13.5 Cycling of Matter

Example: Oxygen Cycle:



NITROGEN CYCLE



MAN-ENVIRONMENT RELATIONSHIP

RELATION BETWEEN MAN AND ENVIRONMENT

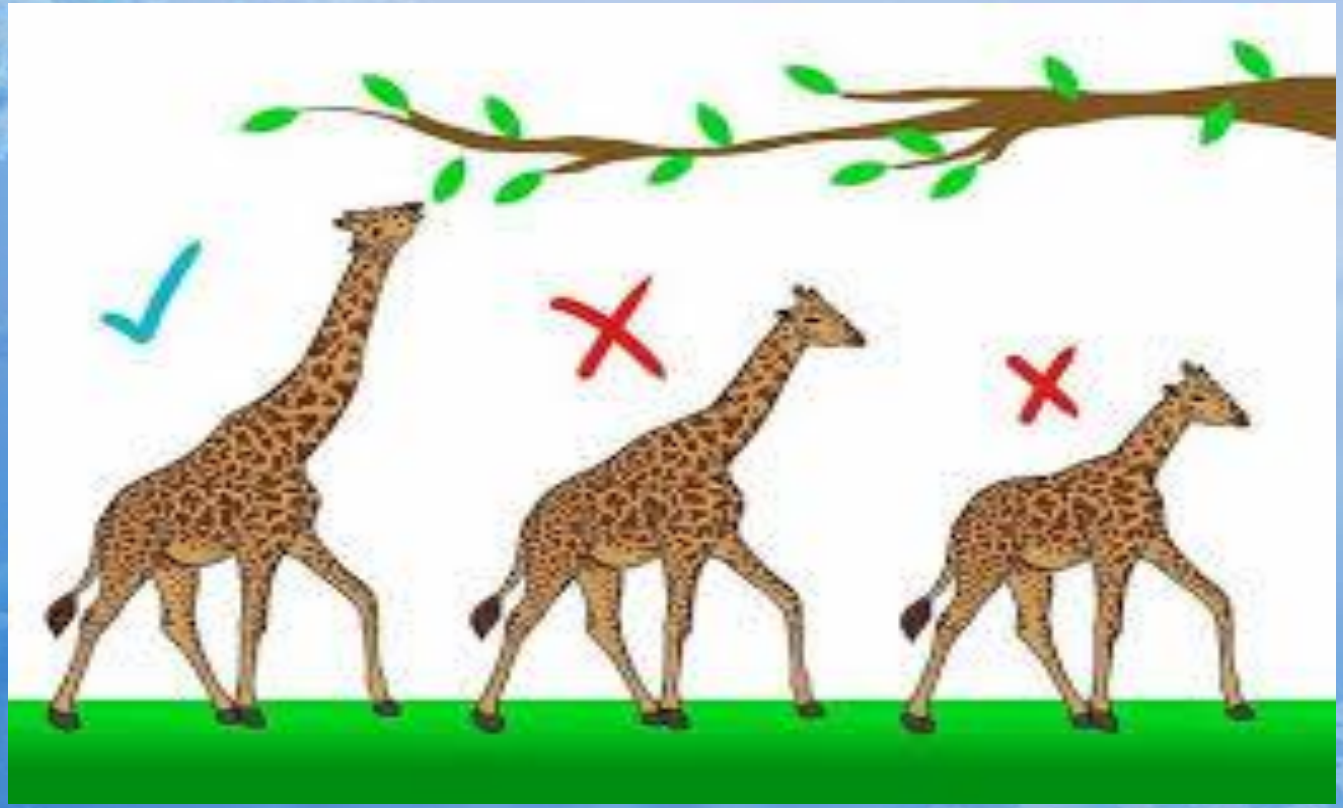
- The relationship of man and environment has also influenced the development of human society.
- It may be noted that of all the organism, man is the most skilled and civilized and therefore, it is significant to note the following three aspects of man-

1. **Physical man** is component of biological community and as such requires basic elements of physical environment such as air, water, food and habitat etc. like other biological population and release waste in the eco systems.
2. **Social man** establishes the social institutions, forms of social organization and formulates laws and policies to safeguard his existence, interest and welfare.
3. **Economic man** derives and utilize resources from the physical and biological environment with his skills and technologies.

NATURAL SELECTION

- **Natural selection** is the process in nature by which organisms better adapted to their environment tend to survive and reproduce more than those less adapted to their environment.
- The mechanism that Darwin proposed for evolution is **natural selection**. Because resources are limited in nature, organisms with heritable traits that favor survival and reproduction will tend to leave more offspring than their peers, **causing** the traits to increase in frequency over generations.

EXAMPLE



SYMBIOTIC RELATIONSHIP

WHY STUDY ENVIRONMENTAL STUDIES?

- Environment studies is all about learning the way we should live and how we can develop sustainable strategies to protect the environment. It helps individuals to develop an understanding of living and physical environment and how to resolve challenging environmental issues affecting nature. In addition to studying the physical aspects of the environment, it also emphasizes the need to conserve biodiversity and adopt a more sustainable lifestyle and utilize resources in a responsible way. To create awareness among today's generation on pressing environmental problems, the University Grants Commission (UGC) has made it mandatory for the universities to introduce a course in environmental studies and teach students about the eco-system, pollution and problems concerned with the environment. Let us discuss the dire need to include environmental studies in the course curriculum.

- **Learn how to use resources sustainably**
- With natural resources such as air, water, oil, minerals are getting depleted rapidly, the environmental studies course can help students understand the importance of these resources and how we can improve the situation by taking appropriate actions in our regular lives to preserve these resources.

- **Create awareness about preserving the environment**
- Whether it is spreading awareness against plastic use or air pollution, universities can conduct various beyond-the-classroom activities as a part of this course to make students understand the significance of protecting the environment. Activities such as conducting awareness programs and rallies can prevent the degradation of the environment.

- **Participate in the mass movement to protect nature**
- While pursuing a course in environmental studies, students can be a part of mass public awareness movements and encourage their fellow batchmates to participate. Whether it is taking an initiative by planting trees in the campus, conducting workshops on various pressing issues or joining an NGO that supports environmental conservation, students can learn about various ways of protecting and conserving the environment.

- **Foster a healthy learning environment**
- Such important non-academic courses empower students to take a lead in creating a healthier, greener and sustainable learning environment where students understand the importance of saving the environment and take necessary steps to conserve the natural resources. Environment studies also help them develop the knowledge and skills required to address challenging environmental issues.

- **Pursue a full-time career in environment studies**
- Career opportunities in environmental studies are thriving with multiple options in the energy industry, animal conservation and more. You can prepare yourself for a fulfilling career that will include everything from conducting research, protecting the environment, crunching statistics, analyzing data, working in the field, interviewing people about disaster management and drafting policies with lawmakers to conserve the planet.