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

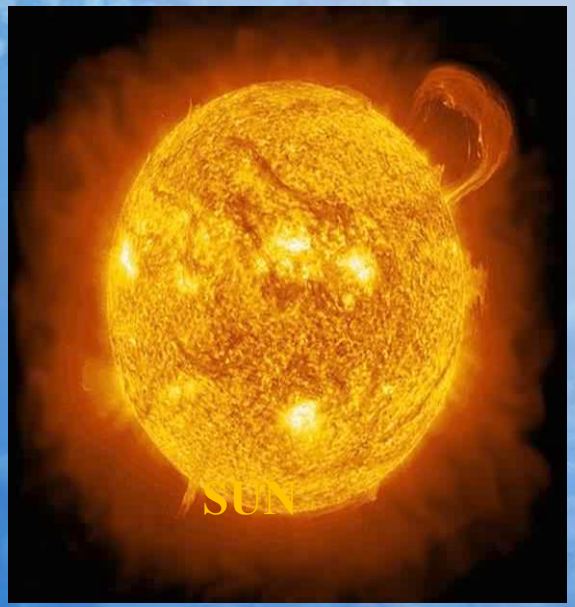
FIRST LAW of THERMODYNAMICS:

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

SECOND LAW of THERMODYNAMICS

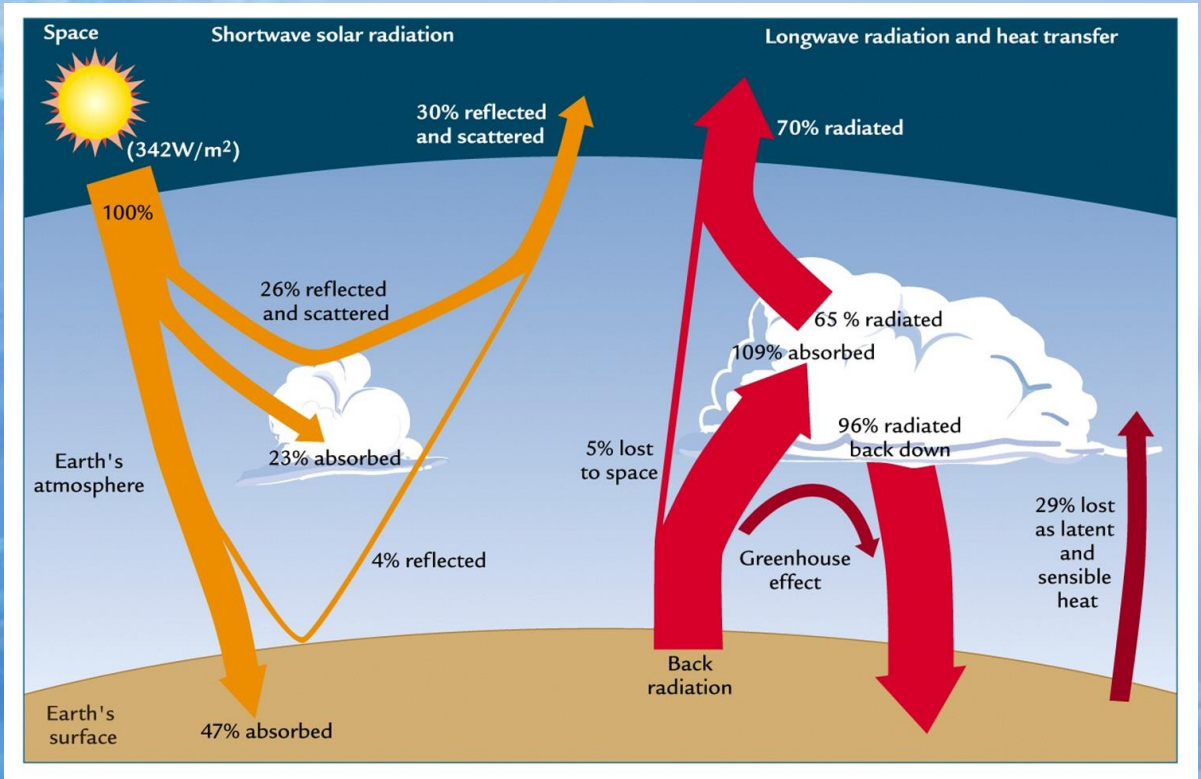
- **Transformations of energy always result in some loss or dissipation of energy**

INCOMING SOLAR RADIATION

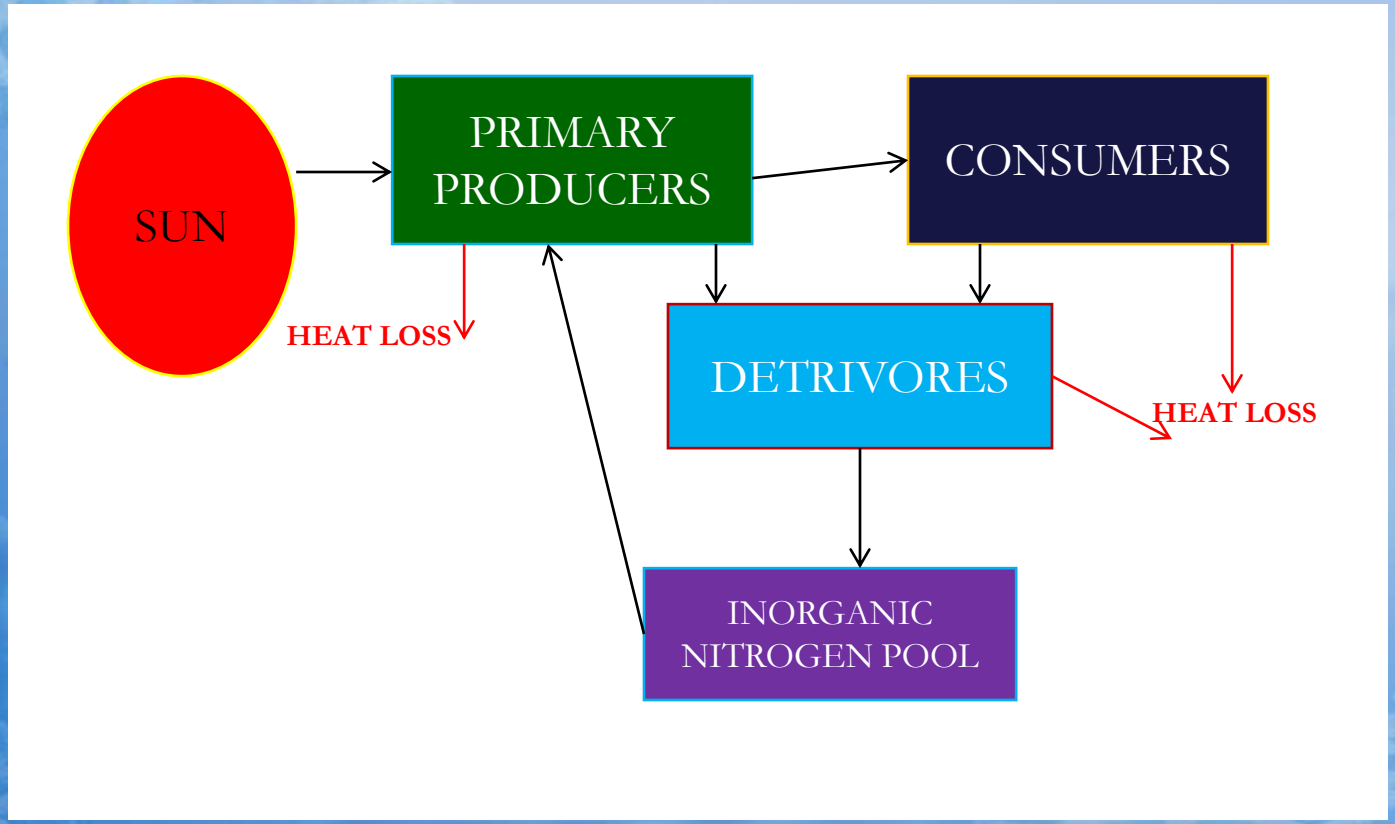


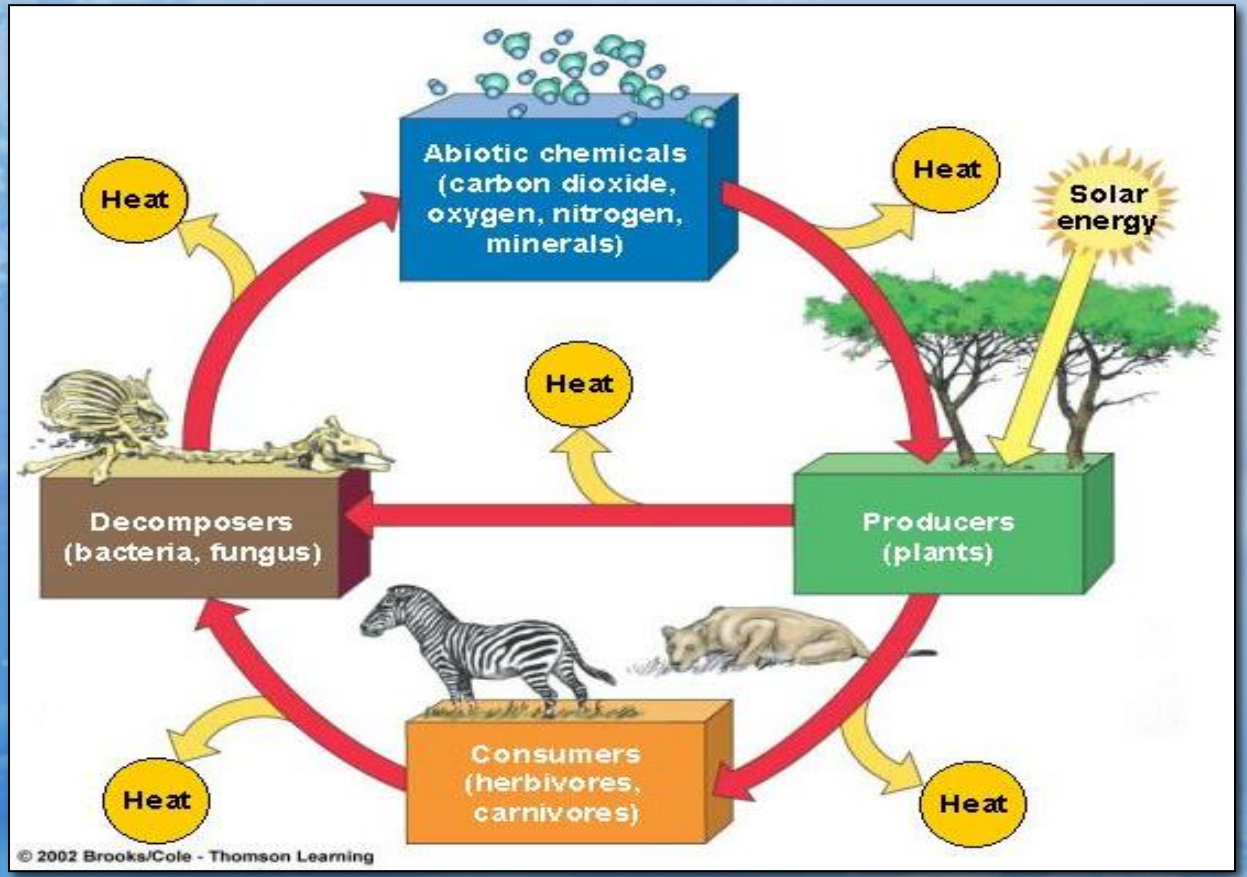
DISTANCE between Sun and the Earth is 150 million Kms

DISTRIBUTION of INCOMING and OUTGOING SOLAR ENERGY



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
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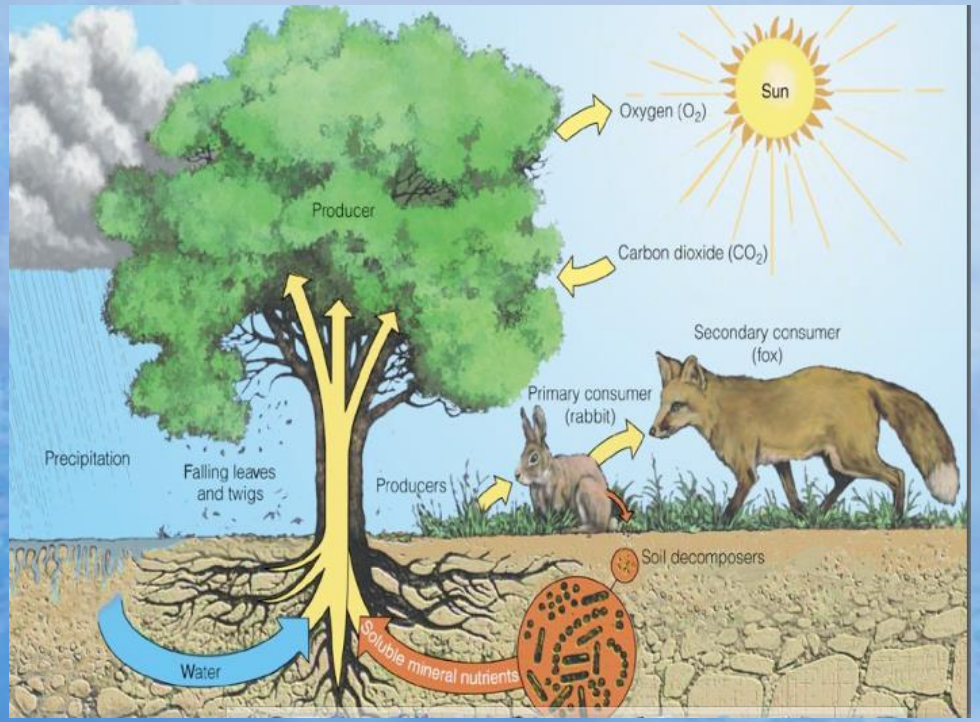
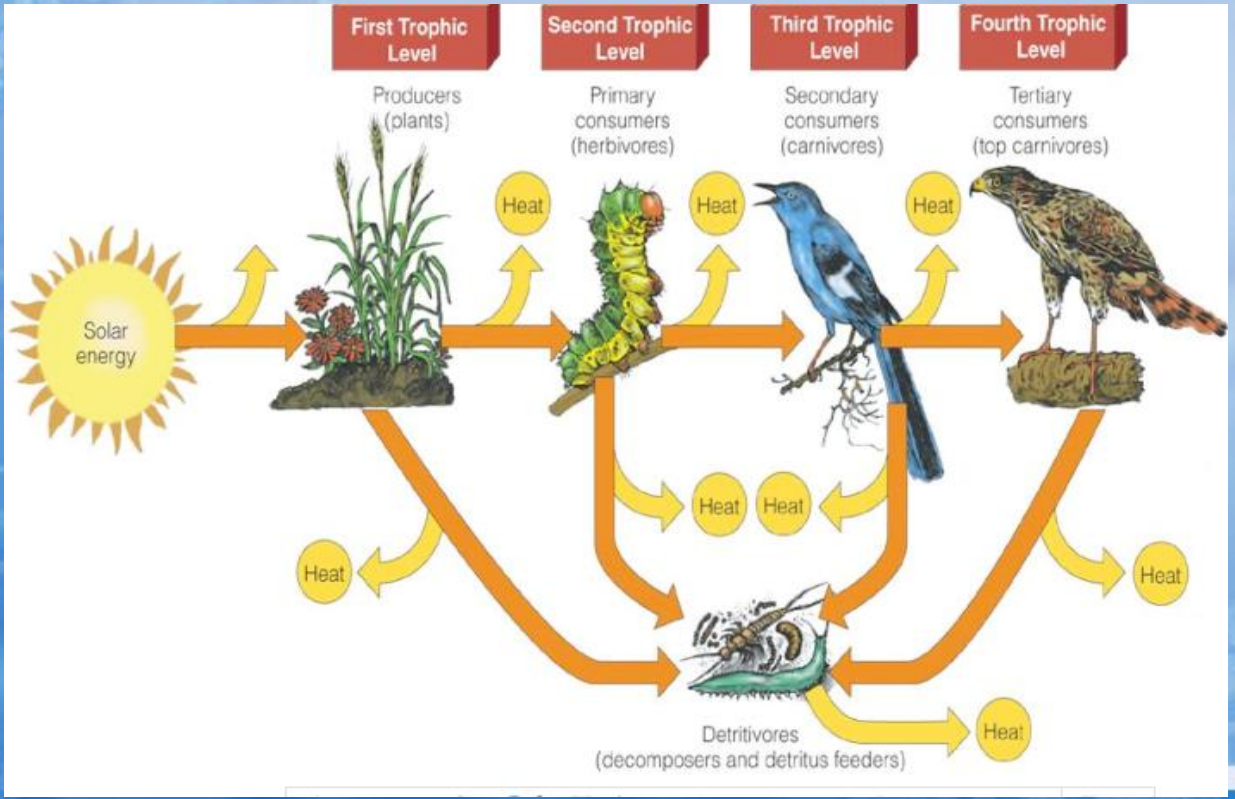
TROPHIC LEVELS

- 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

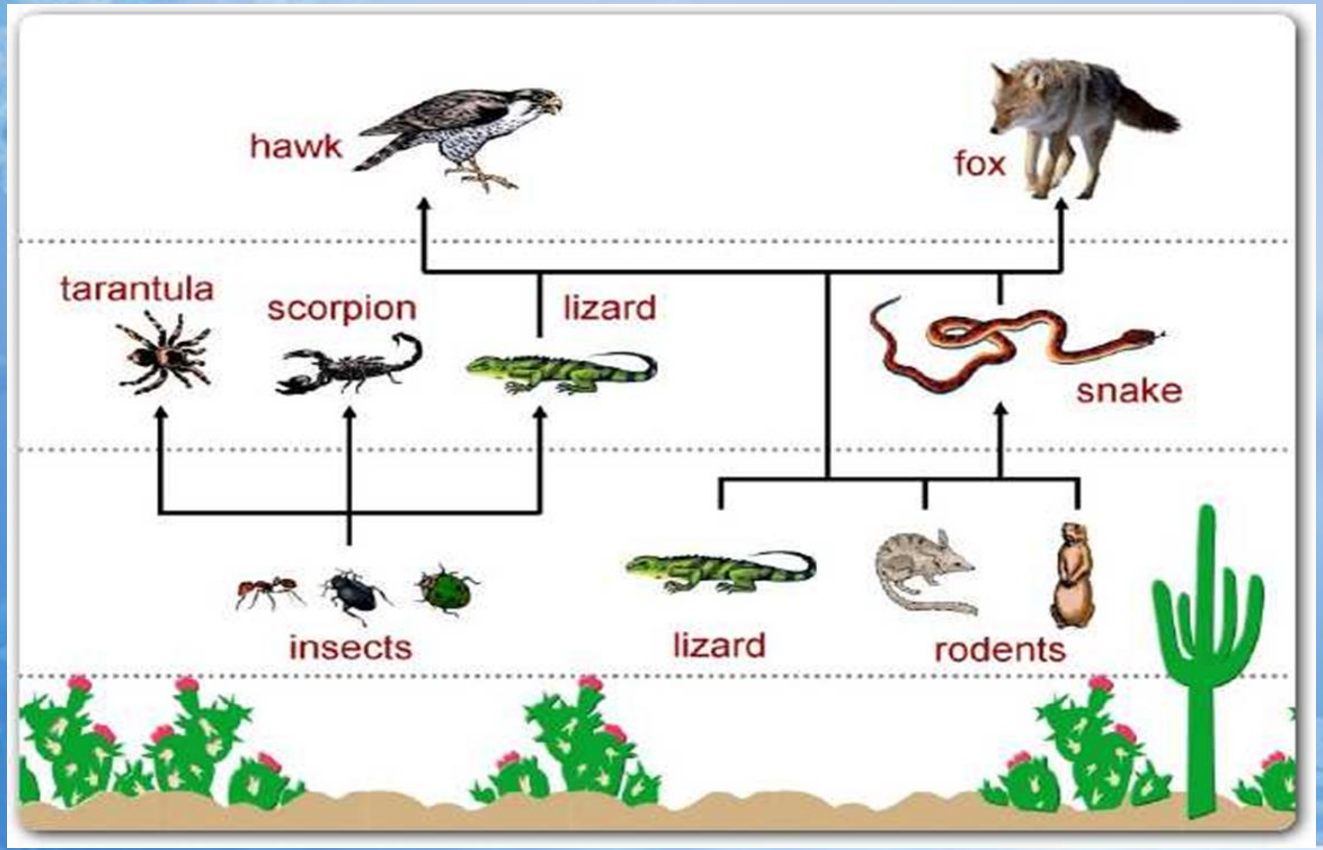
CARNIVORE

HERBIVORE

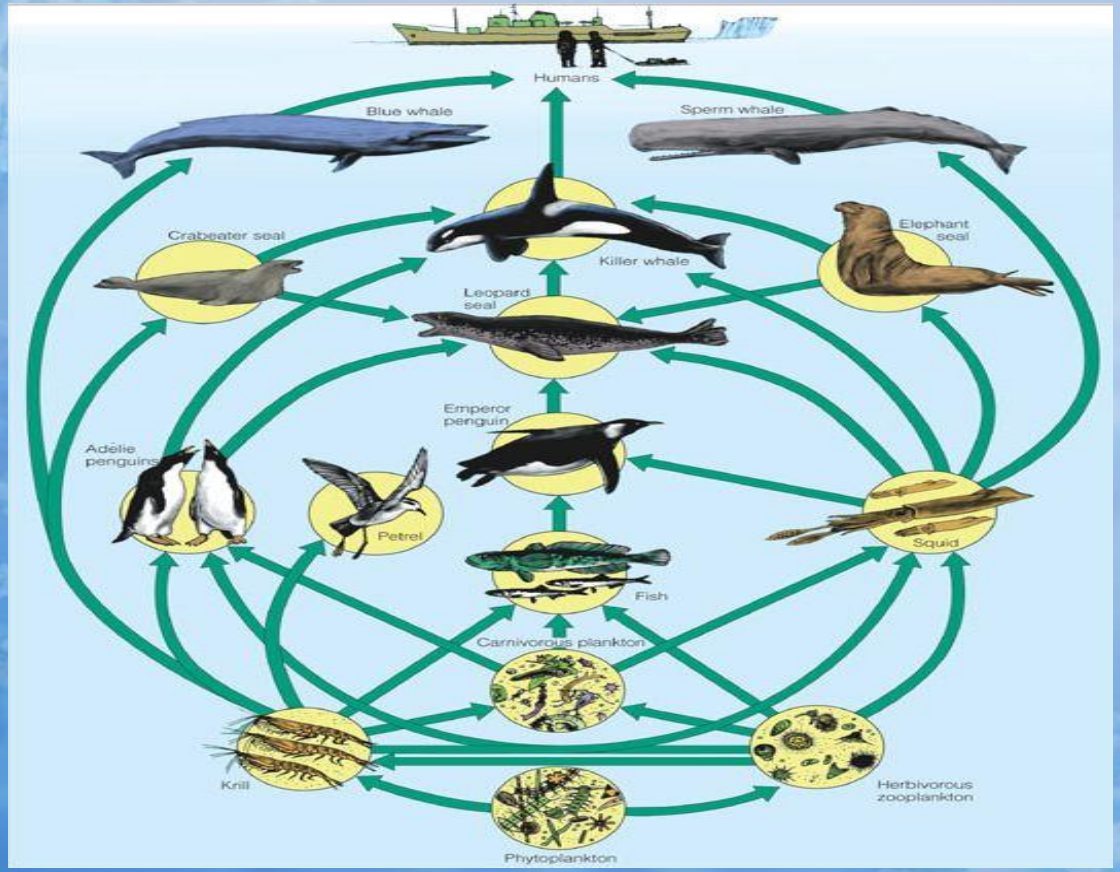
PRODUCER

FOOD CHAIN

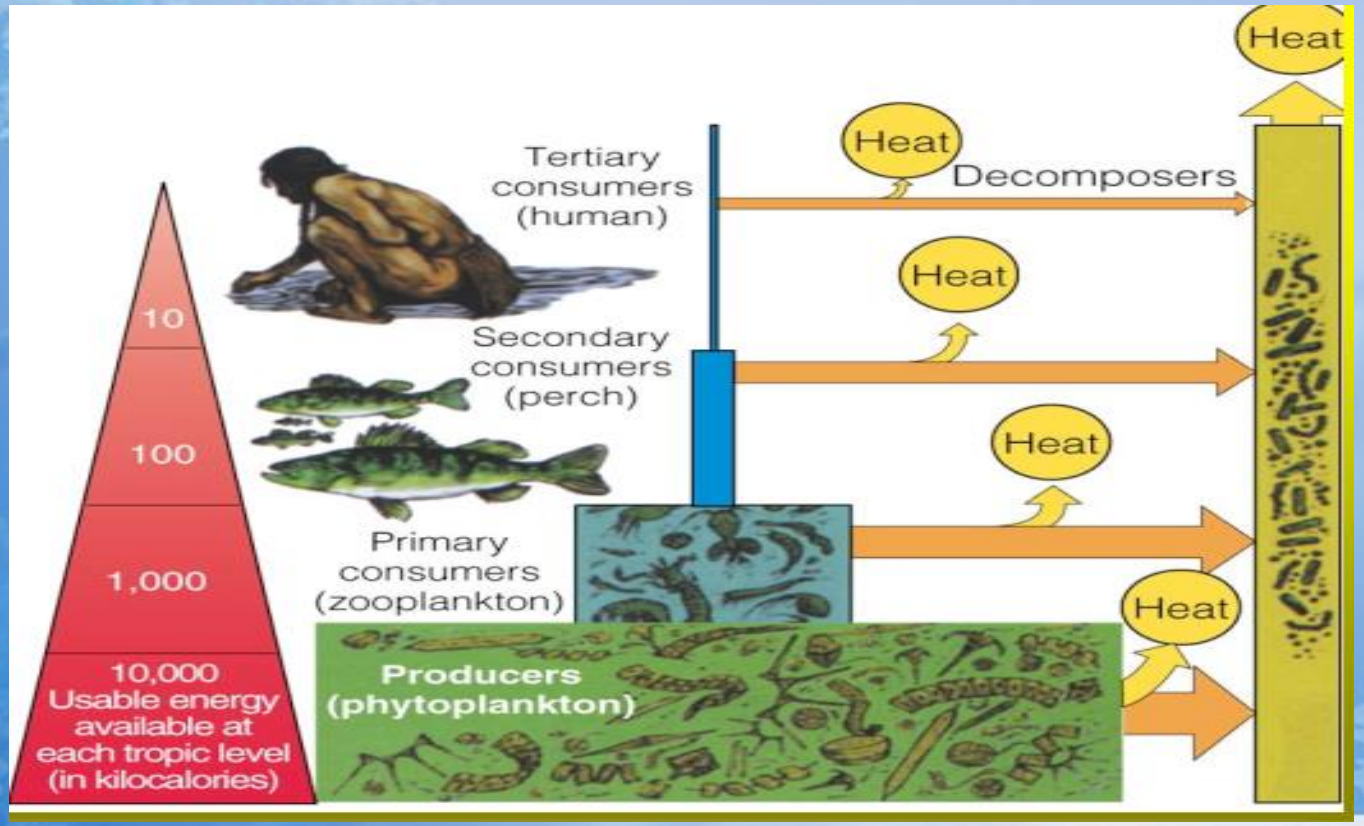
FOOD WEB


hawk
fox
tarantula
scorpion
lizard
snake
insects
lizard
rodents

FOOD 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 PYRAMID



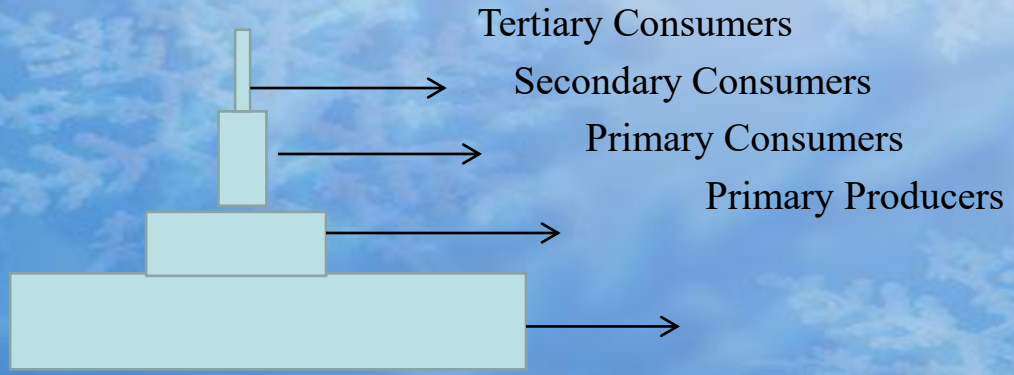
FOOD CHAINS AND PYRAMIDS

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

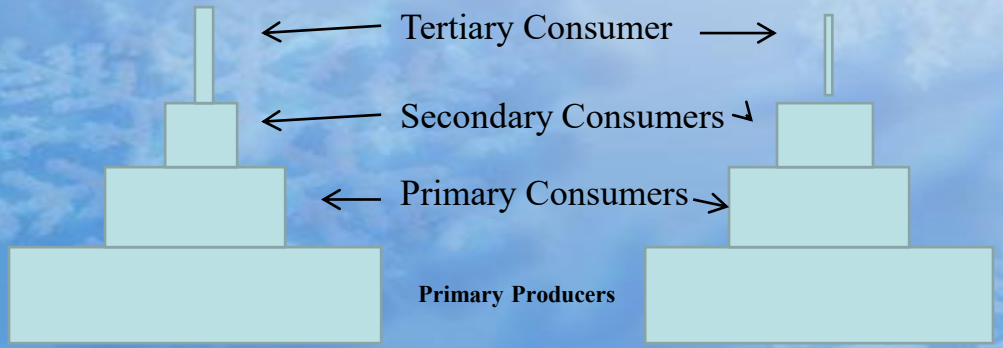
Pyramid of numbers
Pyramid of biomass: **Biomass** is biological material
Pyramid of productivity

PYRAMID OF NUMBER

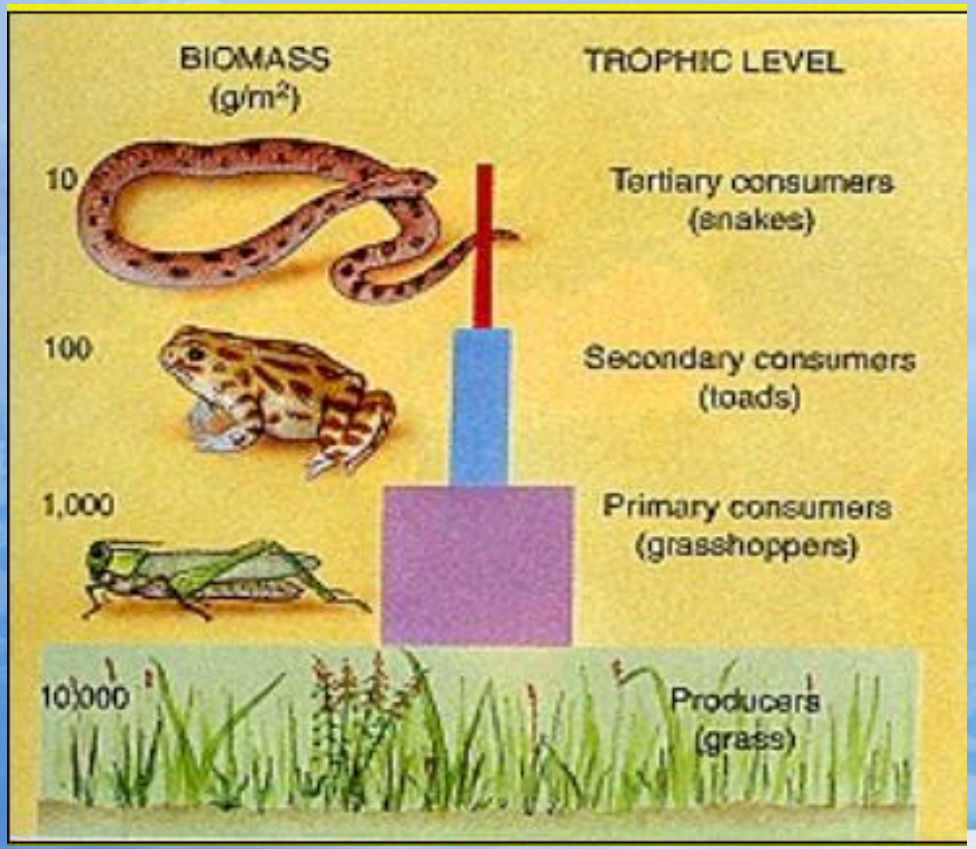
These show numbers of organisms at different trophic levels, which depend on



PYRAMID OF BIOMASS PYRAMID OF PRODUCTIVITY



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

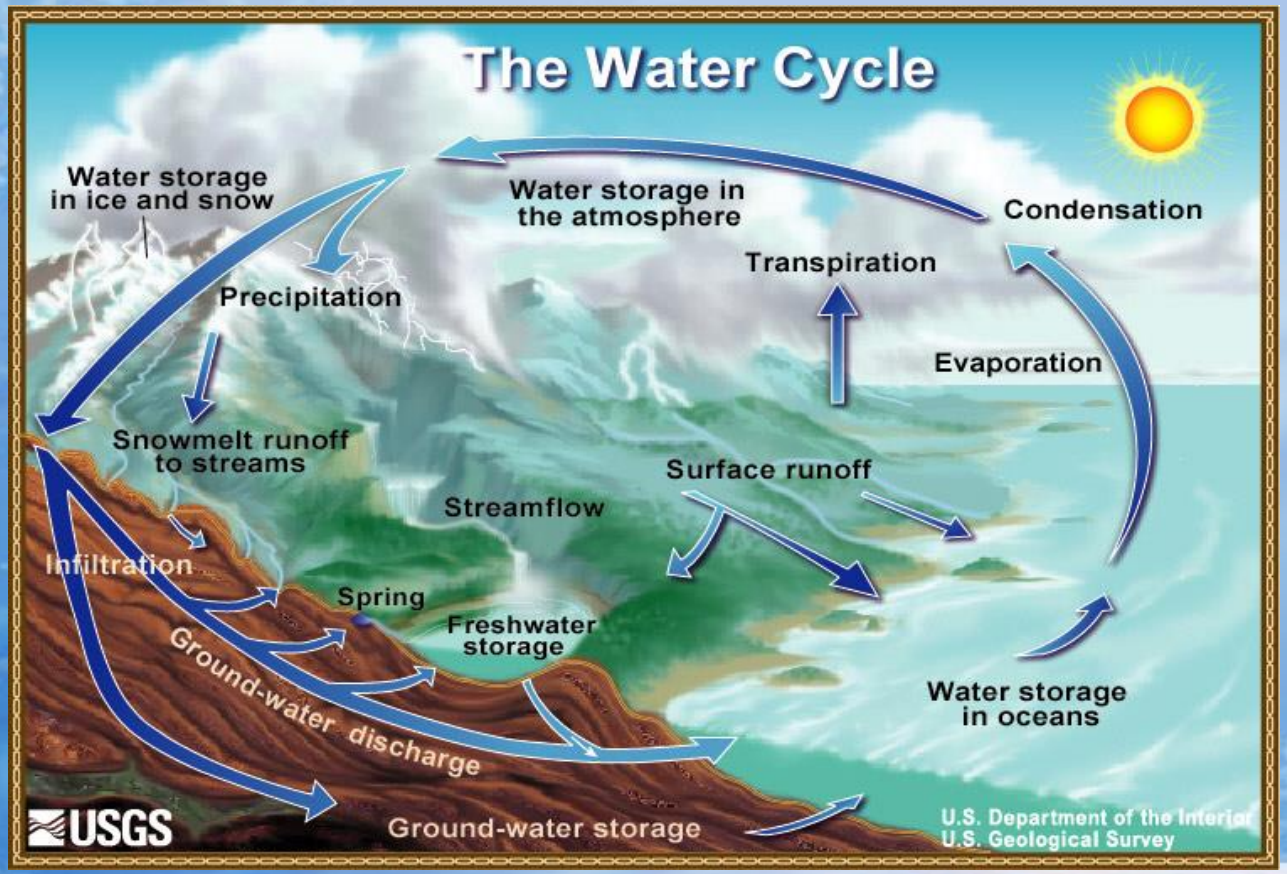
NITROGEN CYCLE

OXYGEN CYCLE

PHOSPEROUS CYCLE

NITROGEN CYCLE

WATER CYCLE


The Water Cycle
Water storage in ice and snow
Water storage in the atmosphere
Condensation
Transpiration
Precipitation
Evaporation
Snowmelt runoff to streams
Surface runoff
Streamflow
Infiltration
Spring
Freshwater storage
Water storage in oceans
Ground-water discharge
Ground-water storage
USGS
U.S. Department of the Interior
U.S. Geological Survey

WATER ON THE EARTH

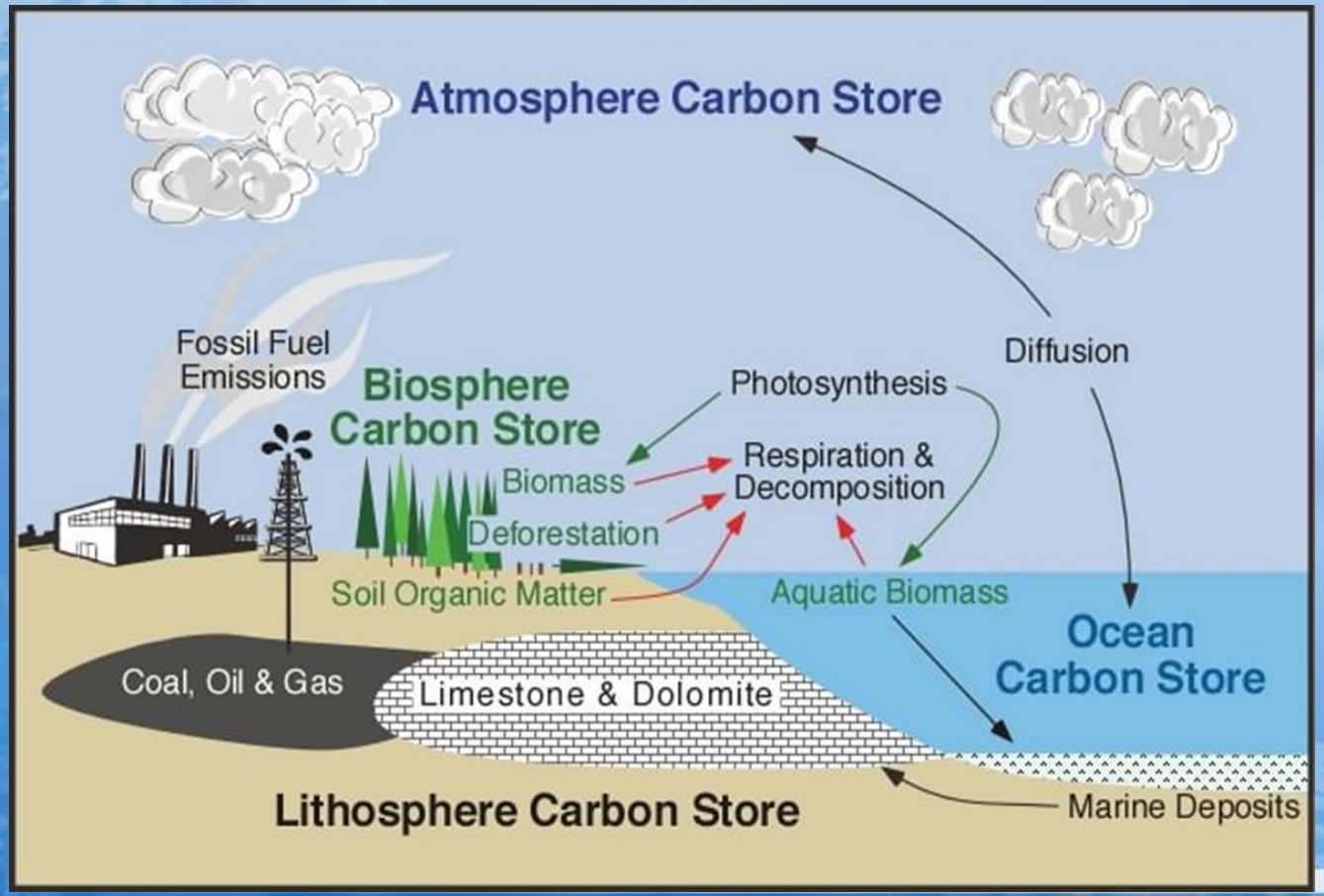
- Although 79% of the earth is covered in water with 97.5% of it is salt water.
- ONLY 3% OF THE WATER IS FRESHWATER.
- Most of the freshwater is in glaciers and ice caps.
- Less than 1% of the freshwater on the earth is readily available.

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