



# BINGHAM UNIVERSITY

## BIOLOGICAL SCIENCES DEPARTMENT

### BIO 101 : General Biology I

#### Lecture II

## Components of Ecosystem



# SUMMARY

- Components of ecosystem = Biotic + Abiotic
- Predation, parasitism, saprophytism, commensalism, symbiosis or mutualism and competition are feeding relationships in an ecosystem.
- Food chain is a linear feeding relationship
- food-web is a complex inter connecting feeding relationships among plants and animals in an ecosystem.

# SUMMARY TODAY CONT.....

- **Pyramid of Number:** Progressive decrease in number of individuals along the food chain in a community as the organism increases in size.
- **Pyramid of energy:** Progressive lost of energy in form of heat in food chain from one trophic level to another through the series of steps involving eating and being eaten.
- **Pyramid of biomass** is the total mass of organism (biomass) estimated at for each trophic level.
- **Energy is the capacity to do work.**
- **Laws of thermodynamics governs energy transformation in ecosystem.**



# COMPONENTS OF ECOSYSTEM

- **ABIOTIC** (Physical & climatic) factors e.g. soil, water, light, temperature, wind and pH.
- **BIOTIC** (Biological) factors include:
  - ❑ Producers: These are mainly green plants.
  - ❑ Consumers: These are animals
  - ❑ Decomposers: These are the micro-organisms e.g. bacteria & fungi.



# Abiotic vs. Biotic Factors

- **Abiotic factors** = non-living components that affect living organisms
  - Ex. Temperature,
  - sunlight, rocks



- **Biotic Factors** = all living things or their materials that directly or indirectly affect organisms in its environment (includes interactions)
  - Ex. Plants, animals,
  - fungi, bacteria





# Effect of Biotic and Abiotic Factors

- Interactions with biotic and abiotic factors can have an effect on several different levels: cellular, organismal, population, ecosystem
- Cellular Level: ex. temperature, water availability can affect a cell's function.
- Organismal level: ex. interactions (such as mutualism, predation) as well as abiotic factors (water, temperature)

# ECOSYSTEM

## ABIOTIC FACTORS

## BIOTIC FACTORS

PHYSIOGRAPHIC

CLIMATE

EDAPHIC

PRODUCERS

CONSUMERS

DECOMPOSERS

TOPOGRAPHY

TEMPERATURE

SOIL TYPE

RELIEF

RAIN

MOISTURE

ALTITUDE

WIND

ALKALINITY &  
ACIDITY

STEEPNESS OF  
SLOPE

HUMIDITY



# Biotic components

- **Producers:** These are mainly green plants.
- **Consumers:** These are animals
- **Decomposers:** These are the micro-organisms  
e.g. bacteria and fungi.



# Abiotic components

- Physiographic factor
- Climatic factor
- Edaphic factor (Soil factor)

# Physiographic factors



- Topography i.e. **surface features of a place**
- Relief i.e. **the difference in elevation of a place**
- Altitude i.e **height above sea level**
- Steepness of slope i.e **vertical gradient**



# Climatic factors

- Temperature
- Rain
- Wind
- Humidity



# TEMPERATURE

- The degree of hotness or coldness of a body
  - ✓ contributes to erosion & creation of soil
  - ✓ affects what animals and plants can survive in an area, since different organisms have different tolerances for cold and heat



# Rain

- The amount of precipitations the earth receives
- The chemical balance of living tissues is a challenge in terrestrial and fresh water environments
- Important component in erosion & creation of soils



# WIND

**Air in motion.**

**Wind is an important ecological factor which affects both directly and indirectly.**

**Violent winds often break off twigs or branches of plants and sometimes even uproot the trees and shrubs.**

**The vegetation of such areas is mostly composed of species which have a prostrate habit of growth and a tenacious underground root or rhizome system.**



# WIND Cont....

- **Contributes to erosion**
- **Affects perceived temperature via evaporation & convection**
- **Affects desiccation rate**
- **Affects growth form of plants**



# Humidity

- It affects organisms directly, because of its effect on the rate of transpiration.
- It is affect by temperature.
- In the atmosphere, water is present in the form of water vapors (atmospheric humidity). Clouds and fog are the visible forms of humidity.
- Humidity is described in three different terms:



## **(a) Specific Humidity:**

It refers to the “amount of water vapours present per unit weight of air”.

## **(b) Absolute Humidity:**

It refers to the “amount of water vapours present per unit volume of air”.

## **(c) Relative Humidity:**

It refers to the “amount of water vapours actually present in the air, and is expressed as percentage of the amount which the air can hold at saturation at the existing temperature”.  
Absolute and relative humidity change with the changes in temperature.



# *Edaphic factor (Soil factor)*

- Soil type
- Moisture
- Acidity and Alkalinity



# FOOD RELATIONSHIP IN THE COMMUNITY

**PREDATOR** hunts, captures, kills another organism ( the prey)  
i.e. **PREDATION.**

**PARASITISM:** This is the feeding relationship in which one organism (the parasite) lives & feeds on the **HOST.**

# TYPES OF PARASITES:



- **ECTOPARASITES** (they live on the surface of the host & derived their food) e. g Tick, Lice
- **ENDOPARASITES**. They live inside the body of the host. e.g. *Tenia solium*, *T. saginatta*, *Ascaris lumbricoides*, *plasmodium SPP*, etc.



**SAPROPHYTISM:** Feeding relationship between an organism (saprophyte) & decomposing materials e.g. *Mucor mucedo*, *Rhizopus nigricans*.

**COMMENSALISM:** Feeding relationship between two organisms of different species, one derives food or other benefits from the association while the other remains unharmed or unaffected. e.g. polyps & hermit crab, colon bacteria and human



# **SYMBIOSIS OR MUTUALISM:**

**Mutual relationship between two organisms in which both (symbionts) benefits e.g. lichen (alga & fungi)**

# **COMPETITION:**When a shared resource is in short supply, organisms compete, and those that are more successful survive.

# LICHEN (alga & fungi )



# MAIN TYPES OF SYMBIOSIS



## MUTUALISM

## COMMENSALISM

## PARASITISM

# Functions of ecosystem



**Living organism in an ecosystem may be classified into:**

**PRODUCERS**, e.g. green plants

**CONSUMERS** e.g. Goat ( $1^{\circ}$  consumer)  
lion ( $2^{\circ}$  consumer)

**DECOMPOSERS**: These are bacteria & fungi that feed on organic material & contribute to the process of decay of organic materials.

# FOOD CHAIN



- Food chain is a linear feeding relationship involving transfer of energy through food from producers to consumers e.g.
- Producers → Consumers → 2<sup>o</sup> Consumers
- Green plants → Herbivores → Carnivores
- Elephant grass → Goat → Lion
- Dead animal → Maggots → Common frog → Grass snake
- Rosebush sap → aphid → ladybird → spider → Insectivorous bird → Hawk

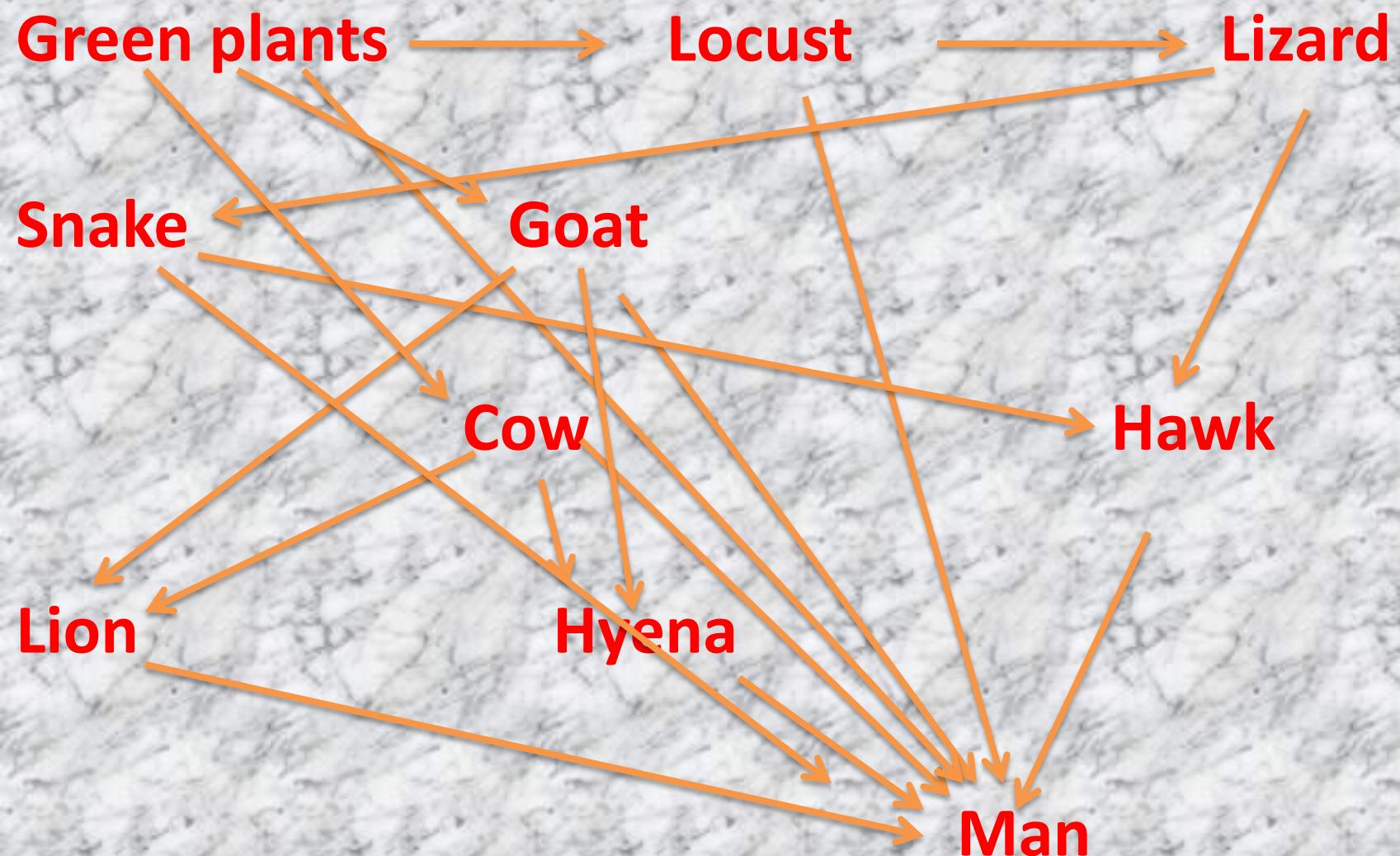
- **PRODUCERS** (Green plants) most abundant, start of the food chain, produce food during photosynthesis, store energy for herbivores.
- **HERBIVORES:** 1° consumers, feed on plant material, build up energy for carnivores
- **CARNIVORES:** 2° consumers, feed on herbivores for energy.
- **DECOMPOSERS:** feed on dead organic materials. help recycle nutrients.

# FOOD WEB.



**Complex inter connecting  
feeding relationships among  
plants and animals in an  
ecosystem.**

# FOOD WEB.



# THE PYRAMID OF NUMBER



**Progressive decrease in number of individuals along the food chain in a community as the organism increases in size.**

**As the trophic levels rise from the first to the fourth, the predators become fewer, larger, fiercer, and more agile**

**Increase in size and decrease in number of organisms.**



**3<sup>RD</sup> LEVEL CARNIVORE**

**2<sup>ND</sup> LEVEL CARNIVORE**

**1<sup>ST</sup> LEVEL CARNIVORE**

**HERBIVORES**

**PRODUCERS**

**Increased size**

**Increased number**

# THE PYRAMID OF ENERGY

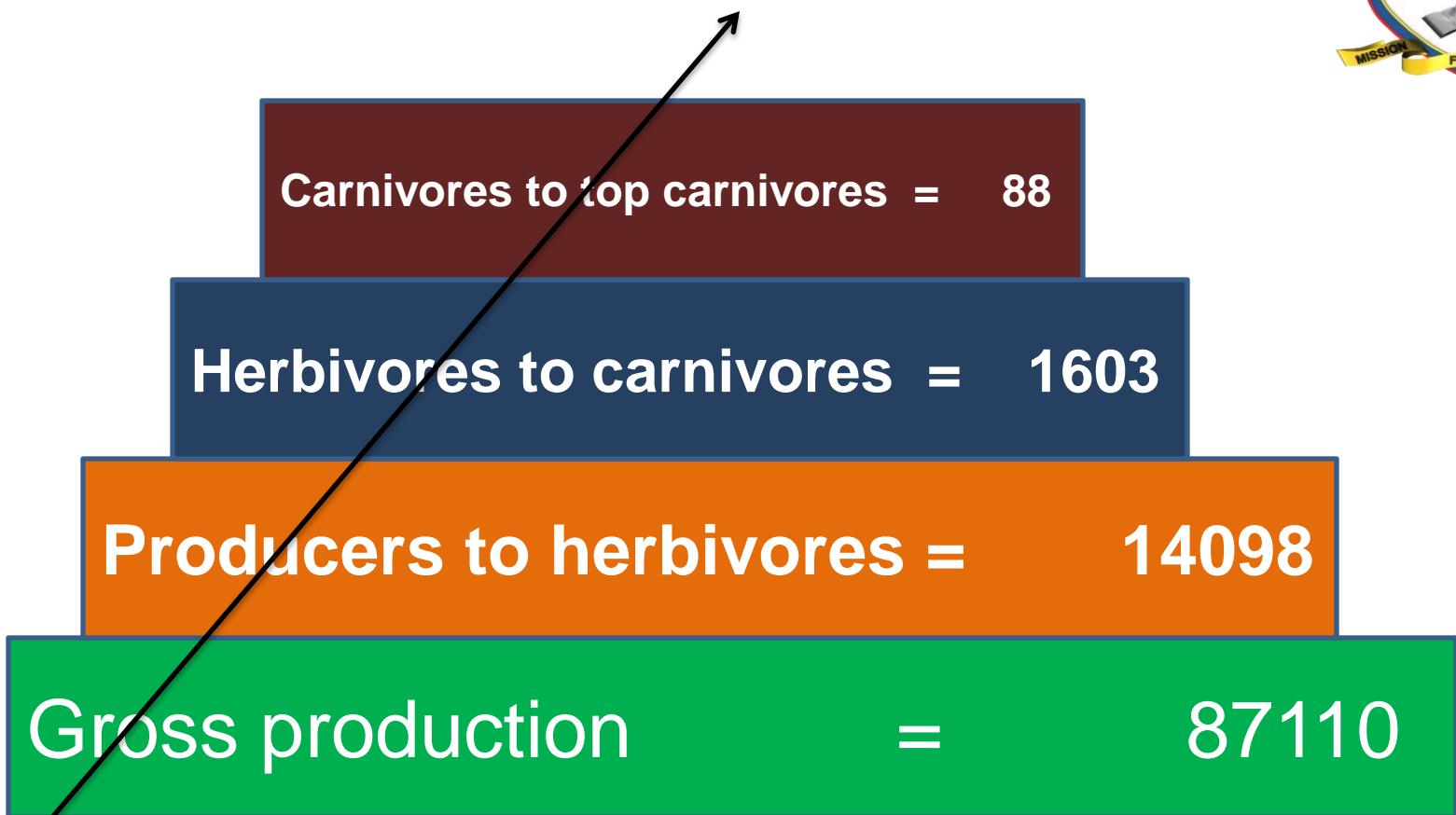


**Representation of energy flow in food chain from one trophic level to another through the series of steps involving eating and being eaten.**

**Most of the chemical energy processed in metabolism are dissipated as heat energy in the process of respiration.**



- Energy flow in  $\text{km}^{-2}\text{yr}^{-1}$ . (from J.D.T, 2002)



**Progressive energy lost in form of heat across trophic levels**

# PYRAMIDS OF BIOMASS



**Total mass of organism (biomass) is estimated for at each trophic level.**

**This can be done through wet masses or destructive methods.**



# BIOGEOCHEMICAL CYCLES

- The transfer of matter involves biological, geological and chemical processes; hence the name biogeochemical cycles is derived. Biosphere, hydrosphere, lithosphere, and the atmosphere are the main four categorical areas for the transportation and transformation of matter within planet Earth.



# Nutrient Recycling

**Nutrient recycling is the way in which elements are continuously being broken down and/or exchanged for reuse between the living and non-living components of an ecosystem.**



# Nutrient Recycling Cont.....

**There is a limited amount of nutrients on earth e.g. the water cycle – where water is constantly being recycled in nature.**

**When plants and animals die, their nutrient content is not wasted.**

**Bacteria and fungi decompose the remains and release the nutrients back into the abiotic environment (i.e. into the soil, nearby water and air).**



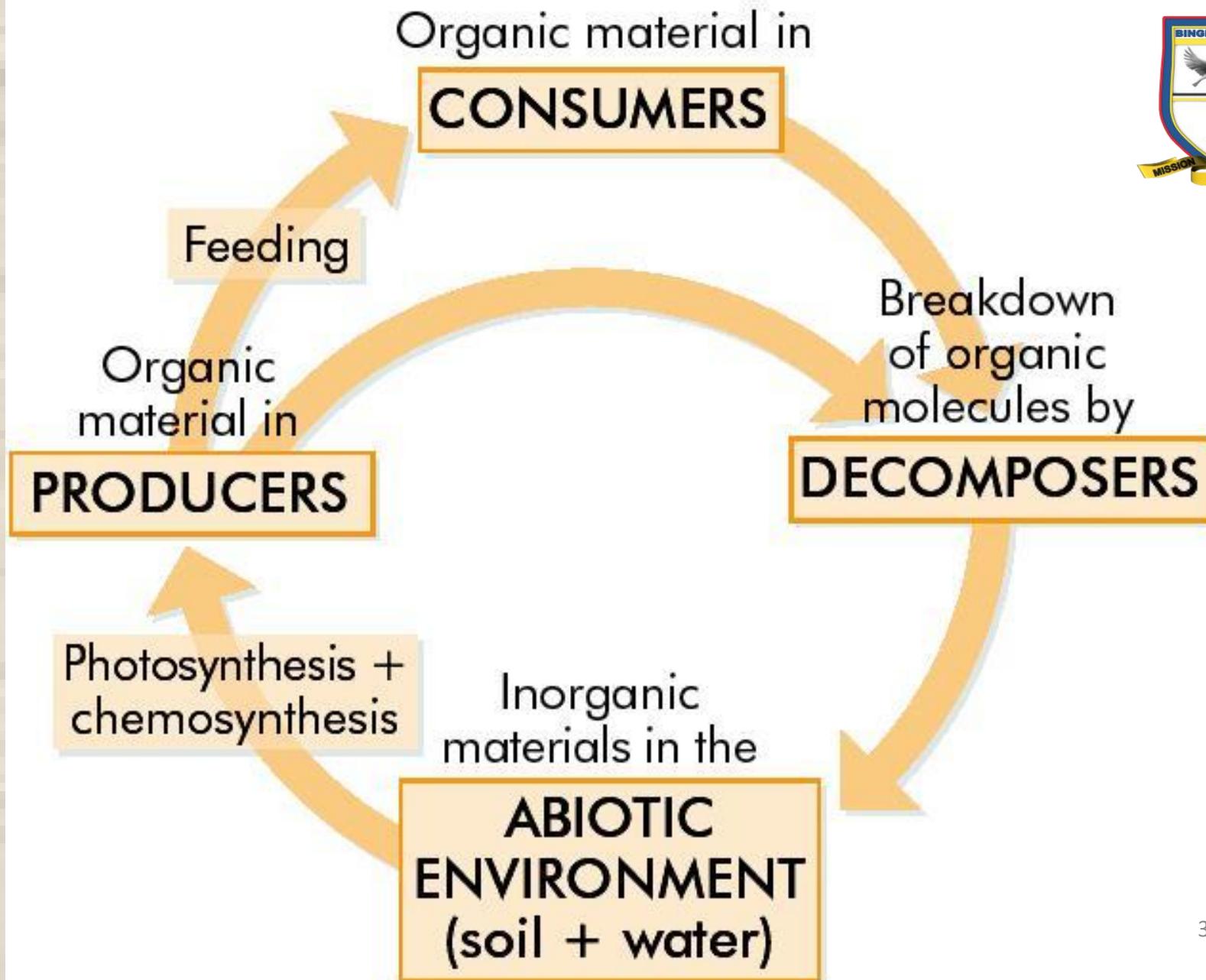
# Nutrient Recycling Cont.....

These nutrients are then taken up by other plants and used to make new organic material.

This material is passed on down the food chains and is reused by all the chain members.

When death occurs for these members, the nutrients are again returned to the abiotic environment and the cycling of nutrients continues in this circular way.

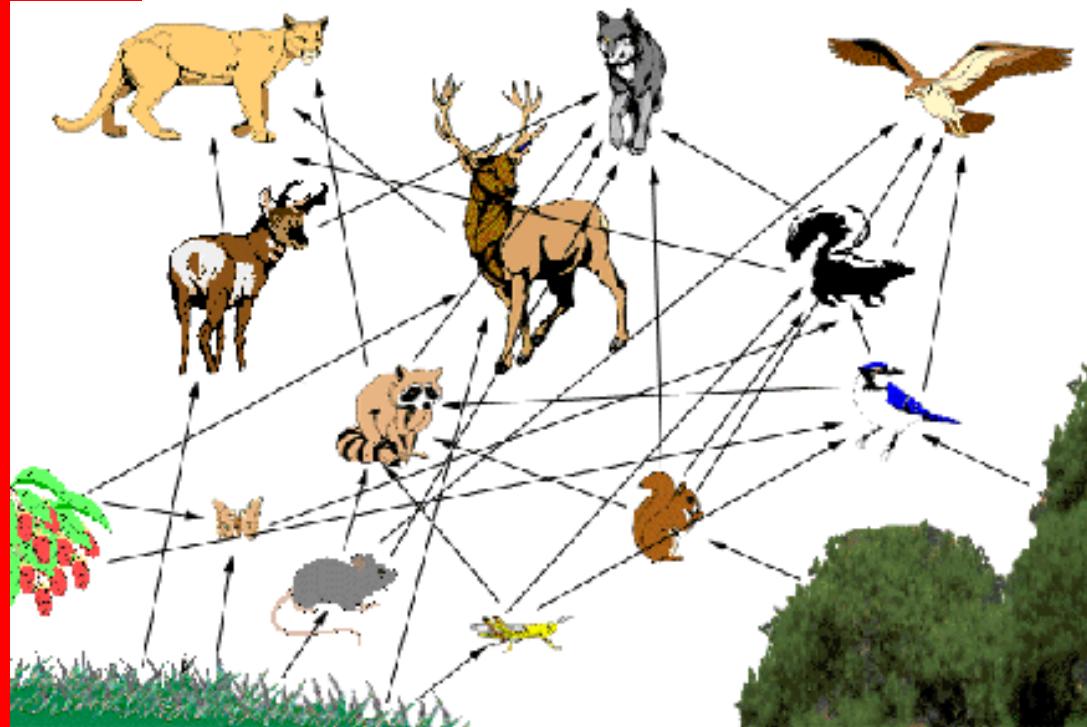
# Recycling nutrients within an ecosystem





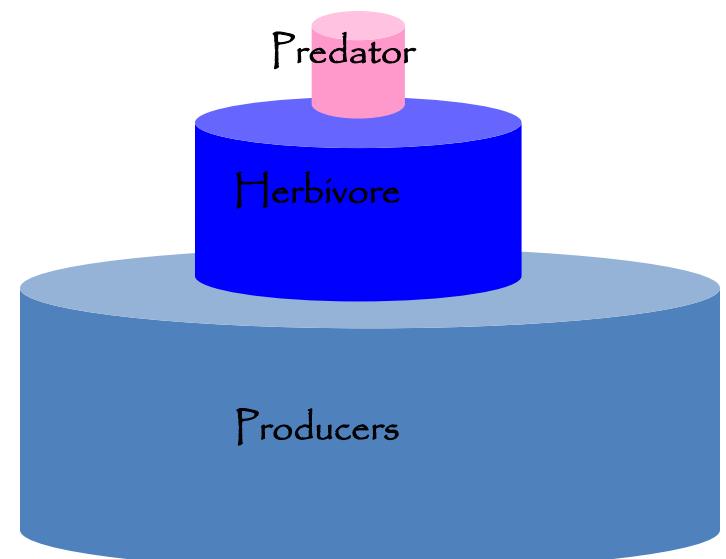
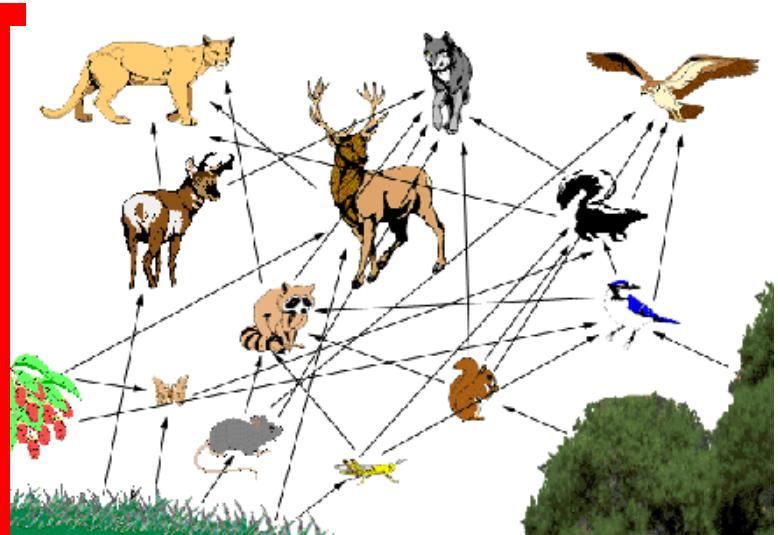
# Materials Cycled

- Nutrients
  - Carbon
  - Hydrogen
  - Nitrogen
  - Oxygen
  - Phosphorus
  - Sulfur
- Energy?
  - Is energy cycled?



# Energy vs. Nutrients

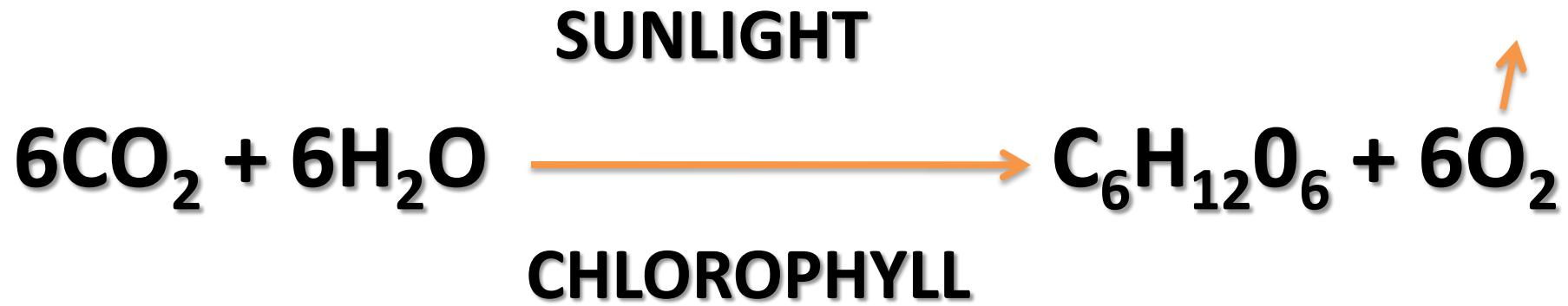
- **Nutrients cycle**
  - Conservation of material
  - A lot of new material does not generally enter an ecosystem
  
- **Energy flows**
  - A one-way movement of energy through an ecosystem
  - Energy originates by gathering solar energy
  - Energy lost through growth and metabolism





**Plants in a process of  
PHOTOSYNTHESIS make  
use of radiant energy of  
the sun and convert it to  
chemical energy in food  
(Primary production).**

# PHOTOSYNTHESIS





# CONCEPT OF ENERGY

**Energy is the capacity to do work. Biological activities require consumption of energy which ultimately comes from the sun. Energy stored in plant tissues is transformed into mechanical & heat form of energy during metabolic activities.**

**In the biological world, the energy flows from the sun to plant & then to all heterotrophic organisms, such as micro-organisms, animals & man.**

# LAWS GOVERNING ENERGY TRANSFORMATION IN ECOSYSTEM



**Energy transformation in an ecosystem can also be explained in relation to the laws of thermodynamics, which are fully applied to close system.**



- **1<sup>st</sup> law:**

**The law of conservation of energy, which says that energy may be transformed from one form into another but is neither created nor destroyed.**

- **2<sup>nd</sup> Law:**

**States that processes involving energy transformation will not occur spontaneously unless there is degradation of energy from a non-random form.**





# Questions

