ECOLOGY

[*Ekos* - house / *logy* - study of]

- *Simple definition*: **Ecology** - The STUDY OF our "HOUSE" (Earth).
- *Regents definition*: **Ecology** - The STUDY OF how ORGANISMS interact with the LIVING (*biotic*) and the NONLIVING (*abiotic*) things that surround them.

I. HISTORY

A. Ancient Greeks: GAIA - the Greek Goddess of Earth.

B. Many ancient cultures cherished and respected the Earth.

EXAMPLES:

(1) NATIVE AMERICANS.

"We do not inherit the Earth from our parents,
we only borrow it from our children's children."
Chief Seattle - 1939

(2) Many EASTERN RELIGIONS are based on a *oneness with nature*.

C. March, 1969: APOLLO IX -----> ***"SPACESHIP EARTH"***

- For the first time, ***HOME*** is thought of as the whole planet.

D. Early 1970's: The birth of the modern environmental movement.

THE GAIA HYPOTHESIS

- An *educated guess* proposed by JAMES LOVELOCK.
- The Gaia Hypothesis views the Earth as a LIVING ENTITY or organism.

II. ECOLOGICAL ORGANIZATION

Levels of Biological Organization (review)
cells -----> tissue -----> organ -----> organ system -----> organism

- Just like living things or organisms, our environment is more easily studied at different levels of organization.

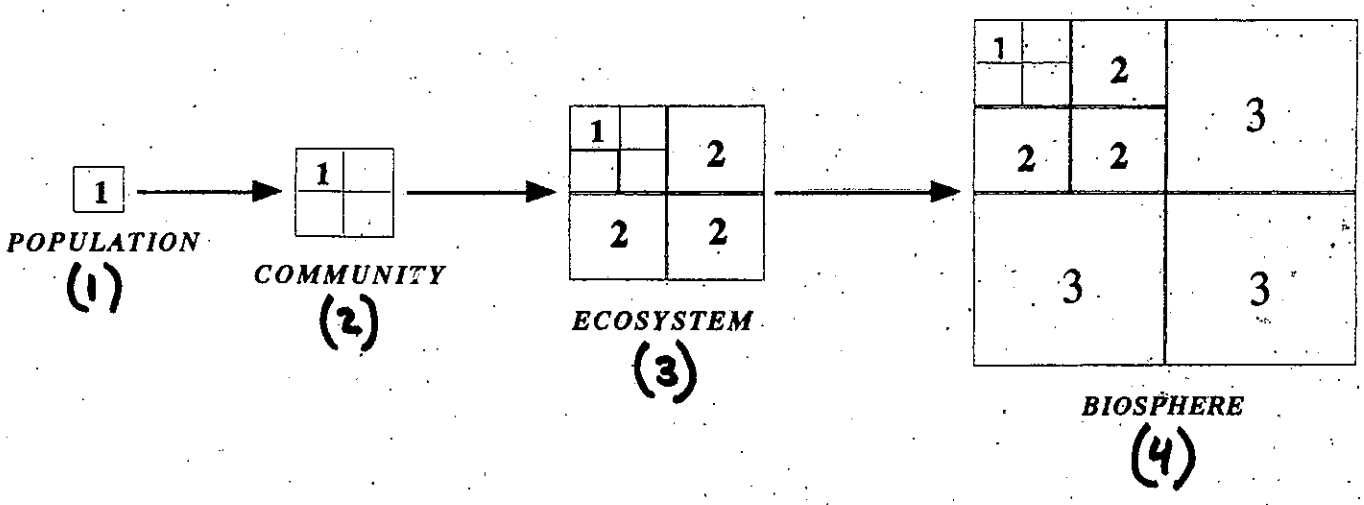
A. Levels of Ecological Organization.

(1) **Population** - - - ALL THE MEMBERS OF A SPECIES IN AN AREA
EXAMPLE: All the white tail deer in the Adirondacks Mountains.

(2) **Community** - - ALL THE POPULATIONS IN AN AREA
EXAMPLE: All the organisms in the Adirondacks Mountains.

(3) **Ecosystem** - - - - THE LIVING COMMUNITY AND PHYSICAL ENVIRONMENT FUNCTIONING TOGETHER.
EXAMPLE: The Adirondack ecosystem is made up of the *living* community and the *nonliving* physical environment.

(4) **Biosphere** - - - - PORTION OF EARTH WHERE LIFE EXISTS
ALL of the ecosystems combined makes up the **BIOSPHERE**.



III. PARTS OF AN ECOSYSTEM

• Ecosystems consists of BIOTIC (*LIVING*) and ABIOTIC (*NONLIVING*) factors.

A. *BIOTIC FACTORS*

• ALL of the LIVING things that affect an ecosystem.

• There are 2 ways in which **BIOTIC FACTORS** (*living things*) interact:
(1) Nutritional Relationships (*eat or be eaten*)
(2) Symbiotic Relationships

(1) *NUTRITIONAL RELATIONSHIPS*

• Involves the transfer of NUTRIENTS from one organism to another.

(a) Autotrophs (*self feeders*)

• Organisms capable of making their own food by the process of PHOTOSYNTHESIS.

• *Photosynthesis* convert INORGANIC molecules into ORGANIC molecules using SUNLIGHT.

• Because of their ability to *produce* their own food, **autotrophs** are often referred to as PRODUCERS when listed in a food chain.

Chemical Equation for Photosynthesis:

$$\_CO_2 + \_H_2O \xrightarrow[chlorophyll]{sunlight} C_6H_{12}O_6 + \_O_2$$

[inorganic] —photosynthesis→ [organic]

* Photosynthesis also converts the SOLAR energy from the SUN into the CHEMICAL energy of GLUCOSE making autotrophs (PRODUCERS) a vital start to any food chain.

SOLAR ENERGY —photosynthesis→ *CHEMICAL ENERGY*

(b) **Heterotrophs** (*other feeders*)

- Organisms that CANNOT synthesize their own food and so are dependent on OTHER organisms for food.

Types of Heterotrophs

1. ***Herbivores*** - PLANT-EATING ANIMALS
2. *Carnivores* - MEAT-EATING ANIMALS
3. *Omnivores* - EAT BOTH PLANTS AND ANIMALS

Types of Carnivores

1. ***Predators*** - ANIMALS THAT KILL AND CONSUME PREY
2. *Scavengers* - ANIMALS THAT FEED ON THE REMAINS OF OTHER ANIMALS THAT THEY HAVE NOT KILLED.
3. *Saprophytes* - BREAK DOWN THE REMAINS OF DEAD PLANTS AND ANIMALS.
   (decomposers)

(2) SYMBIOTIC RELATIONSHIPS

- Organisms living together in CLOSE association.

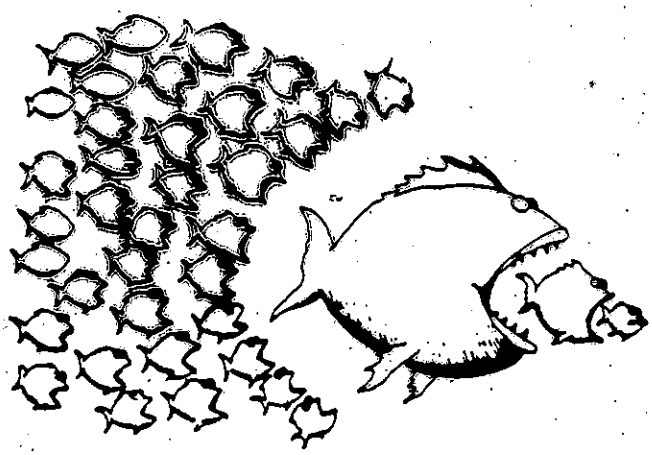
Types of Symbiosis

1. ***Mutualism*** - BOTH ORGANISMS BENEFIT (+, +)
   (+, +)
   EXAMPLES: *Protozoa within the guts of termites.*
   Bacteria in the colon of humans.
2. Commensalism - ONE ORGANISM BENEFITS THE OTHER IS UNHARME
   (+, 0)
   EXAMPLES: *Barnacles on whales. / Orchids on tropical trees.*
3. Parasitism - ONE ORGANISM BENEFITS, THE OTHER IS HARMED.
   (+, -)
   EXAMPLES: *Athlete's foot fungus on humans. / Heartworm in dogs.*

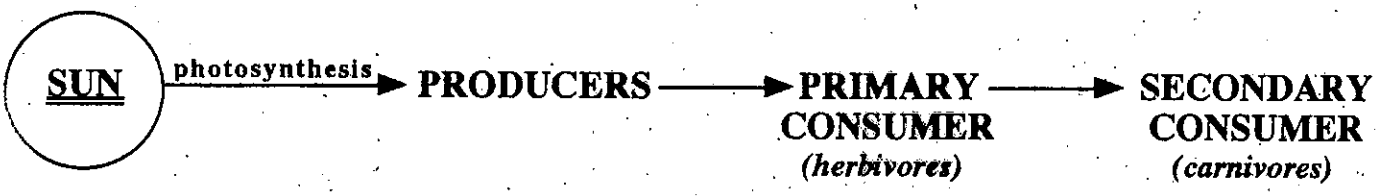
IV. ENERGY FLOW THROUGH AN ECOSYSTEM

- If an ecosystem is to be SUSTAINABLE it must contain a constant flow of energy. (*able to continue all by itself*)
- The *ultimate source* of energy for our biosphere is the SUN.
- The life activities characteristic of living organisms require ENERGY.
- PRODUCERS convert the SOLAR energy of the sun into the CHEMICAL energy of food (GLUCOSE) by the process of PHOTOSYNTHESIS thus making energy available to ALL living things.

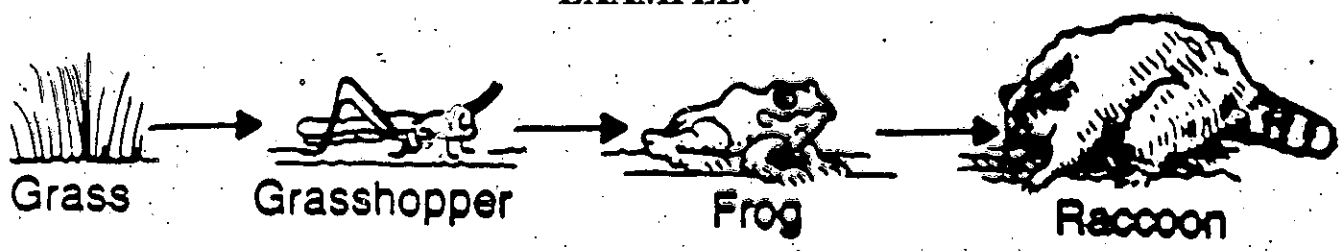
A. *FOOD CHAINS*



- Shows the pathway of energy (food) from one organism to the next.



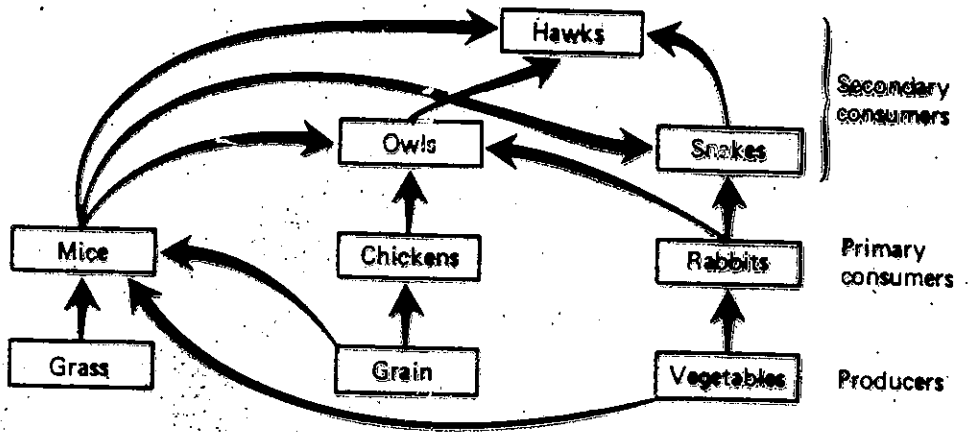
EXAMPLE:



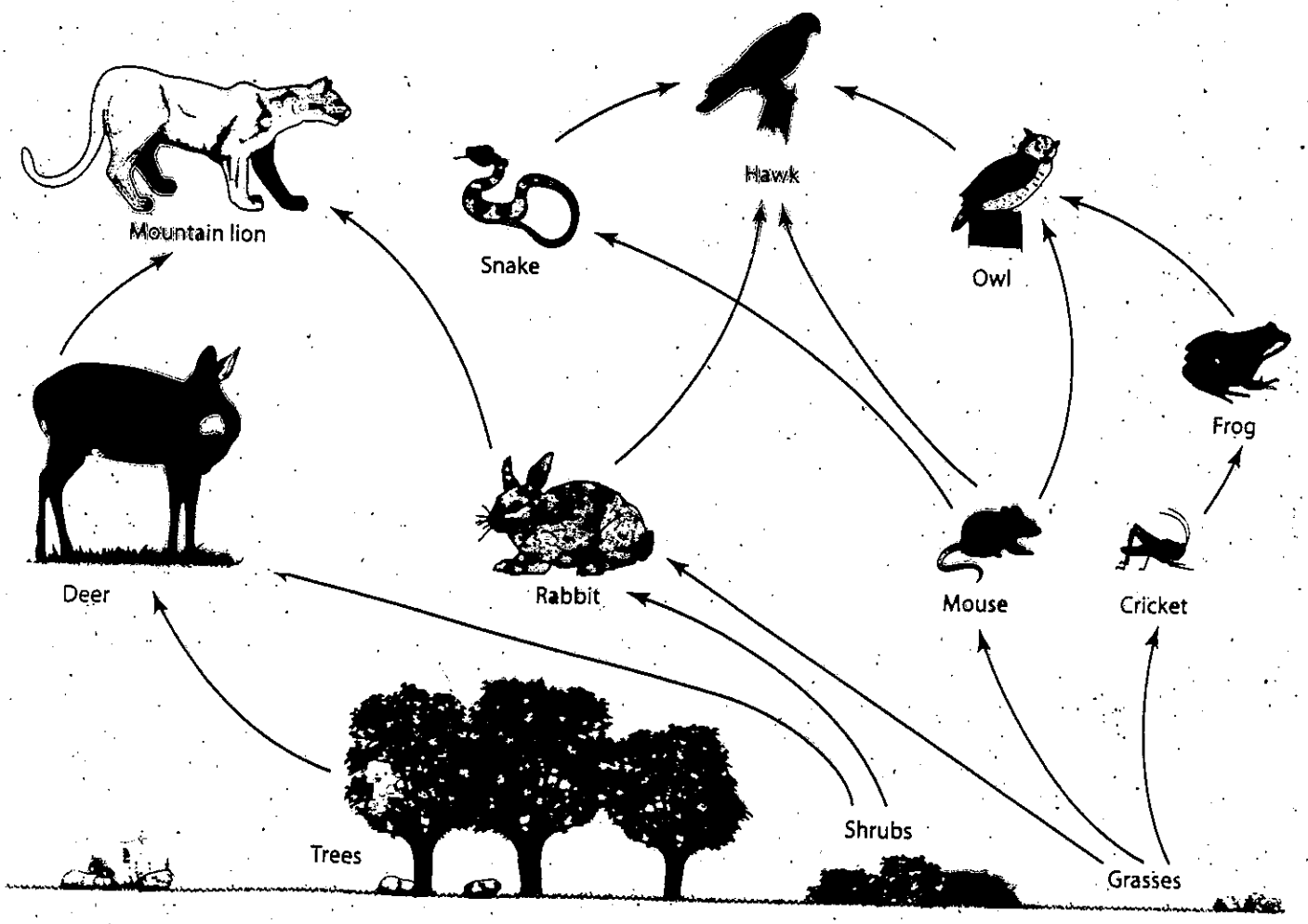
B. FOOD WEBS

- Shows the INTERACTIONS and INTERCONNECTIONS among the different food chains of a community.

EXAMPLE 1.



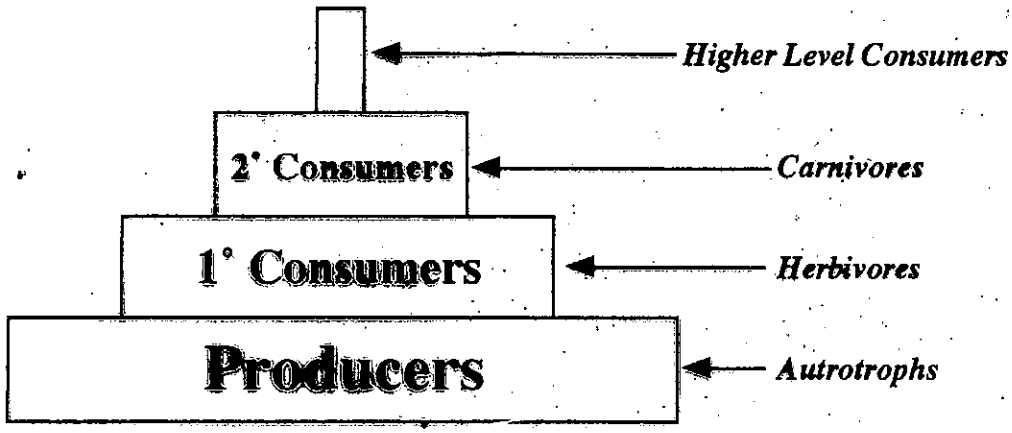
EXAMPLE 2.



C. FOOD/ENERGY PYRAMIDS

- The conversion of energy from one form to another is **NOT** 100% efficient.
- Some energy is always lost, usually in the form of HEAT resulting in a DECREASE of energy as you move up the food web.

Pyramid of Energy

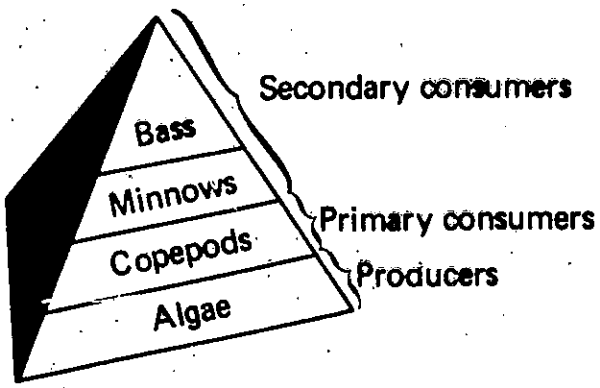


D. PYRAMID OF NUMBERS

- The *decrease* of ENERGY at each successive feeding level (*trophic level*) means that there is also a *decrease* in the NUMBER of organisms found in each *trophic level* as you move up the food web.

REMEMBER: **ALL** living things need energy to carry out life functions.

Pyramid of Numbers



V. BIODIVERSITY

- The number of DIFFERENT kinds of SPECIES within an ecosystem.
- STABLE ecosystems have a lot of biodiversity.

A. Ecosystems with a large biodiversity include:

(1) MARINE ECOSYSTEMS (THE OCEAN)

(2) TROPICAL RAIN FORESTS

Bill Nye: Biodiversity

(1) Where do most things on planet earth live?

(2) What happens if too many species disappear from ecosystems?

(3) What happens when "one part of the chain is taken out"?

(4) How can lawn fertilizer affect rivers and streams? (Human Impact)

(5) What is the best way to wipe out a species?

(6) What percent of all species live in water (aquatic) environments?

(7) Why do lawns (like golf courses) hurt biodiversity?

(8) Finish the sentence:
"The more diverse the species, _____."

VI. POPULATIONS

A. *Environmental Limits on Population Size*

- In any ecosystem, the *growth* and *survival* of organisms depend on the LIMITED amount of RESOURCES available to them.
- Factors in the environment that LIMIT the size of populations are known as LIMITING FACTORS.
- *Limiting Factors* can be ABIOTIC or BIOTIC.

EXAMPLES:

Limiting Factors	
BIOTIC	*ABIOTIC*

B. *Competition*

- The STRUGGLE for the LIMITED resources among organisms.

Evolution Review

Overproduction + Competition ⟶ Natural Selection

Only the most fit individuals survive and pass on their genes to their offspring. Therefore, competition in an important force in the process of ***EVOLUTION***.

B. Carrying Capacity

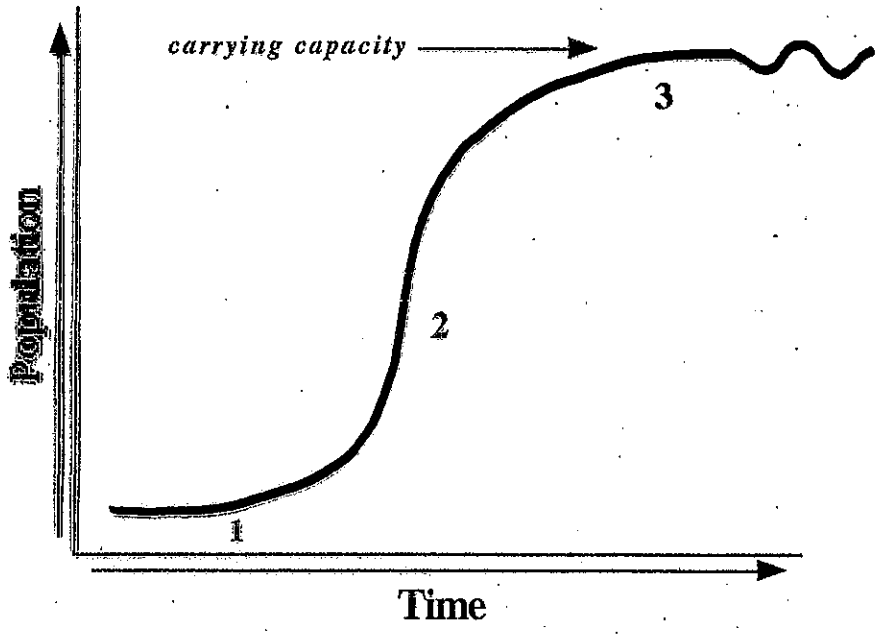
- The NUMBER of organisms of any single species that an ecosystem can support.

1. Population Growth Curve

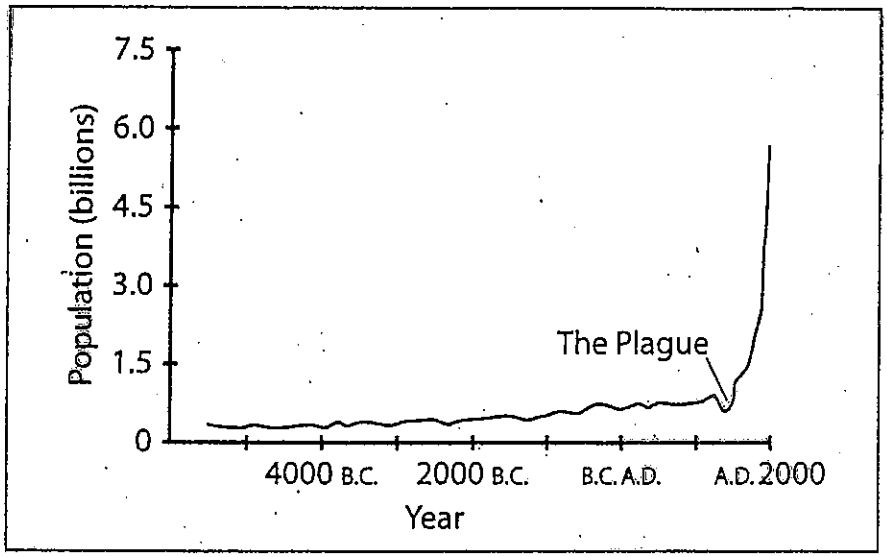
(1) ESTABLISHMENT

(2) GROWTH

(3) STABILIZATION



2. Human Population Growth Curve



QUESTION:

How many human beings can our biosphere support?

or

What is the carrying capacity of planet Earth for Homo sapiens?

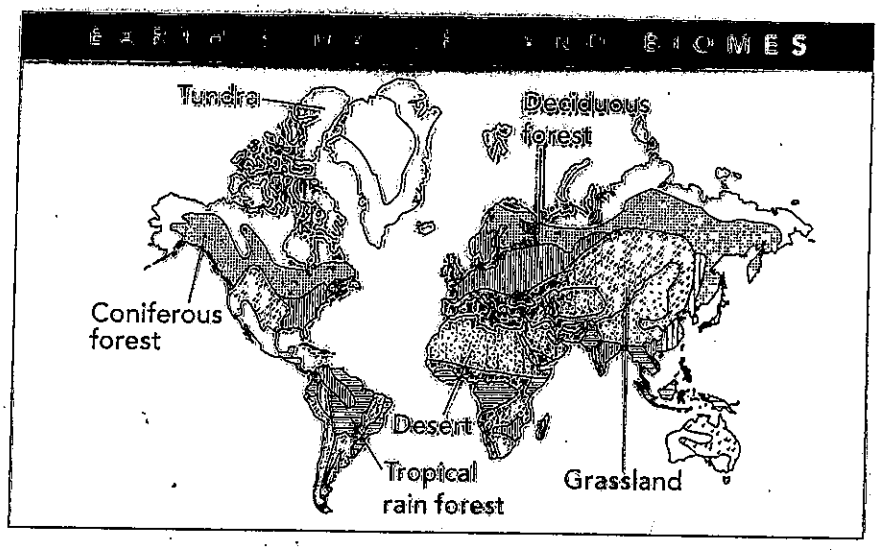
(human beings)

VII. ENVIRONMENTAL CHANGE

- The series of events by which one ECOSYSTEM changes into another is called ECOLOGICAL SUCCESSION.

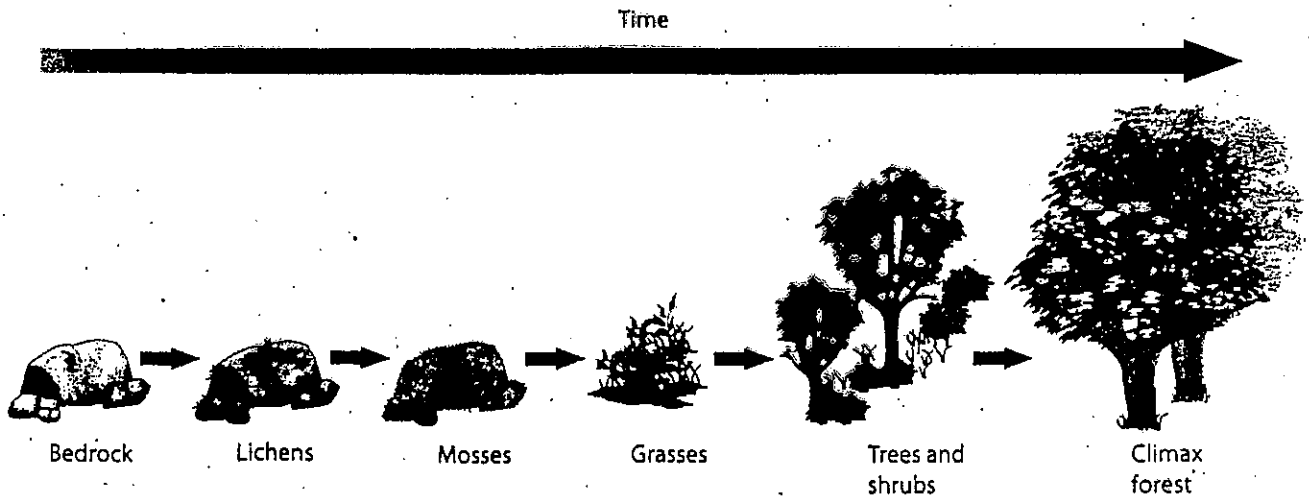
- ABIOTIC factors determine the kind of PLANTS or FLORA that develops. Some important abiotic factors include:

(1) WATER (2) TEMPERATURE



Example of Ecological Succession

(1) Succession from a bare rock into forest



Kind of like evolution, ecological succession can take a looooooooooong time.

VIII. MATERIAL CYCLES

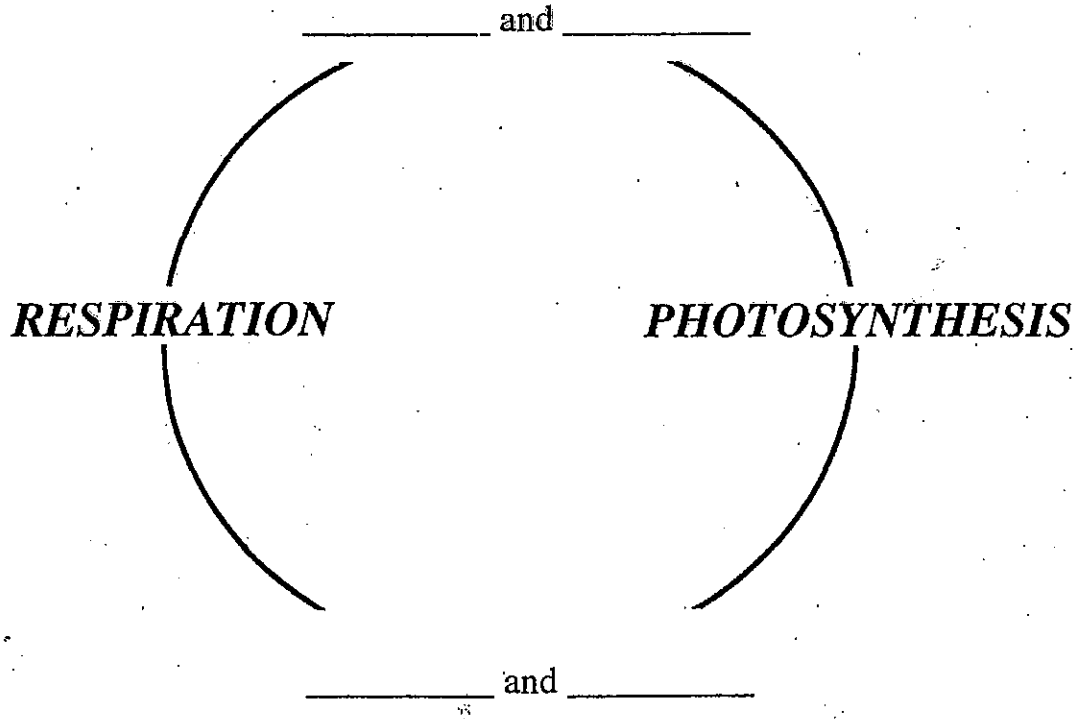
- Involves the REUSING and RECYCLING of important ELEMENTS and COMPOUNDS throughout an ecosystem.

These important elements and compounds include:

Element	Compound

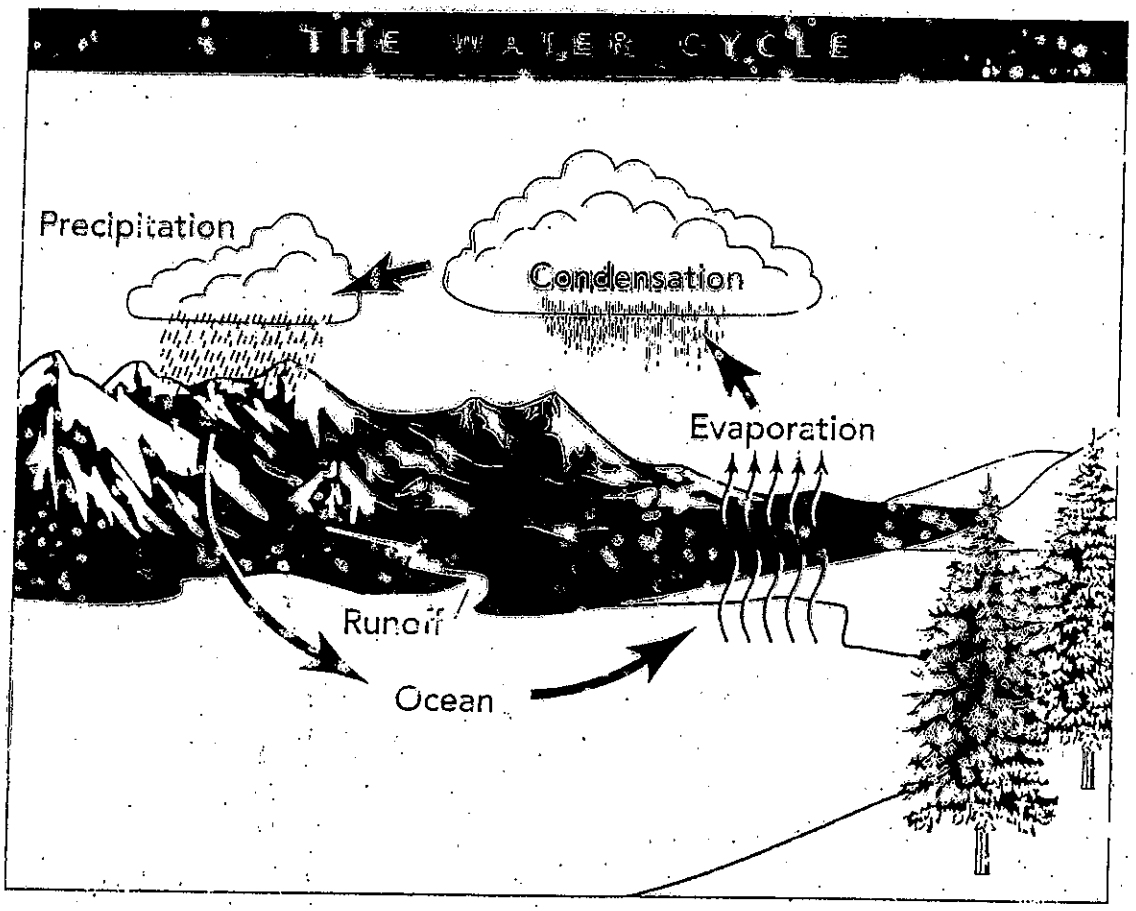
A. *Carbon/Oxygen Cycle*

- Involves the REUSING and RECYCLING of *CARBON* and *OXYGEN* atoms between the processes of PHOTOSYNTHESIS and RESPIRATION.



B. The Water Cycle

- Involves the REUSING and RECYCLING of **WATER** throughout an ecosystem.



Water moves continuously between the atmosphere and the surface of the Earth.

IX. HUMAN IMPACT ON THE ENVIRONMENT

As previously learned, STABLE ecosystems have a HIGH degree of BIODIVERSITY. However, over the past 100 years, the BIODIVERSITY on the planet has DECREASED ...**BIG TIME!**

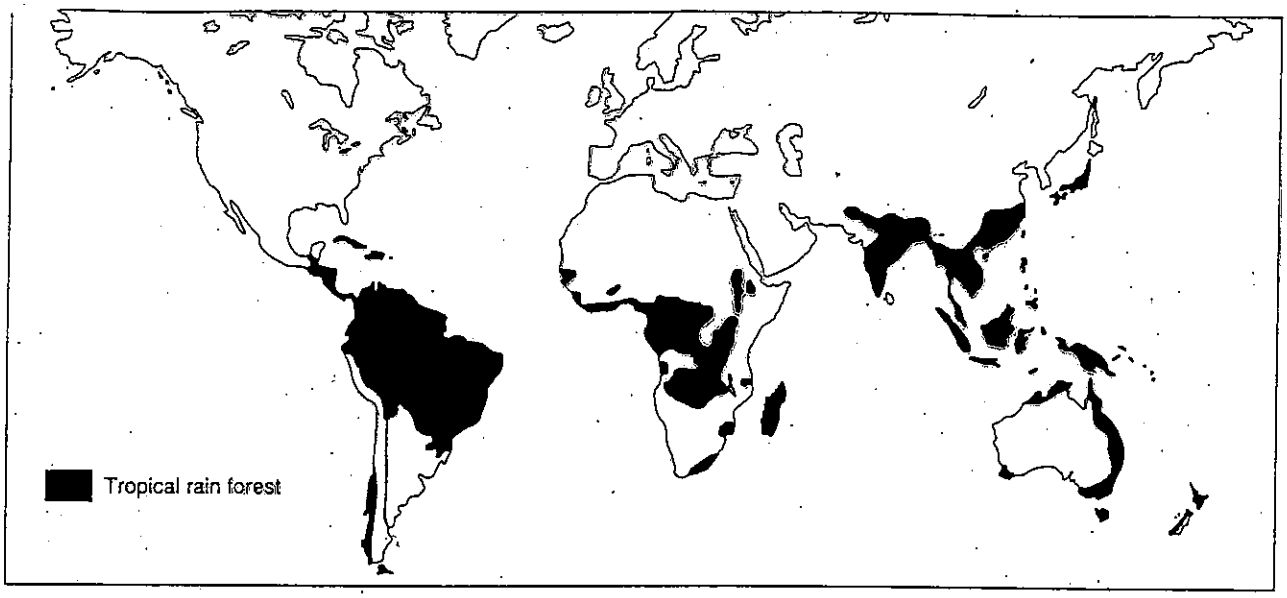
The major causes for the sudden drop in the planet's ***biodiversity*** can be traced back actions of HUMAN BEINGS.

A. *Habitat Destruction* ⟶ *Deforestation*

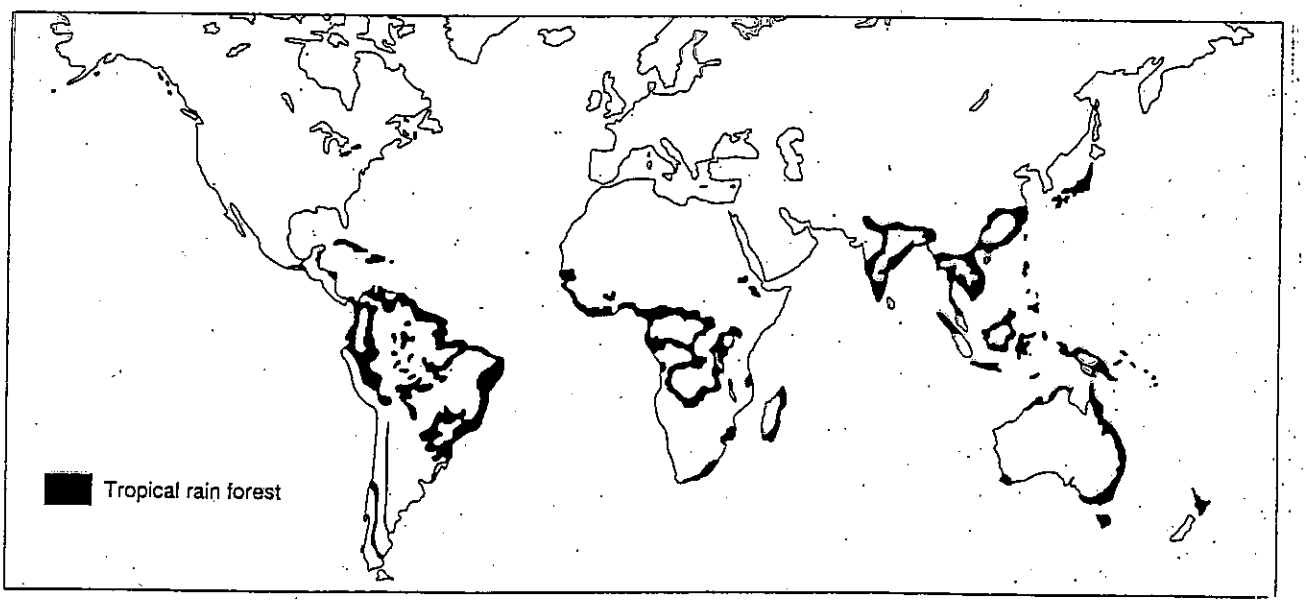
- the CUTTING DOWN of RAIN FORESTS

EXAMPLE: Destruction of Tropical Rain Forests

Map 1 - *The area of tropical rain forests in 1950*



Map 2 - *The area of tropical rain forests in 2000*

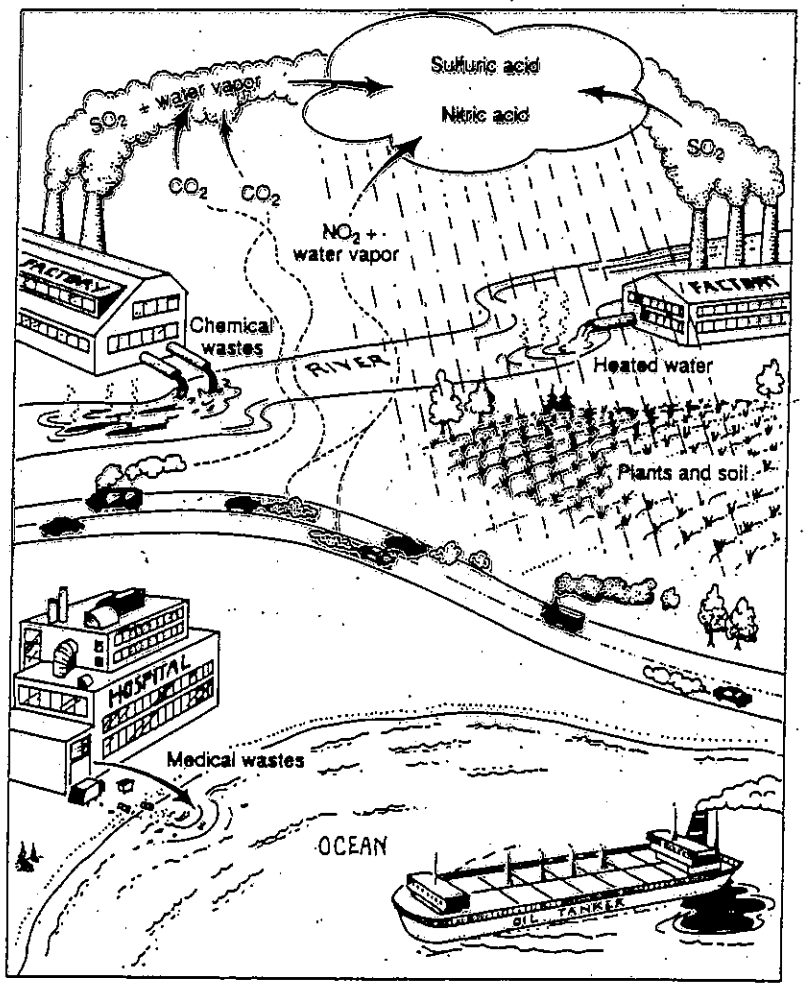


B. Pollution

- the CONTAMINATION of air, water or soil.

(POLLUTANTS - pollution causing chemicals)

The diagram below shows the many ways in which the biosphere becomes polluted.



POLLUTANT	SOURCE

1. Garbage

- When you throw something away, it goes in a garbage can. Once a week the garbage truck comes and the can is emptied, and that's the last you see of it. But what do you think happens to the garbage then? Does it just disappear?

NO WAY JOSE!

- Most ***garbage*** is taken to a garbage dump or buried in a LAND FILL.

Bill Nye: Garbage

(1) How much garbage is produced per person in the United States?

(2) What is a compost pile?

(3) Why are nonbiodegradeable wastes harmful to the environment?

(4) How can landfills contaminate the soil?

(5) What are the 3 R's?

(6) Why shouldn't you dump stuff directly down storm drains.

2. *The Greenhouse Effect* ⟶ GLOBAL WARMING

- The ***greenhouse effect***, when functioning "normally", keeps our planet warm. Natural gases in the atmosphere form a blanket which allows sunlight the reach the earth's surface, but prevents heat from escaping (*much like the glass in a* ***greenhouse***). This blanket of gases traps heat close to the surface of the earth and ***warms*** the atmosphere.

- This warming of the earth's atmosphere is called GLOBAL WARMING.

(1) Greenhouse Gases:

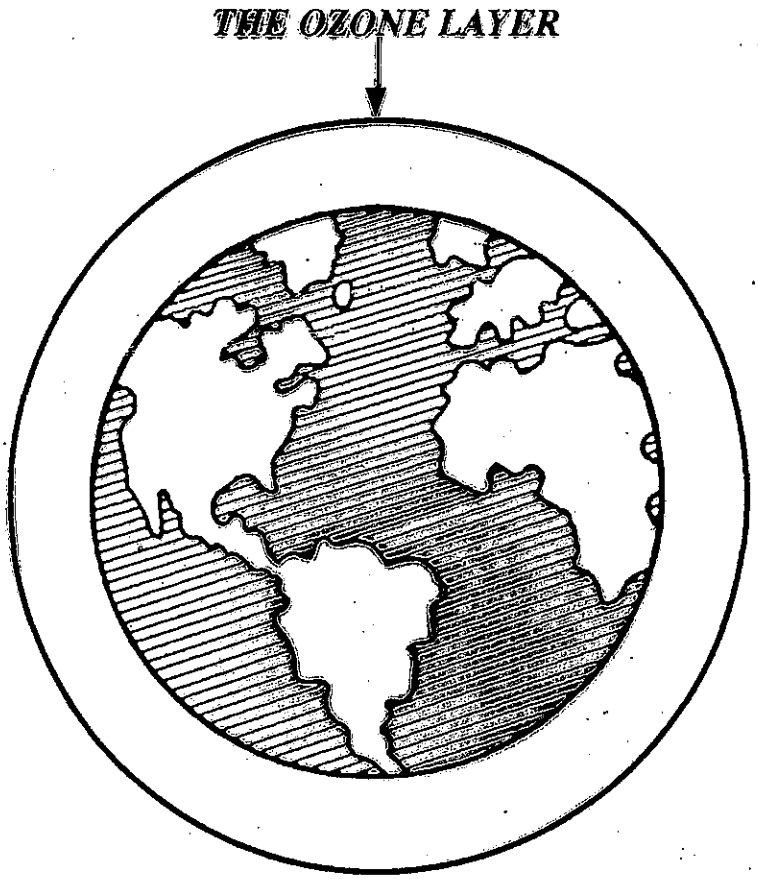
a) CARBON DIOXIDE

- mostly produced from the burning of FOSSIL FUELS and the destruction of TROPICAL RAIN FORESTS.

- Examples of ***fossil fuels*** include: OIL (COAL) GASOLINE

3. *Ozone Depletion*

- The OZONE LAYER is a thin, invisible layer of gas located high up in the sky above the air we breathe.
- The ozone layer PROTECTS life on earth by blocking out the harmful ULTRAVIOLET RADIATION (*U-V Rays*) from the SUN.



(1) How it happens?

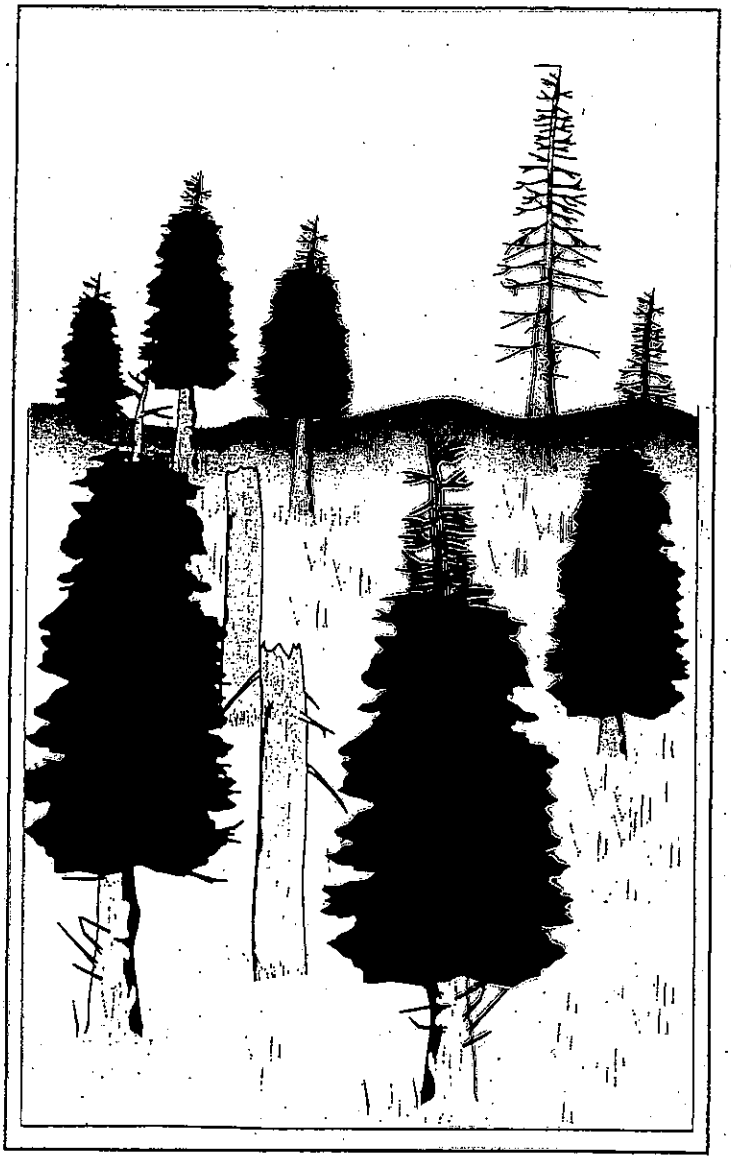
- The ***ozone layer*** is being destroyed by gases people have made. These gases are called CHLOROFLOURO CARBONS or CFC's.
- ***Chloroflourocarbons*** float up to the top of the ATMOSPHERE and "eat up" the ozone layer just like little Pac-Men.
- ***Chloroflourocarbons*** are found in: STYROFOAM
  REFRIDGERATORS / AIR COND.
  AEROSOL CANS

4. *Acid Rain*

(1) How it happens?

- The air pollutant SULFUR DIOXIDE (SO_2) produced by the burning of FOSSIL FUELS gets spewed into the air and mixes with the water in the clouds creating ACID RAIN (pH < 7).
- This ***sulfuric acid*** + ***water*** falls back to the earth as ACID RAIN.

Effects of Acid Rain



ACID RAIN: Trees in the Adirondack Mountains are being destroyed by acid rain.

5. *Biomagnification*

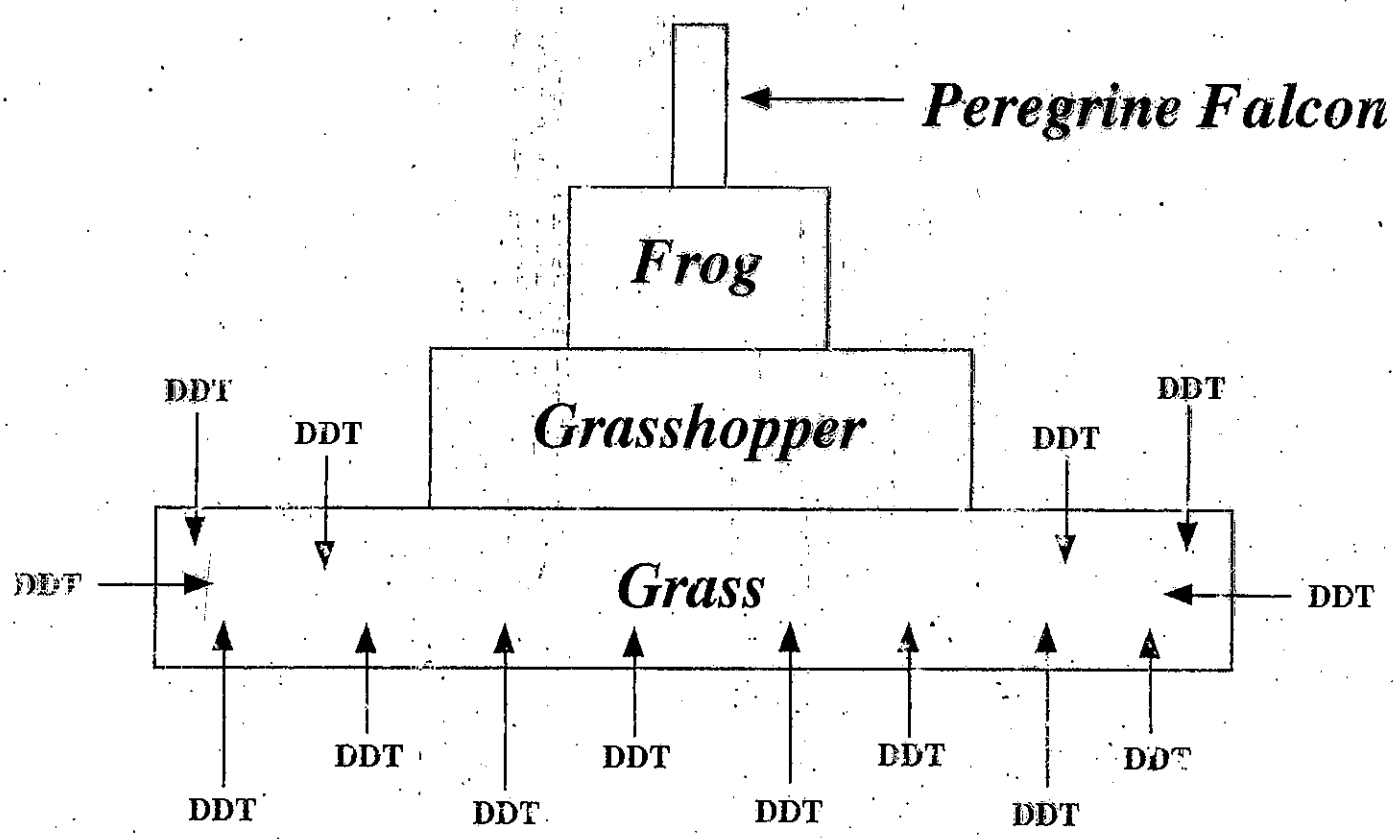
- the INCREASE concentration of POLLUTANTS that occurs as the chemical(s) moves through a food chain and food web.

EXAMPLE: The use of the pesticide DDT in the 1950's.

Grass (0.008 ppm) -----> **Grasshopper** (0.26 ppm) -----> **Frog** (4.46 ppm) -----> **Peregrine Falcon** (23.7 ppm)

Notice how the amount of DDT is *magnified* as it passes through the food chain.

WHY?



- The pesticide DDT enters the food chain at the PRODUCER level by the simple process of DIFFUSION. Once in the FOOD CHAIN, the concentration of DDT INCREASES because the number of organisms at each TROPHIC level DECREASES -----> *PYRAMID of NUMBERS*