ECOLOGY

Ecology:

- the study of the interactions of living things with each other and their physical environment

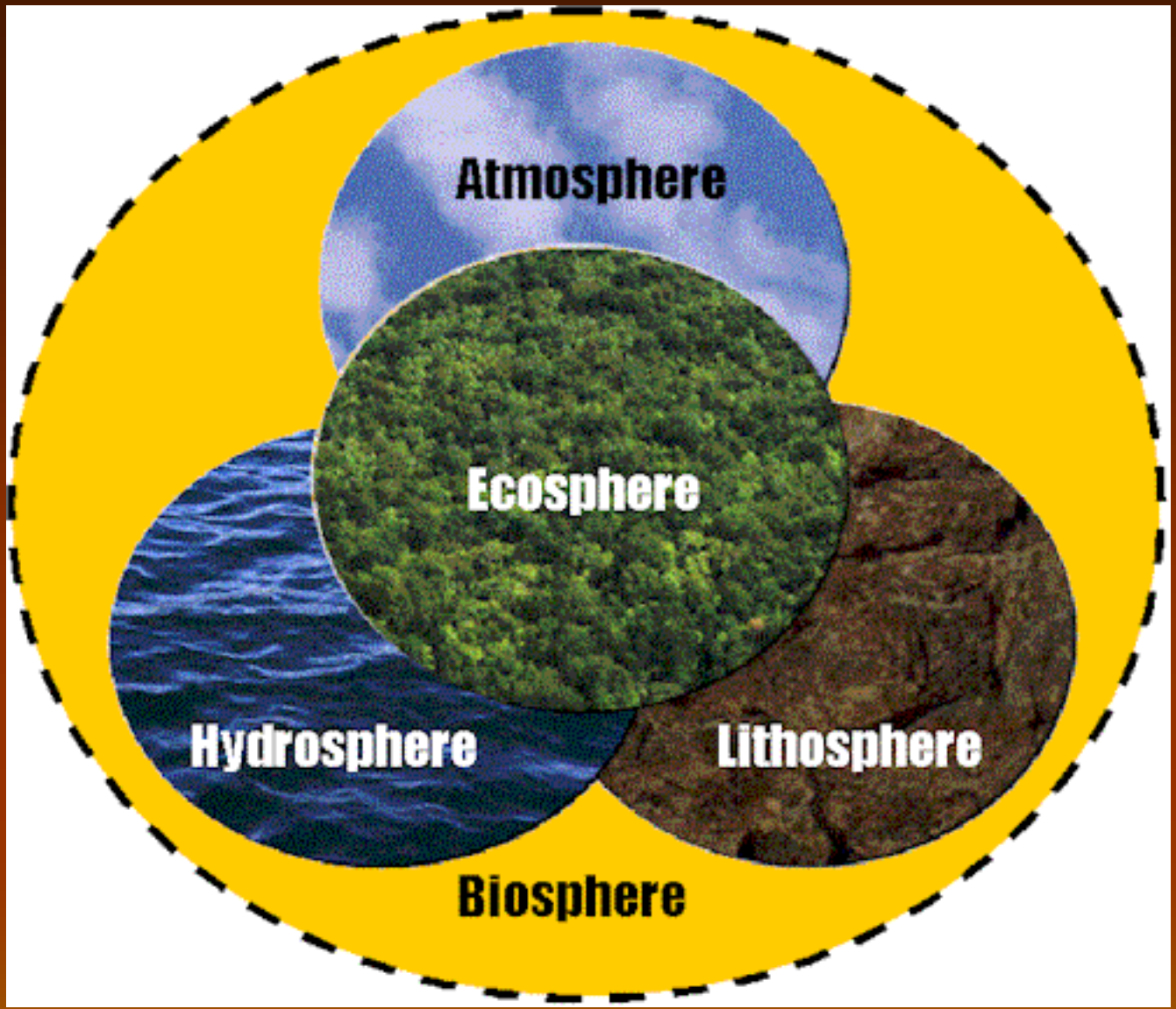
Ecological Organization:

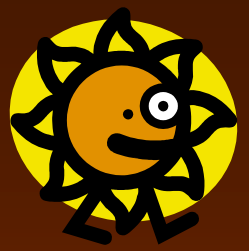
1. Population: all the members of a species inhabiting a given location
2. Community: all the interacting populations in a given area
3. Ecosystem: the living community and the physical environment functioning together as an independent and relatively stable system

4. Biosphere: that portion of the earth where life exists

a. The biosphere is composed of numerous complex ecosystems.

b. An ecosystem involves interactions between abiotic (physical) and biotic (living) factors. The members of the community in the ecosystem and environment must interact to maintain a balance.

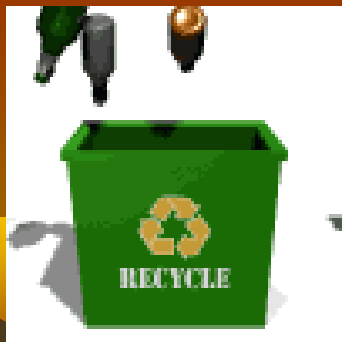

Atmosphere
Ecosphere
Hydrosphere
Lithosphere
Biosphere



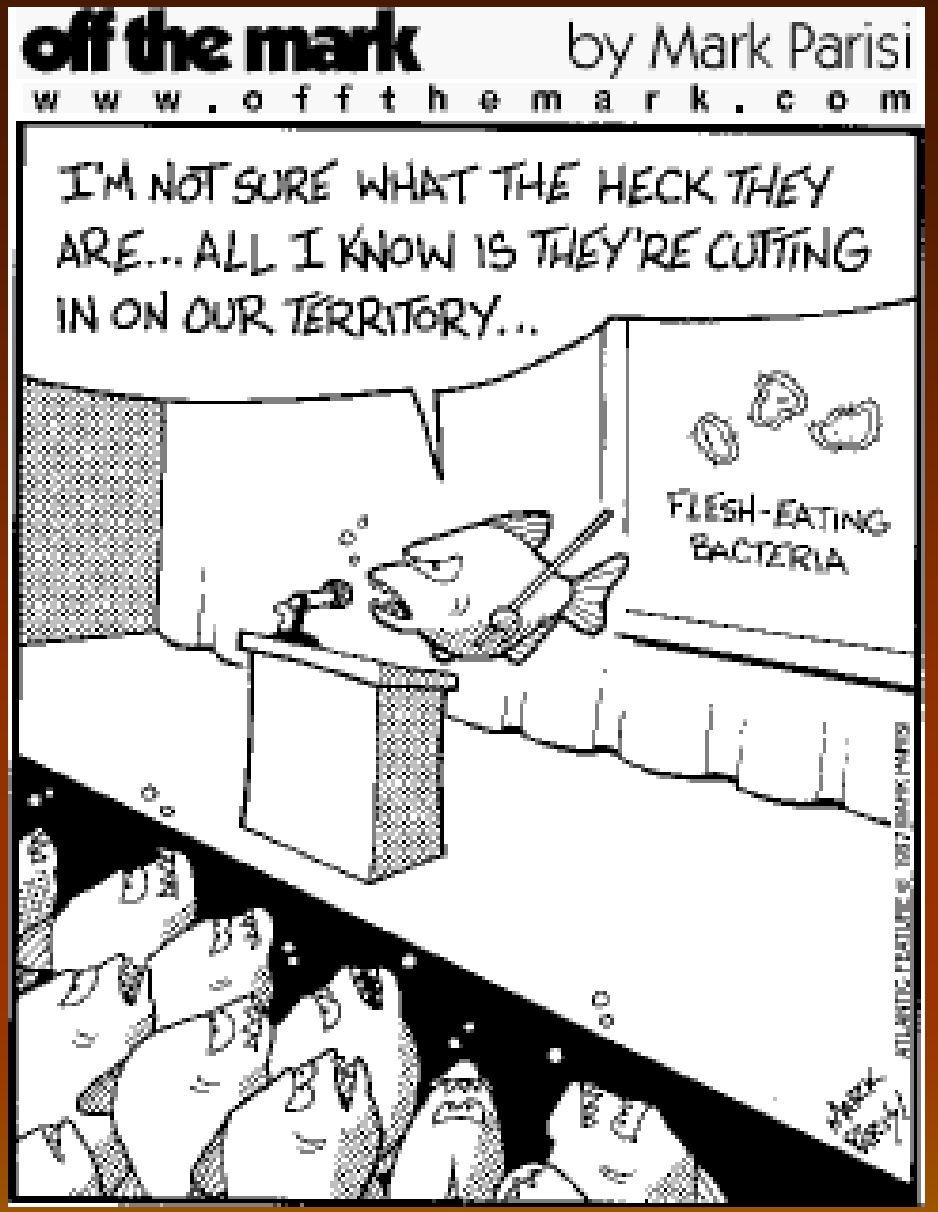
An ecosystem is self-sustaining if the following requirements are met:

1. A constant source of energy and a living system capable of incorporating this energy into organic molecules.

2. A cycling of materials between organisms and their environment.



- In all environments, organisms with similar needs may compete with each other for resources, including food, space, water, air, and shelter.



Abiotic and Biotic

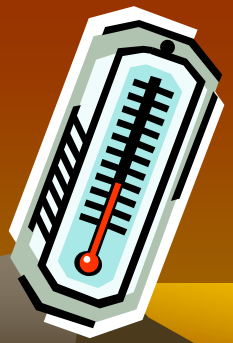
- http://videos.howstuffworks.com/discovery/30139-assignment-discovery-tropical-ecosystem-video.htm

Abiotic factors:

- those physical and chemical factors which affect the ability of organisms to survive and reproduce

Some Abiotic Factors:

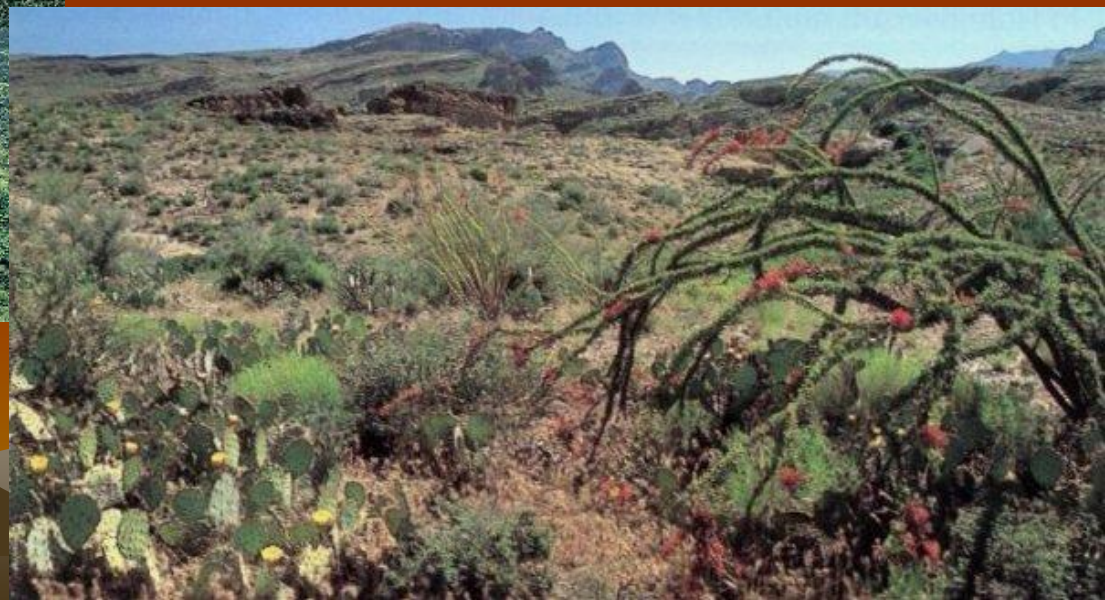
1. intensity of light
2. range of temperatures
3. amount of moisture
4. type of substratum (soil or rock type)
5. availability of inorganic substances such as minerals
6. supply of gases such as oxygen, carbon dioxide, and nitrogen
7. pH



** Each of the prior listed abiotic factors varies in the environment and, as such, may act as a limiting factor, determining the types of organisms that exist in that environment.

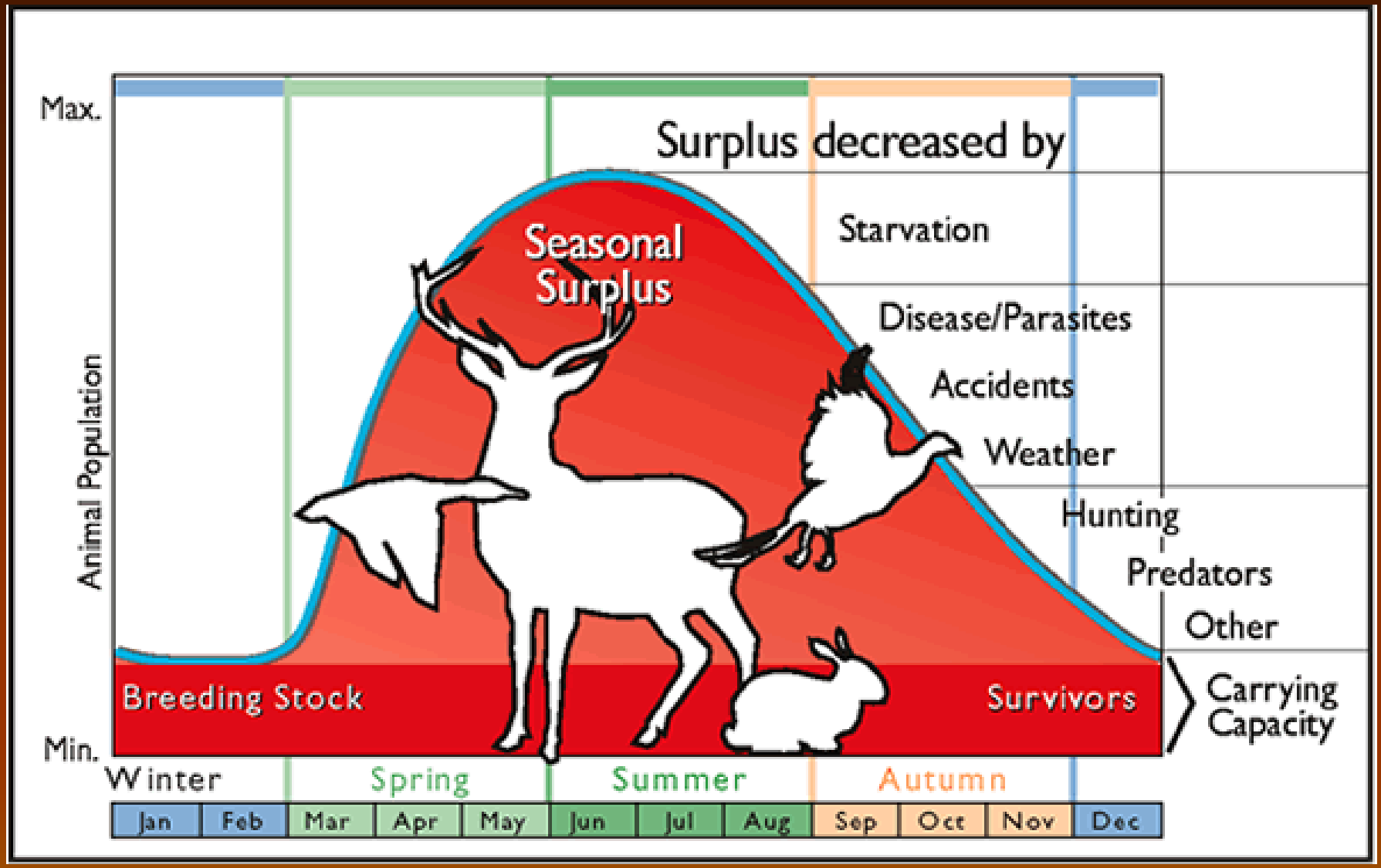
Some examples:

1. A low annual temperature common to the northern latitudes determines in part the species of plants which can exist in that area.
2. The amount of oxygen dissolved in a body of water will help determine what species of fish live there.
3. The dry environment of desert regions limits the organisms that can live there.



Carrying Capacity

- the maximum number of organisms the resources of an area can support
- The carrying capacity of the environment is limited by the available abiotic and biotic resources, as well as the ability of ecosystems to recycle the residue of dead organisms through the activities of bacteria and fungi.


Max.
Min.
Animal Population
Surplus decreased by
Seasonal Surplus
Starvation
Disease/Parasites
Accidents
Weather
Hunting
Predators
Other
Breeding Stock
Survivors
Carrying Capacity
Winter
Spring
Summer
Autumn
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

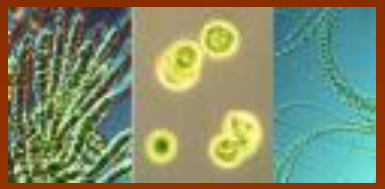
- Steady State - this occurs when the population remains relatively constant over a number of years.
  - This will occur when the number of births equals the number of deaths.

Biotic factors:

- all the living things that directly or indirectly affect the environment
- ** Thus, the organisms, their presence, parts, interaction, and wastes are all biotic factors.

Nutritional Relationships:

A. Autotrophs: can synthesize their own food from inorganic compounds and a usable energy source



B. Heterotrophs: can NOT synthesize their own food and are dependent on other organisms for their food


Types of Heterotrophs:

Saprophytes: include those heterotrophic plants, fungi, and bacteria which live on dead matter - AKA decomposers

Herbivores: plant-eating animals

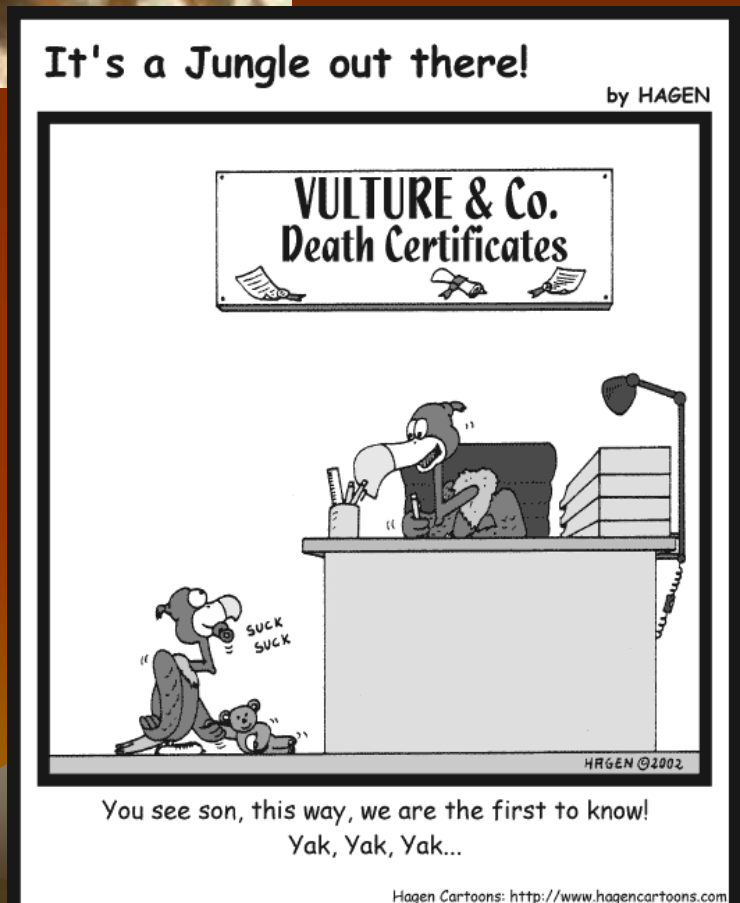
Carnivores: meat-eating animals

Omnivores: consume both plants and meat

Types of Carnivores:

- Predators: animals which kill and consume their prey

- Scavengers: those animals that feed on other animals that they have not killed



Symbiotic Relationships:

- Symbiosis: living together with another organism in close association
- Types of (symbiosis):

MUTALISM

PARASITISM

COMMENSALISM

1. Commensalism: one organism is benefited and the other is unharmed

   ex. barnacles on whales, orchids on tropical trees

2. Mutualism: both organisms benefit from the association

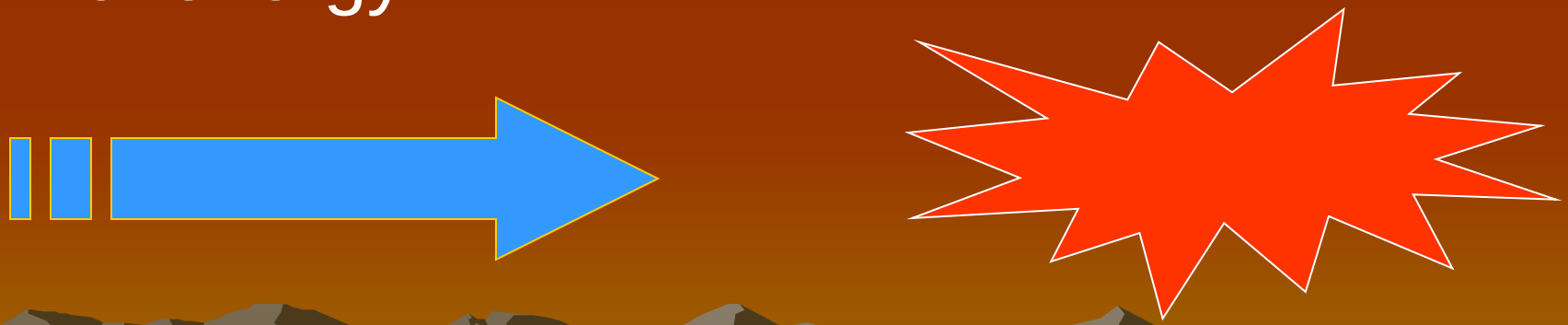
ex. nitrogen-fixing bacteria on legume nodules, certain protozoa within termites (also ruminants)

3. Parasitism: the parasite benefits at the expense of the host

ex. athlete's foot fungus on humans, tapeworm and heartworm in dogs

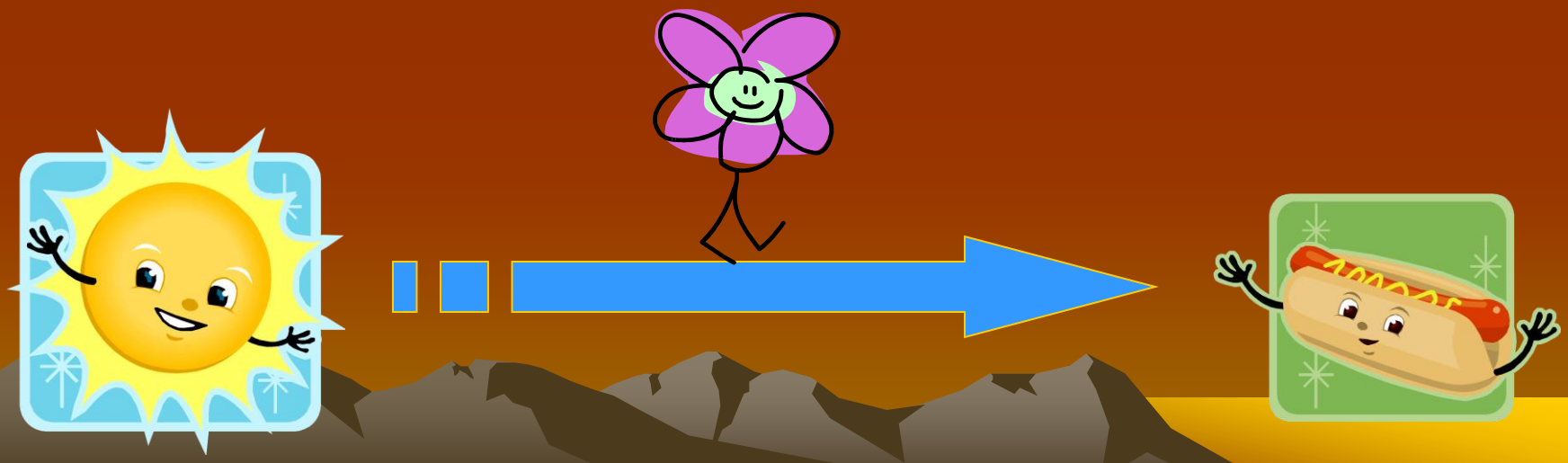
Food Chains and Webs:

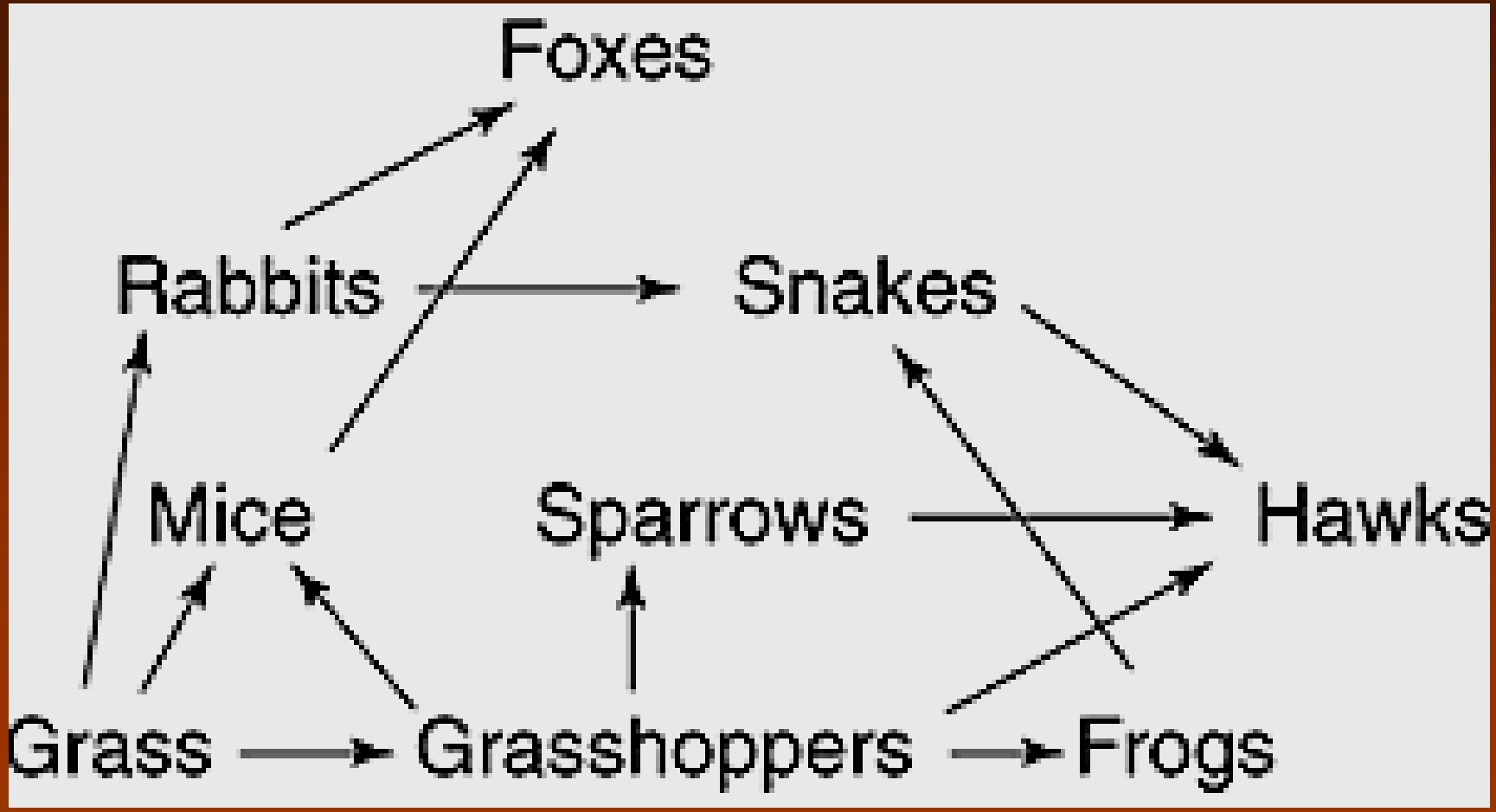
- If an ecosystem is to be self-sustaining it must contain a flow of energy.
- Those life activities that are characteristic of living organisms require an expenditure of energy.



- The pathways of energy through the living components of an ecosystem are represented by food chains and food webs.

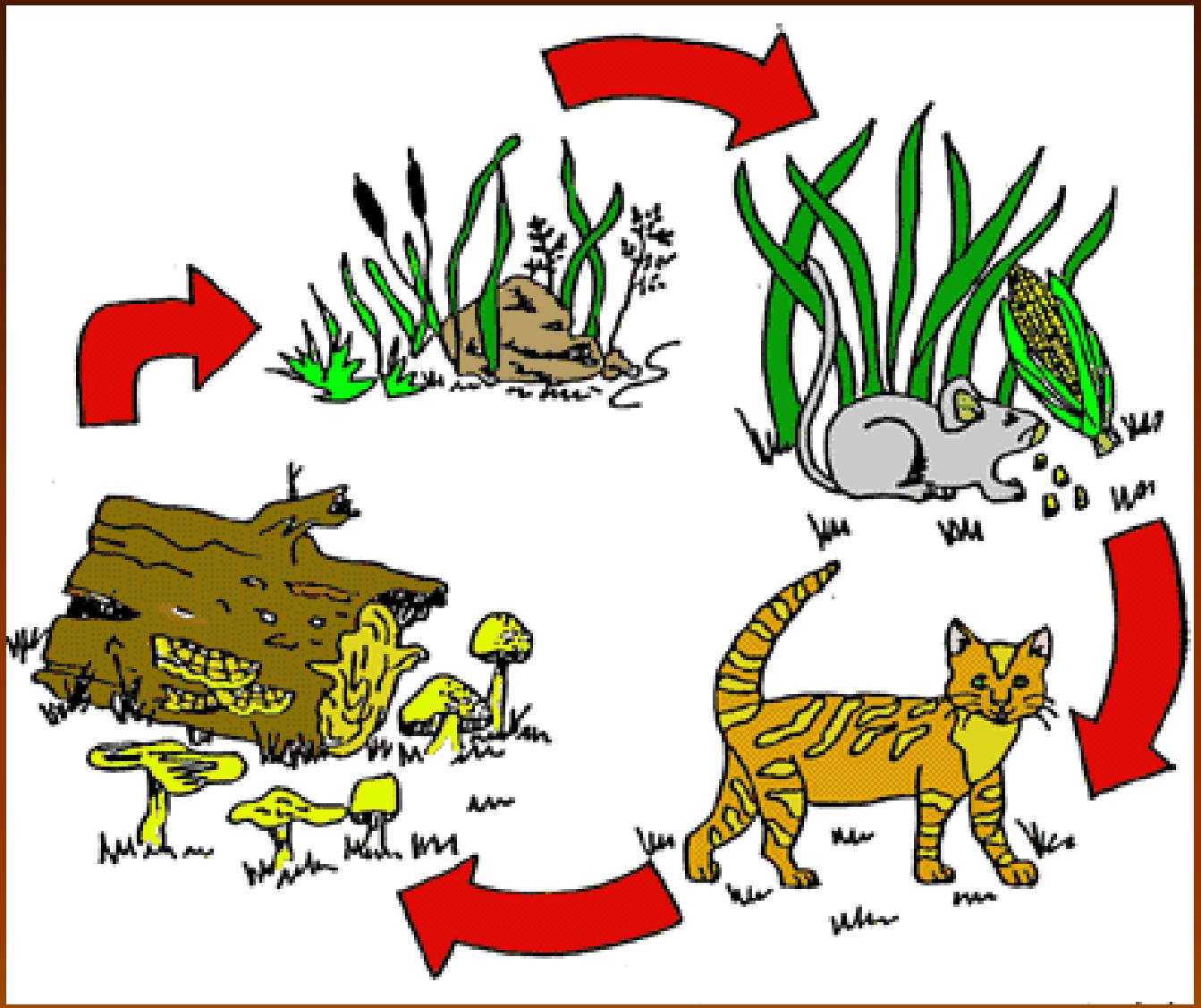
- Producers convert the radiant energy of the sun into the chemical energy of food.




Foxes
Rabbits
Snakes
Mice
Sparrows
Hawks
Grass
Grasshoppers
Frogs

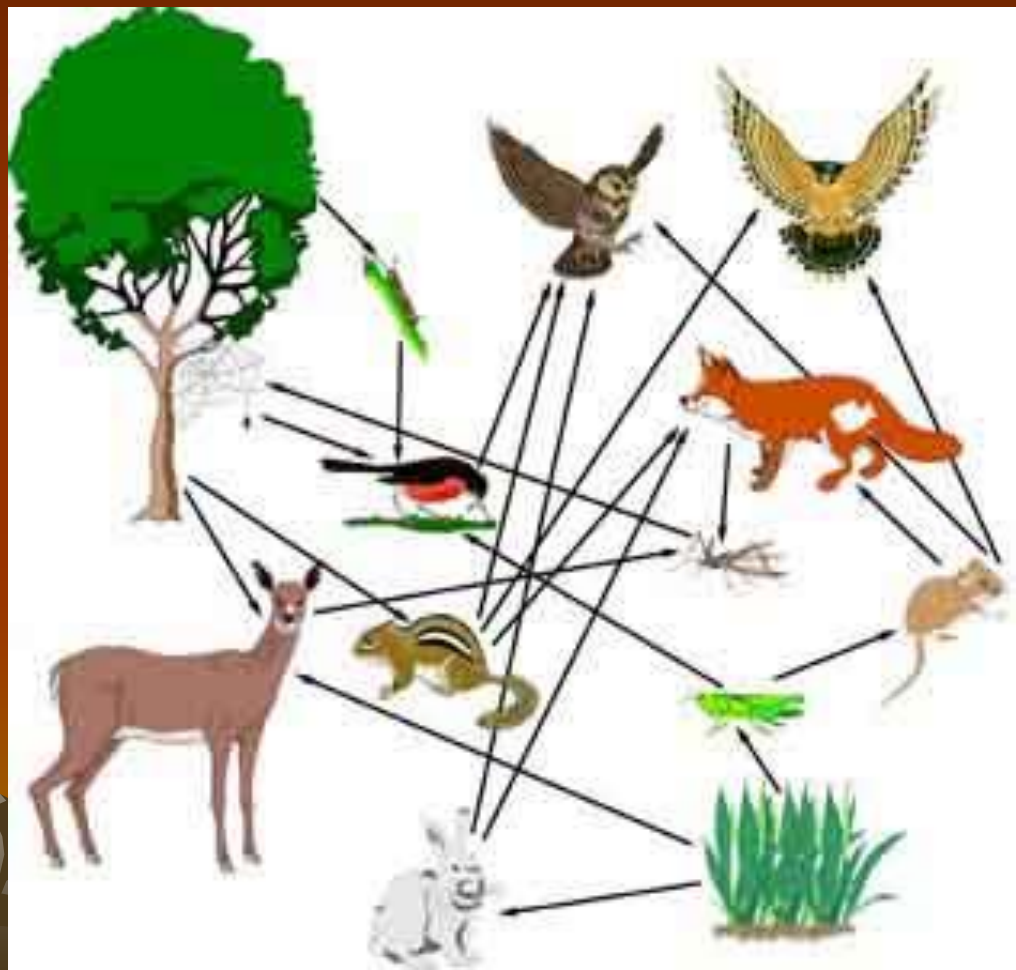
A. Food chain: involves the transfer of energy from green plants through a series of organisms with repeated stages of eating and being eaten

B. Food web: In a natural community, the flow of energy and materials is much more complicated than illustrated by any one food chain.

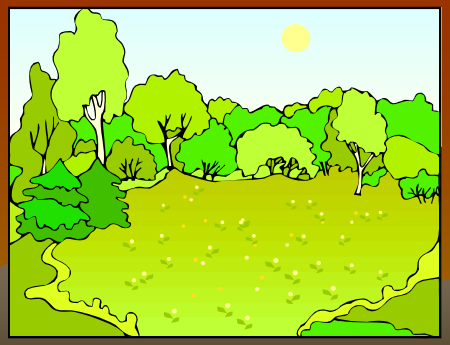


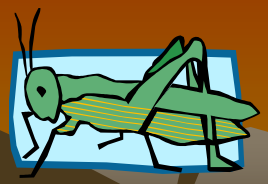
FOOD CHAIN

- Since practically all organisms may be consumed by more than one species, many interactions occur along the food chains of any community.

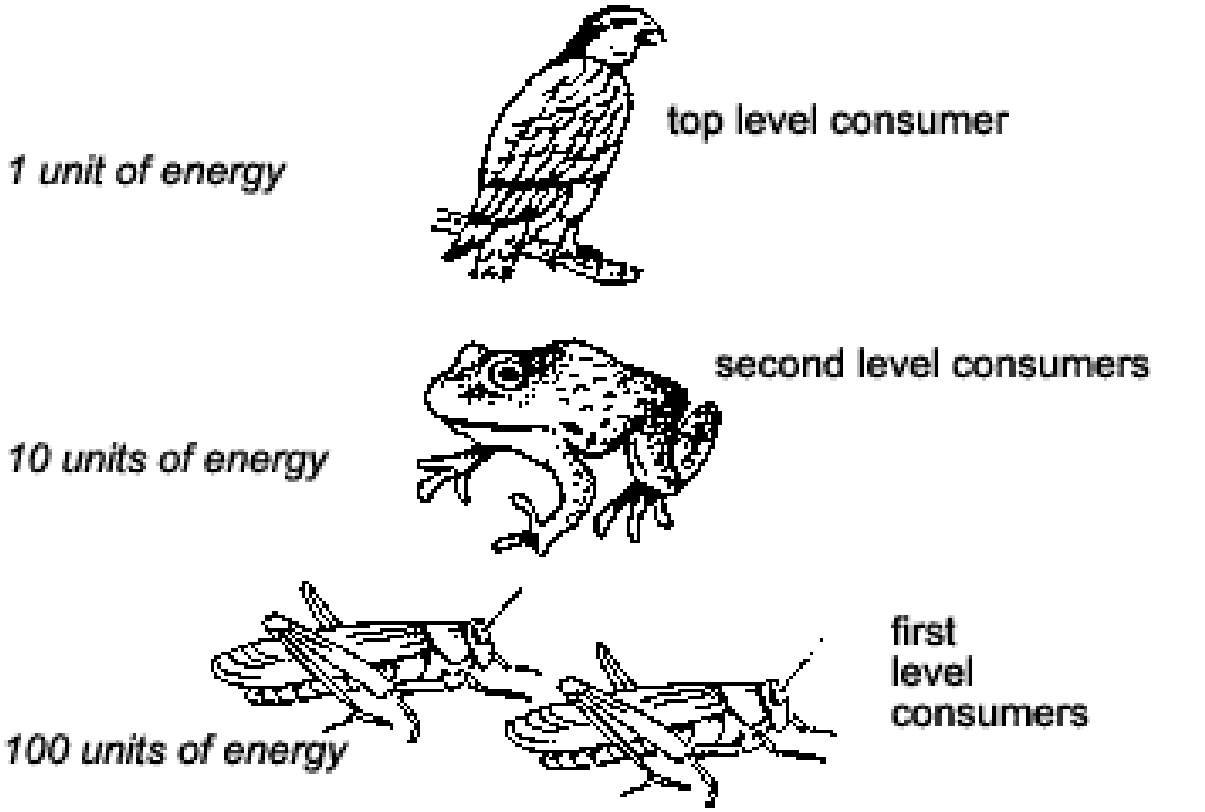


The transfer of energy from the sun to producer to primary consumer then to higher order consumers can be shown in a FOOD CHAIN.

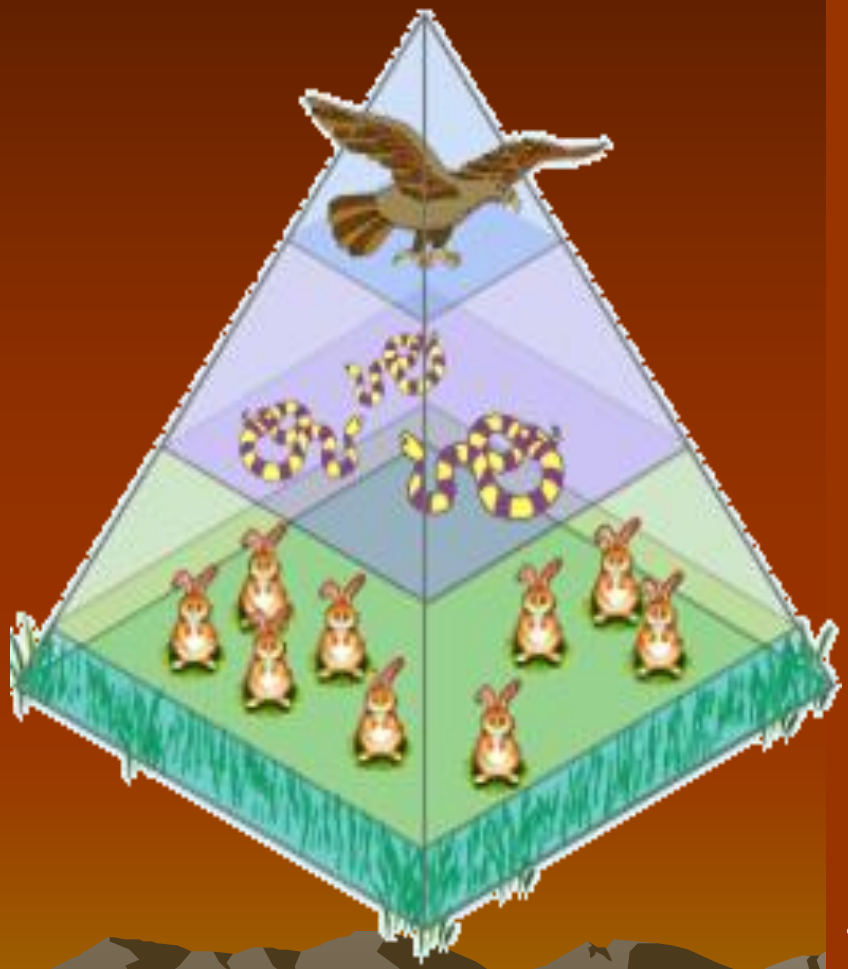




Food Chains Show Available

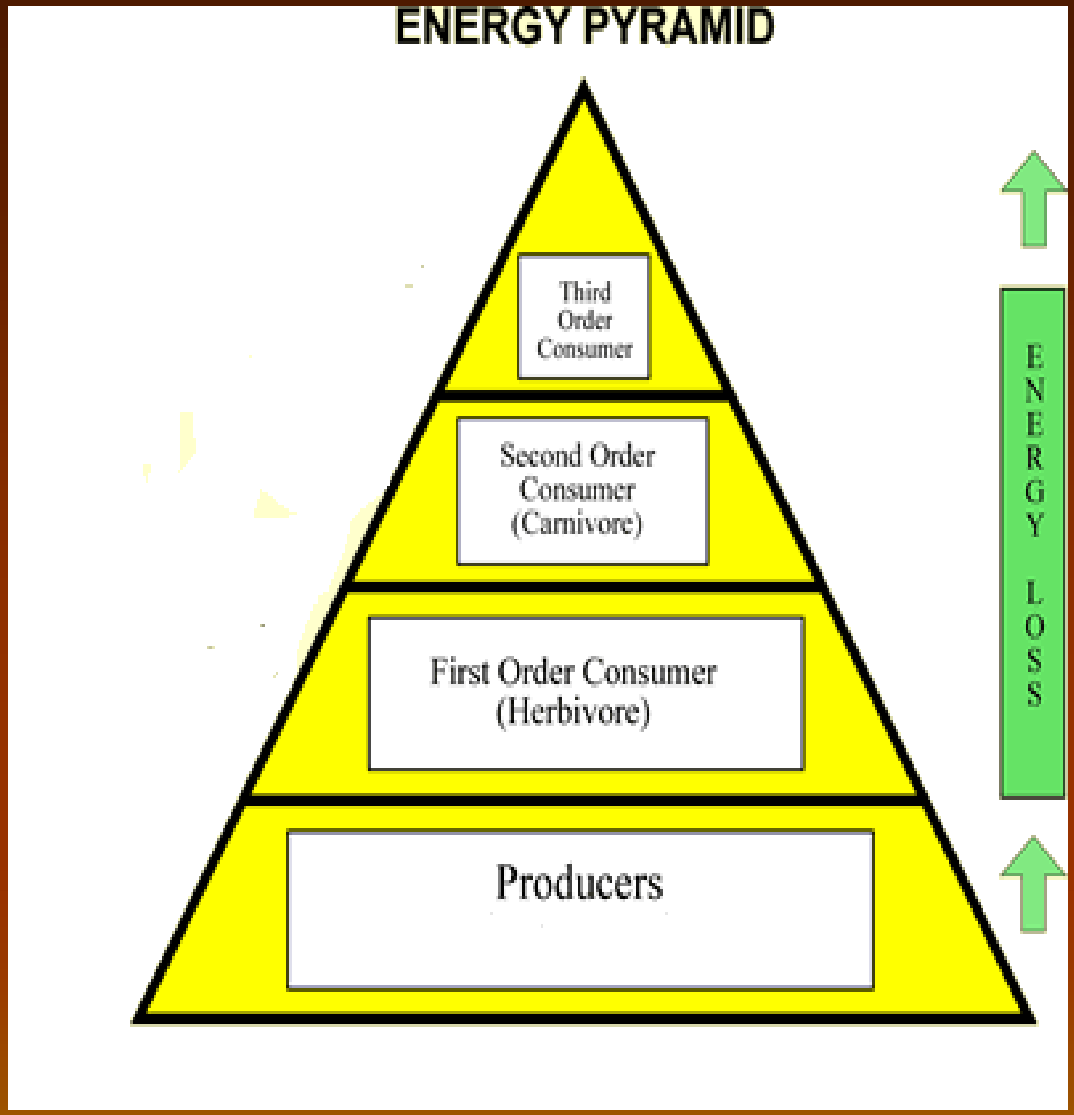


Energy Pyramids Show



- Amount of available energy decreases for higher consumers
- Amount of available energy decreases down the food chain
- It takes a large number of producers to support a small number of primary consumers
- It takes a large number of primary consumers to support a small number of secondary consumers

More Food Chains

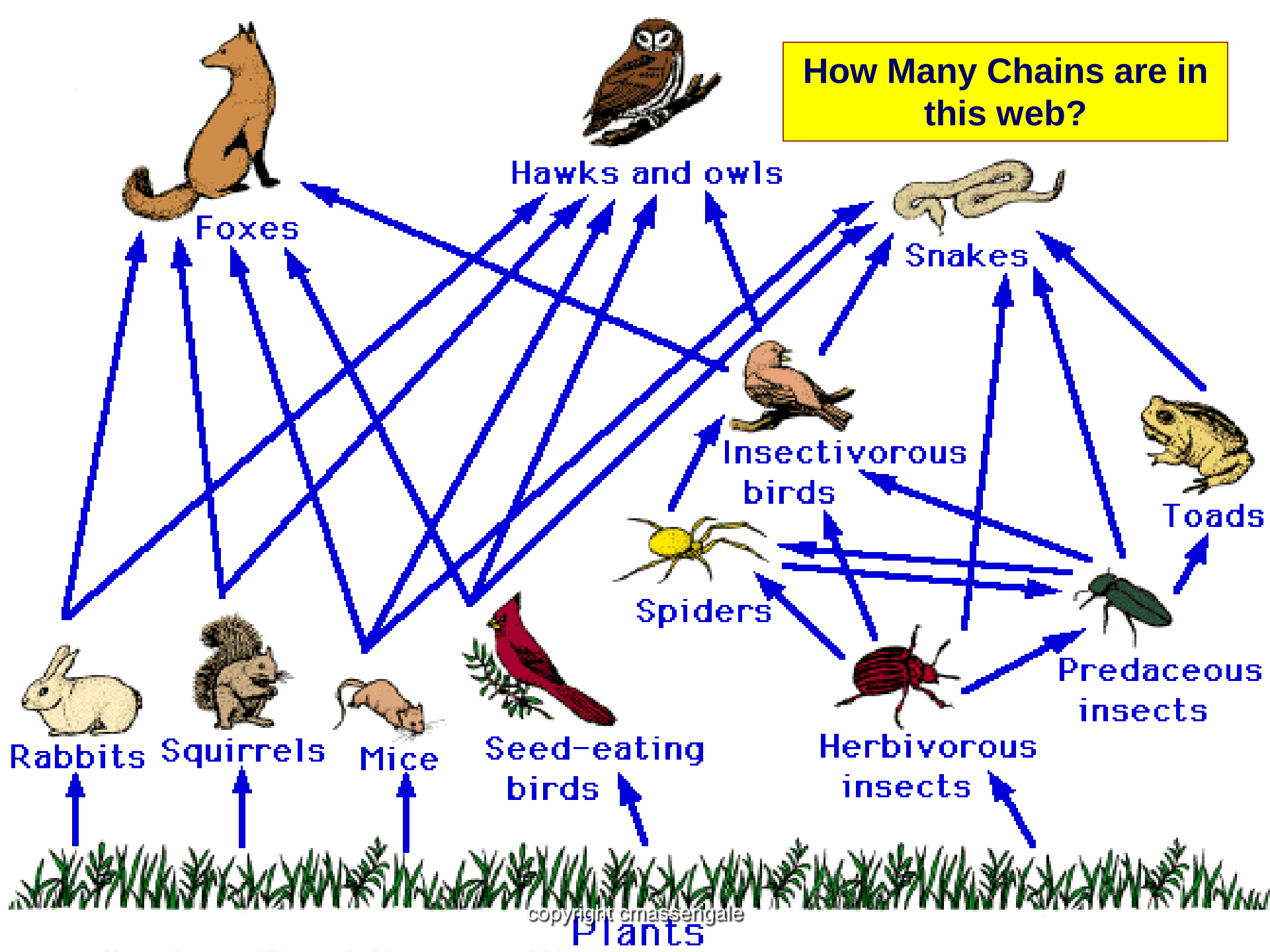


Another way of showing the transfer of energy in an ecosystem is the

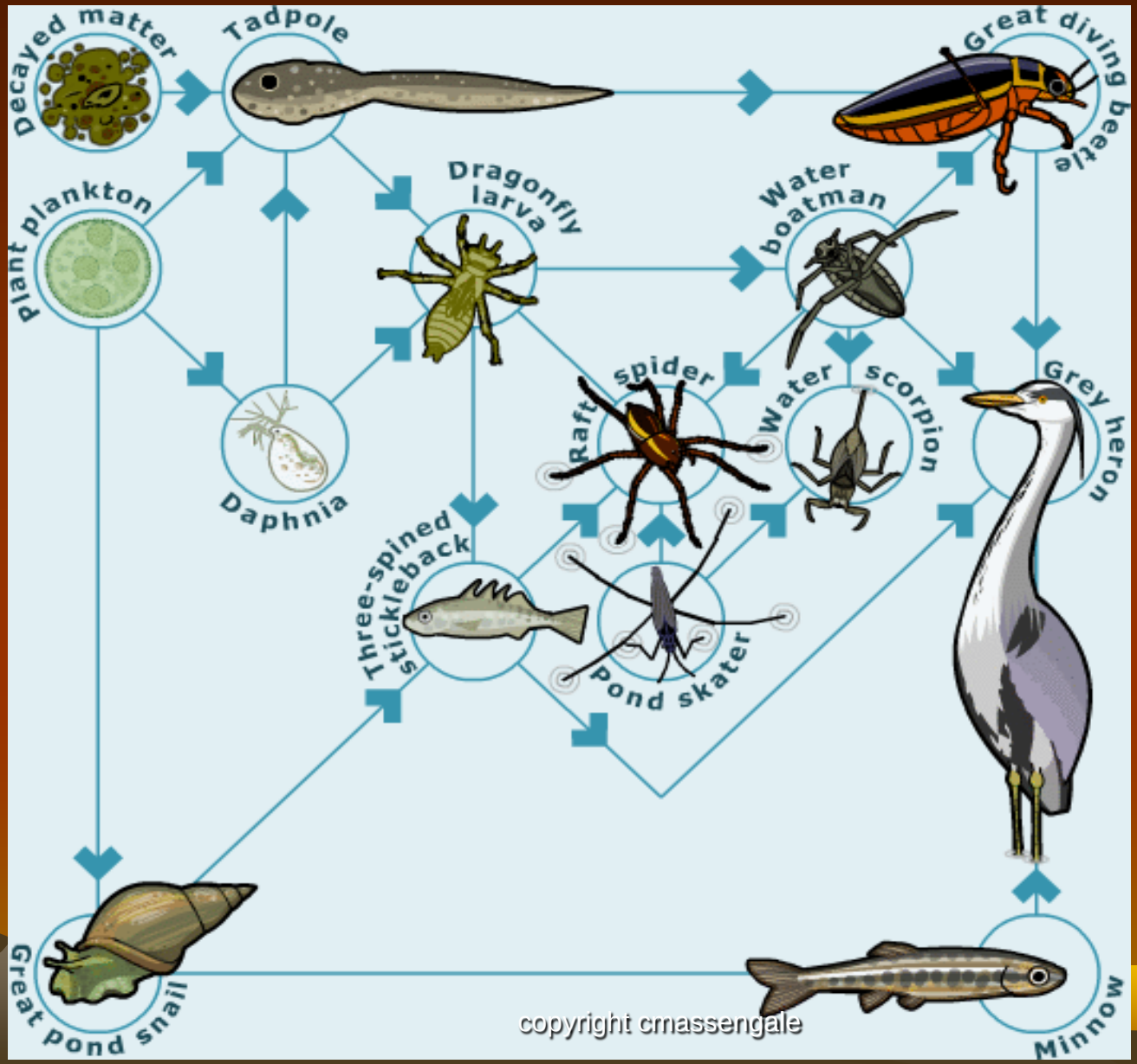
ENERGY PYRAMID

Food Webs:

- Are interconnected food chains
- They show the feeding relationships in an ecosystem


How Many Chains are in this web?
Hawks and owls
Foxes
Snakes
Insectivorous birds
Toads
Spiders
Predaceous insects
Rabbits
Squirrels
Mice
Seed-eating birds
Herbivorous insects
Plants
copyright cmassengale

Identify the Producers, Consumers, & Decomposers:

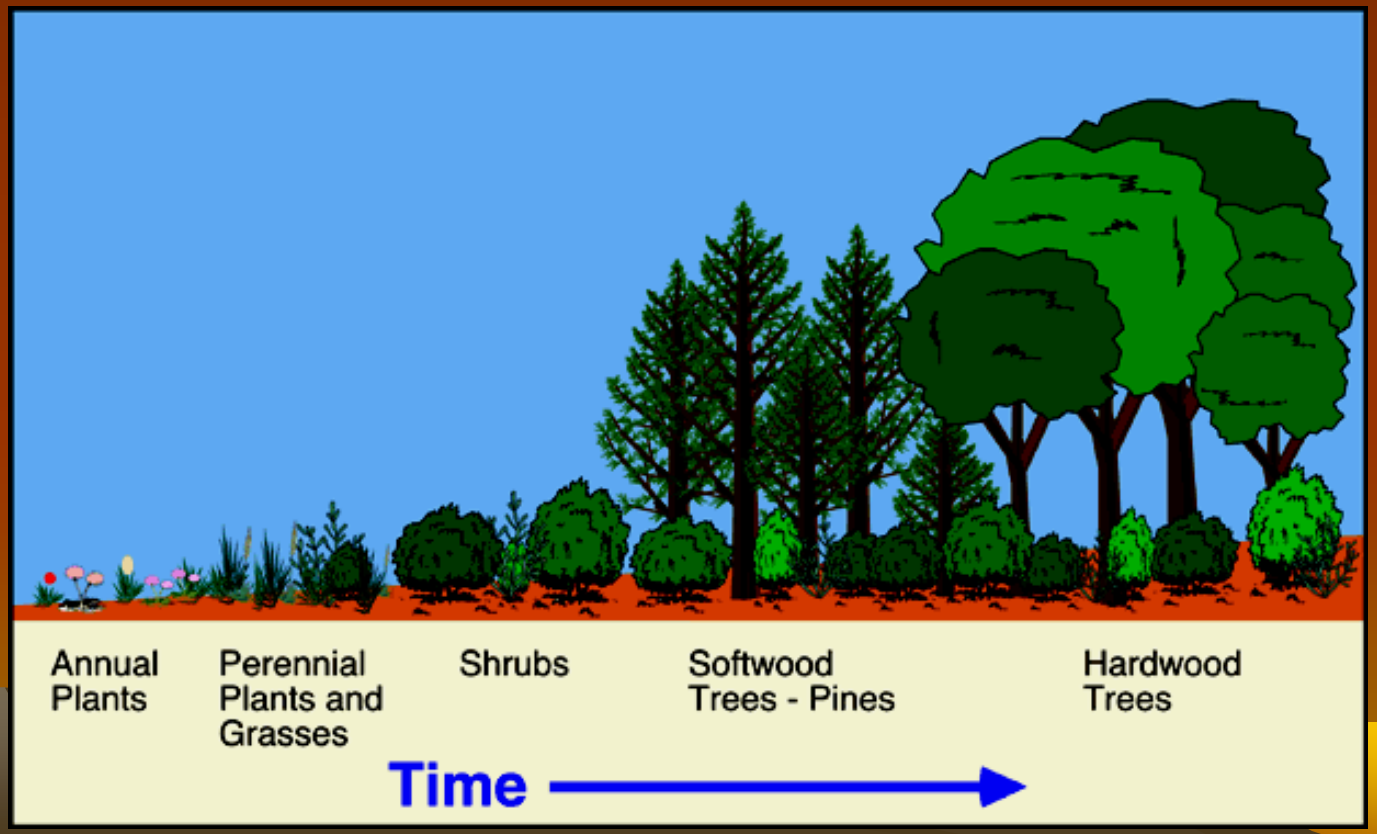


Count the Food Chains!

Succession:

- replacement of populations in habitat as it moves toward a stable state

  (determined by changes in plants)



- The environment may be altered in substantial ways through the activities of organisms, including humans, or when the climate changes.

- Although these alterations are sometimes abrupt (ex. Natural disasters), in most cases species replace others, resulting in long-term gradual changes in ecosystems.

- Ecosystems tend to change with time until a stable system is formed.

- The type of ecosystem that is formed depends on the climatic limitations of a given geographical area.

- ** Each community modifies its environment, often making it more difficult for itself and, apparently, more favorable for the following community which infiltrates the first community over a period of years.

- Primary Succession: the development of plant communities on newly formed habitats that previously lacked plants (ex. a lava flow)

An example of a PRIMARY SUCCESSION

- – Community change on land that has had no previous community present
- e.g., previously under water or ice for a long time, formed volcanically
- water plants at pond edge
- sedges and sediments begin to fill pond
- sphagnum moss and bog shrubs fill pond

- Secondary Succession: return of an area to its natural vegetation following a disruption or removal of the original climax community

An example of a SECONDARY SUCCESSION

1. plowed field
2. annual grasses
3. shrubs and briers
4. cherries, alders, and birches
5. climax community –

- Community change after an extant community has been removed, by man or natural catastrophe
- e.g., abandoned farm land, after fire
- Soil seed bank remains

Climax Community

- a self-perpetuating community in which populations remain stable and exist in balance with each other and their environment

- ** The climax community of a region is always its dominant plant species.

- Altered ecosystems may reach a point of stability that can last for hundreds or thousands of years.
- A climax community persists until a catastrophic change of a major biotic or abiotic nature alters or destroys it.

- (ex. forest fires, abandoned farmlands, floods, areas where the topsoil has been removed)

- After the original climax community has been destroyed, the damaged ecosystem is likely to recover in stages that eventually result in a stable system similar to the original one.
- Ponds and small lakes, for example, fill in due to seasonal dieback of aquatic vegetation and erosion of their banks, and eventually enter into a terrestrial succession terminating in a terrestrial climax community.
- FLORA - plant species - dominate in the sense that they are the most abundant food sources

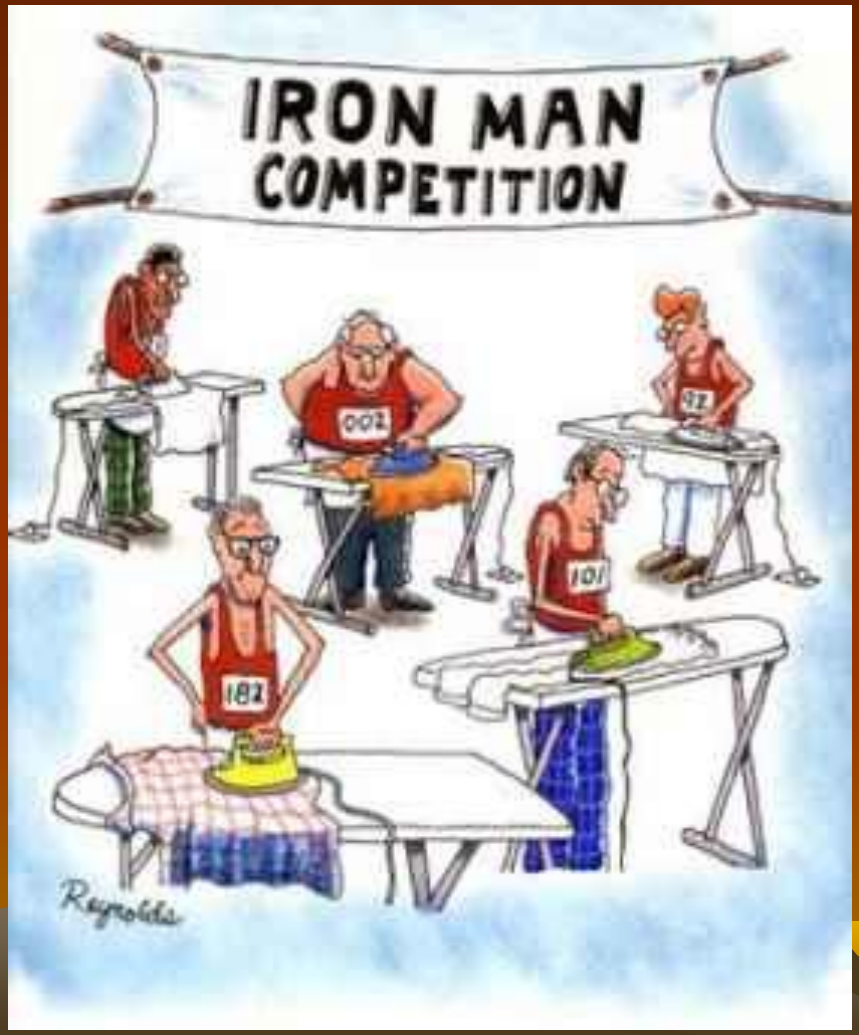
- ** Plant succession is a major limiting factor for animal succession.

- Animal Succession- as the plant community changes so will the animals

- ** Climax communities are identified by the dominant plant species -- the one that exerts the most influence over the other species present.

- Competition: occurs when two different species or organisms living in the same environment (habitat) utilize the same limited resources, such as food, water, space, light, oxygen, and minerals.

- ** The more similar the requirements of the organisms involved, the more intense the competition.



Competitive Exclusion Principle

- If two different species compete for the same food source or reproductive sites, one species may be eliminated.
- This establishes one species per niche in a community.

- Niche (Job): the organism's role in the community, particularly its role in relation to food with other species.

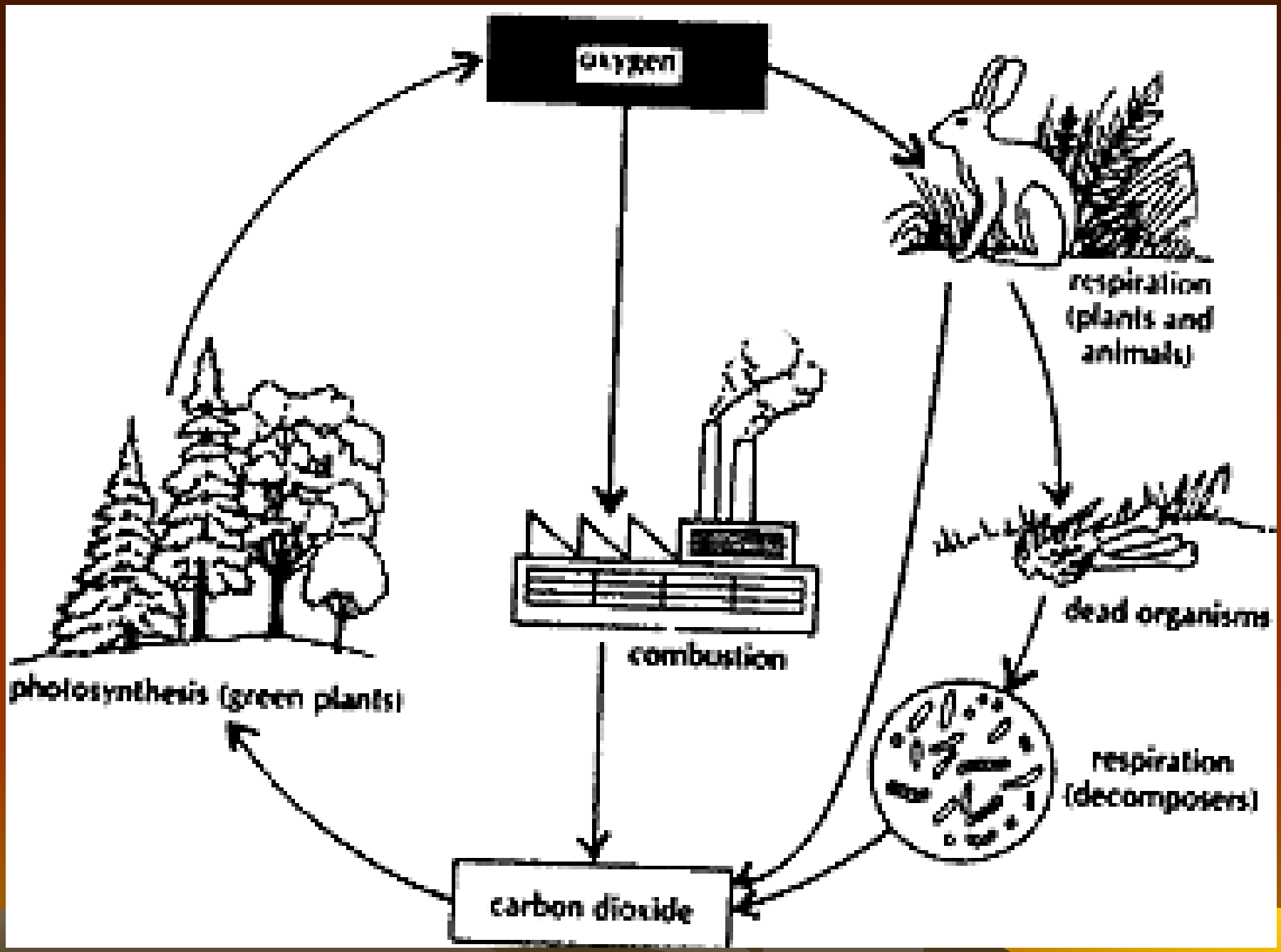
What is a Habitat?

- A habitat is a place where a particular animal or plant species lives.
- Habitat - a place where a plant or animal can get the food, water, shelter and space it needs to live.
- An artificial habitat is a man made place.

- Woodpeckers make holes in this cactus to live.
- When the woodpeckers are finished with this housing, the elf owl and the screech owl move in.
- The elf owl eats insects and the screech owl occupies the same habitat, but have different niches.

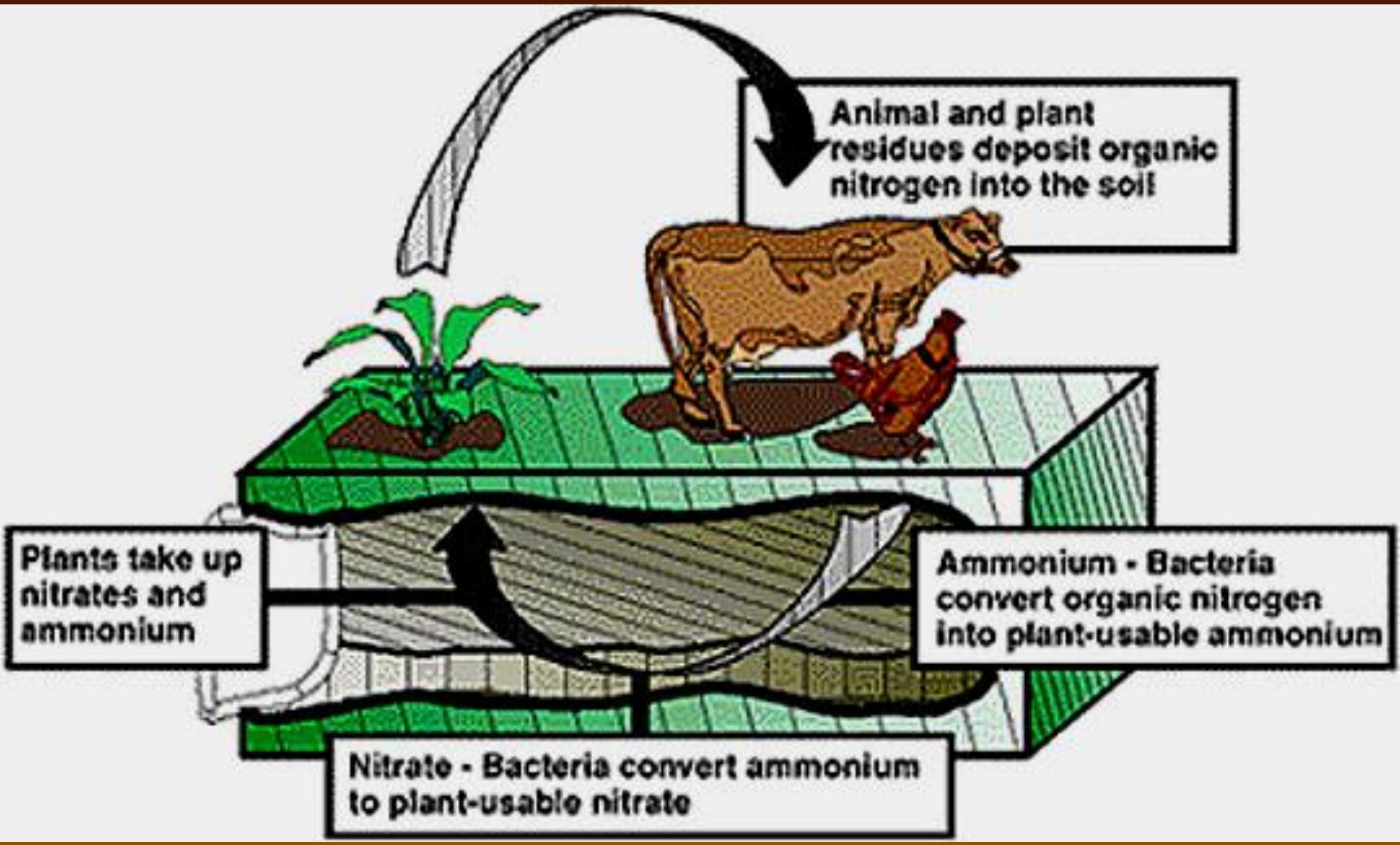
Carbon-Oxygen Cycle

- involves the processes of respiration and photosynthesis.
- In respiration, oxygen and glucose are combined releasing energy and producing water and carbon dioxide.
- In photosynthesis water and carbon dioxide along with the energy from the sun are combined to produce glucose (containing energy) and oxygen.
- Each process compliments the other and the ecosystem maintains its balanced communities.

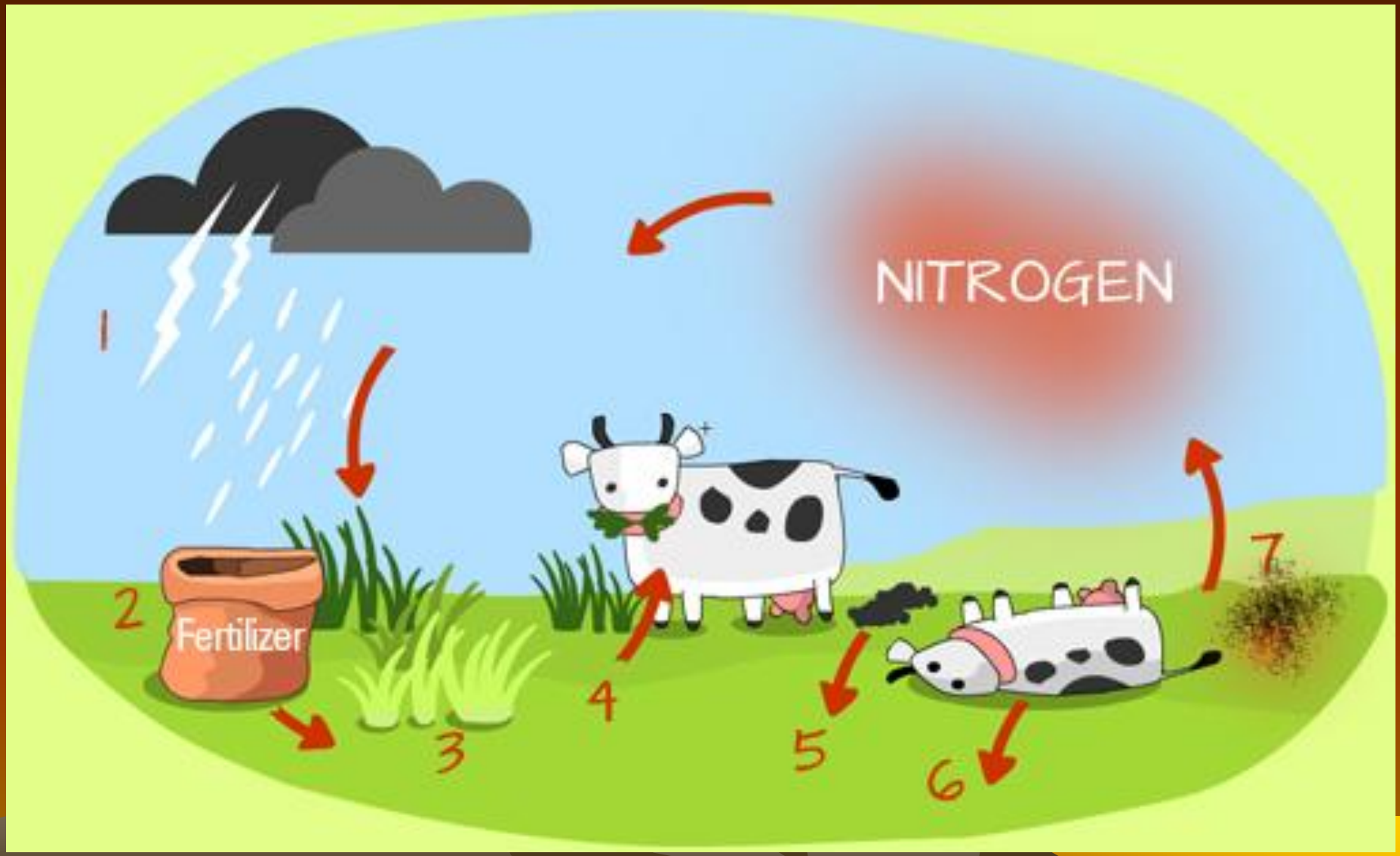

oxygen
respiration (plants and animals)
combustion
dead organisms
photosynthesis (green plants)
respiration (decomposers)
carbon dioxide

Nitrogen Cycle

- Nitrates (used by plants)
- Build plant proteins
- Eaten by animals
- made into animal proteins
- Plants and animals die
- bacteria decay
- Ammonia (NH3)
- Nitrifying Bacteria
- Nitrates (used by plants)


Animal and plant residues deposit organic nitrogen into the soil
Plants take up nitrates and ammonium
Ammonium - Bacteria convert organic nitrogen into plant-usable ammonium
Nitrate - Bacteria convert ammonium to plant-usable nitrate

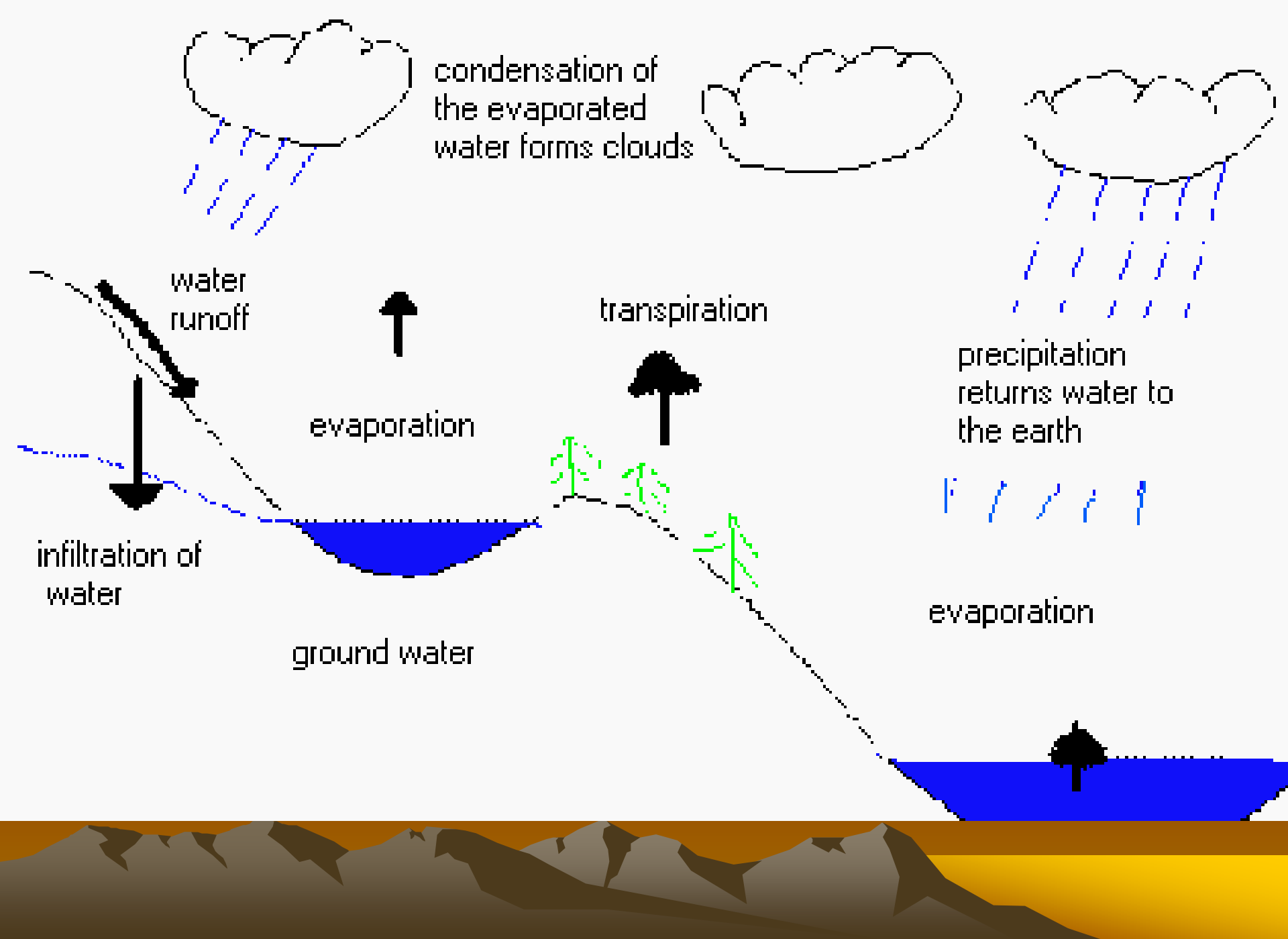
Draw this diagram under Nitrogen Cycle – Leave room to explain each #.



1. Nitrogen is introduced to the soil by precipitation (lightning, rain)
2. Nitrates come from the air. They also come from fertilizer
3. Plants build up protein using ammonia in soil
4. When animals (like cows) eat these plants it builds animal protein
5-6. when animals die, decomposers break them down…nitrates are re-introduced into the soil in the form of ammonia
7. Nitrates are broken down in soil by bacteria and sent to the air as nitrogen

Water Cycle

- involves the processes of photosynthesis, transpiration, evaporation and condensation, respiration, and excretion


condensation of
the evaporated
water forms clouds
water
runoff
evaporation
transpiration
precipitation
returns water to
the earth
infiltration of
water
ground water
evaporation

- Evolutionary processes have resulted in a diversity of organisms and a diversity of roles in ecosystems.

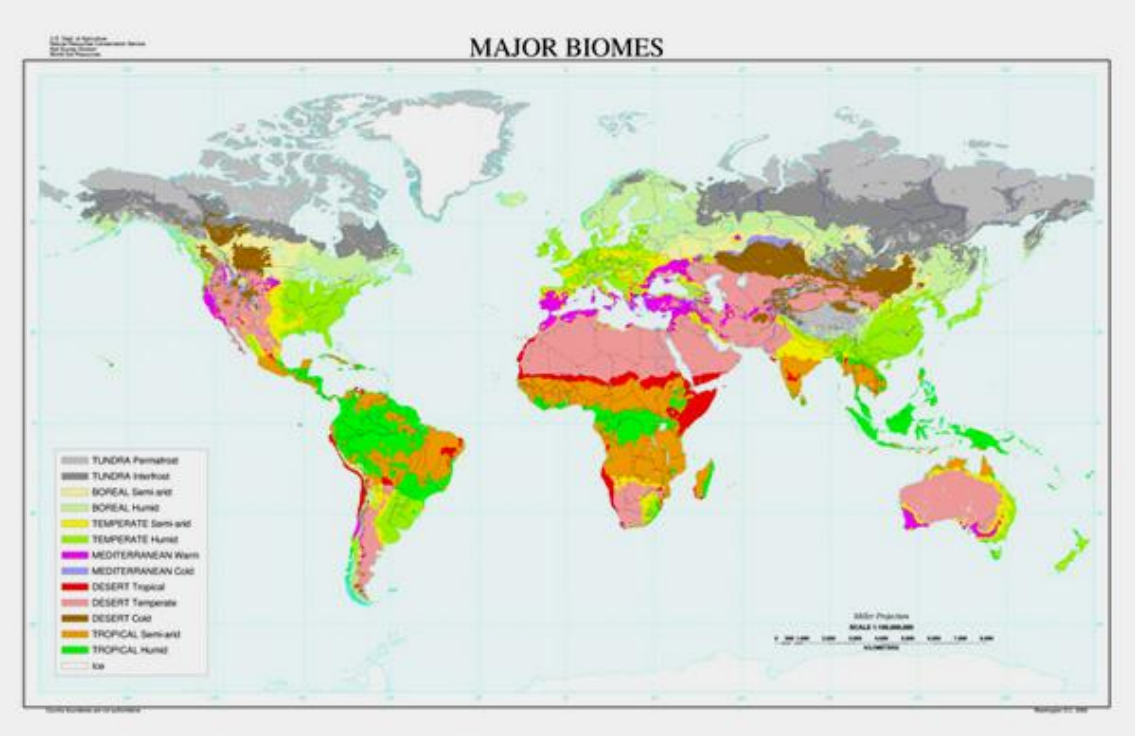
- Biodiversity -- the differences in living things in an ecosystem
- Increased biodiversity increases the stability of an ecosystem.
- Increased biodiversity increases the chance that at least some living things will survive in the face of large changes in the environment.

Biomes

Explore the World Around You!

Biomes of the Earth:

- BIOME - a large geographical community that has a particular type of Climax community (a dominant type of plant (flora) and animal (fauna) life).



Aquatic Biomes

- Aquatic biomes represent the marine ecosystem on Earth

Characteristics:

- Temperatures do not vary as much as land biomes (water absorbs and releases heat)
- Organisms must maintain water balance

There are two types of Aquatic Biomes:

Marine Biomes-Oceans

- Salt water
- Composes 70% of the earths surface
- Contains many different organisms
- Provides most of the earths food nutrients
- Most oxygen is produced here

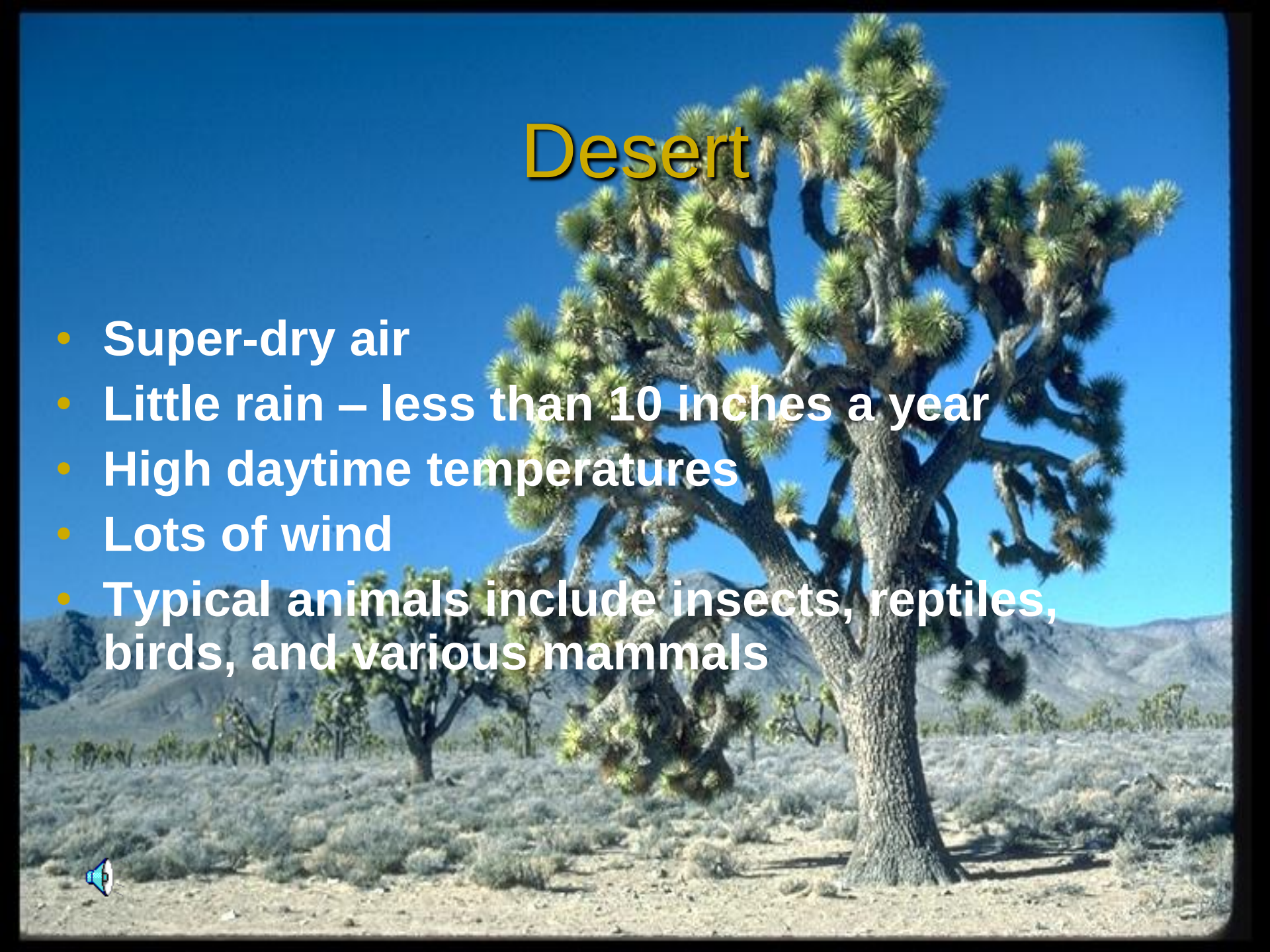
Fresh water Biomes - ponds, lakes, rivers and streams

Which habitats do you recognize?

- Desert
- Rain Forest
- Tundra
- Prairie
- Grassland
- Forest
- Marine
- Zoo

Desert

- Super-dry air
- Little rain – less than 10 inches a year
- High daytime temperatures
- Lots of wind
- Typical animals include insects, reptiles, birds, and various mammals



Rain Forest

- The Rain Forest is made of 3 layers
- The first layer is the canopy
- The second layer is the understory
- The third is the forest floor
- The Rain Forest contains about 45% of all animal species

Tundra

- Extremely short growing seasons (6 to 10 weeks)
- Long, cold, dark winters (6 to 10 months)
- Low Precipitation
- Snow provides insulation
- Wildlife includes birds, reindeer, foxes, bears, seals, and walruses

Prairie

- Temperatures vary summer to winter
- Moderate rain fall
- Seasonal drought and occasional fires
- Typical animal life includes jack rabbits, deer, foxes, coyotes, birds, and many other species

Savannah

- Warm, hot climates
- Major vegetation is grass
- Dry and rainy seasons
- Seasonal fires help maintain balance
- The Savannah is home to various reptiles, rodents, birds, and large mammals such as elephants, and zebras

Forest

- Covers 1/3 of the Earth's area
- Dominated by trees and woody vegetation
- Precipitation is distributed evenly throughout the year
- Animal life includes many things such as bears, deer,and rodents

Marine

- Water covers nearly 75% of the Earth's surface
- There are numerous species of plans and animals who live here.
- These range in size from microscopic organisms to the size of a 100 ft whale.

Coastal Plain

- **The low, flat land of North Carolina's eastern region stretches from the sandy farmland of the Inner Coastal Plain to the state's Outer Banks, a string of barrier islands separated from the mainland by sounds or inlets.**
- **The Outer Banks has three capes -- Cape Hatteras, Cape Lookout, and Cape Fear.**

Piedmont

- **Piedmont is a French word meaning "foot of the mountain," and North Carolina's Piedmont region is sometimes referred to as "the foothills."**
- **The rolling hills of this region range in elevation from just 300 feet in the east to 1,500 feet near the mountains.**
- **The Piedmont is sometimes referred to as a plateau because it is high and mostly flat.**

The Mountains

- **Western North Carolina's majestic landscape features the Blue Ridge Mountains and the Great Smoky Mountains, which help make up the Appalachian Mountains, possibly the oldest mountain range in the United States.**
- **The region is also home to Mount Mitchell. Rising 6,684 feet above sea level, Mount Mitchell is the tallest peak east of the Mississippi River.**
-

The Mountains, cont.

- **The Eastern Continental Divide runs along the top of the Blue Ridge Mountains, separating the rivers flowing east from those flowing west.**
- **Rivers that fall on the eastern side of the divide flow toward the Atlantic Ocean while those on the western side of the divide flow toward the Tennessee and Ohio rivers and into the Gulf of Mexico.**

It's Up To You

- Protect the wonderful world around you!
- Remember each habitat is a unique place where plants and animals make their home.
- We share this Planet with them…….it is not only ours!
- We hold the future of this beautiful Planet in our hands. Our future and our children's and their children's future depends on the environmental choices we make today…..MAKE THE RIGHT ONES!!!!!!

Disruption of Existing Ecosystems

- Urbanization - growth of cities has destroyed land and wetlands ruining natural habitats

- Importation of Organisms - Organisms without any known predators in our area have accidentally been brought to this side of the world.

- Examples: Japanese beetles, Gypsy Moths, Dutch elm disease.
- Since there are now natural enemies for these organisms, they have reproduced at a rapid rate and have caused a lot of damage to plants and crops.

- Poor farming practices - overuse of fields, over grazing by animals and erosion of land.
- When crops are harvested, the plants which contain essential nutrients that should be returned to the soil are also taken away.
- Therefore the ground is less fertile and will eventually not be able to support crops.

- Misuse of Pesticides - The use of pesticides has disrupted food chains.

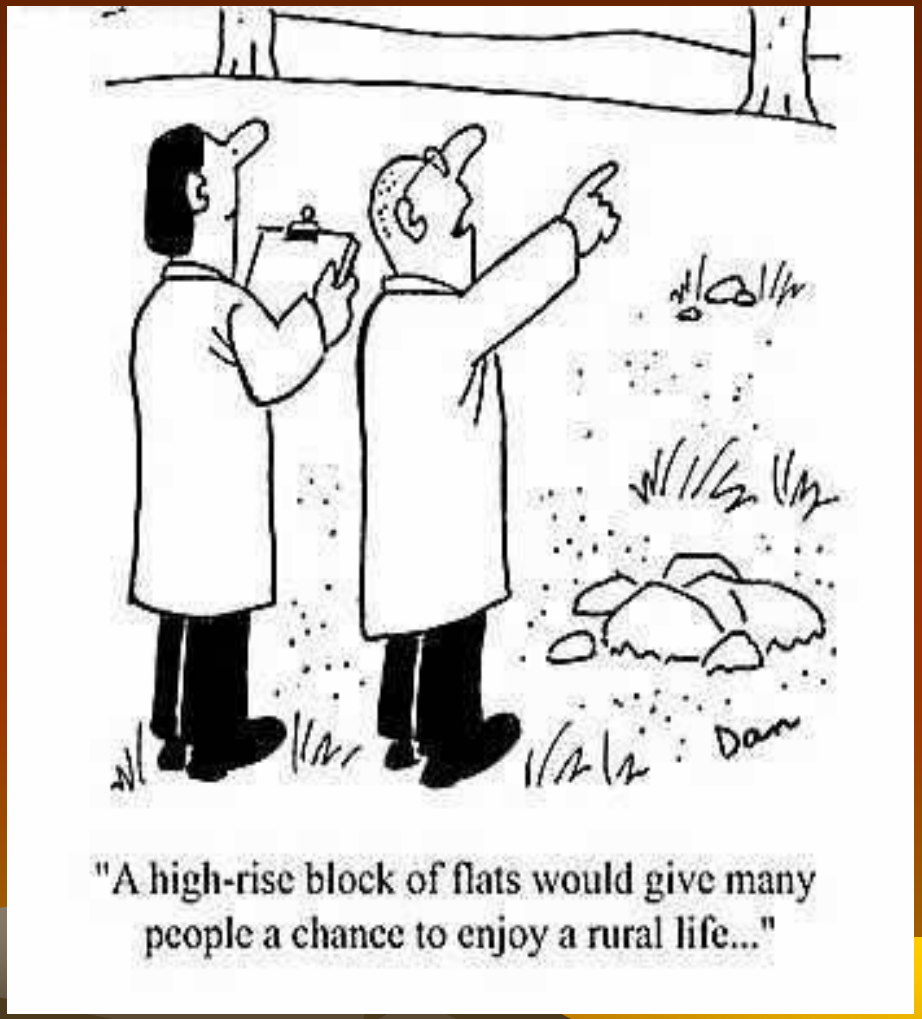
- Examples: DDT has killed beneficial insects. DDT does not break down and eventually becomes concentrated at dangerous levels within the soil.

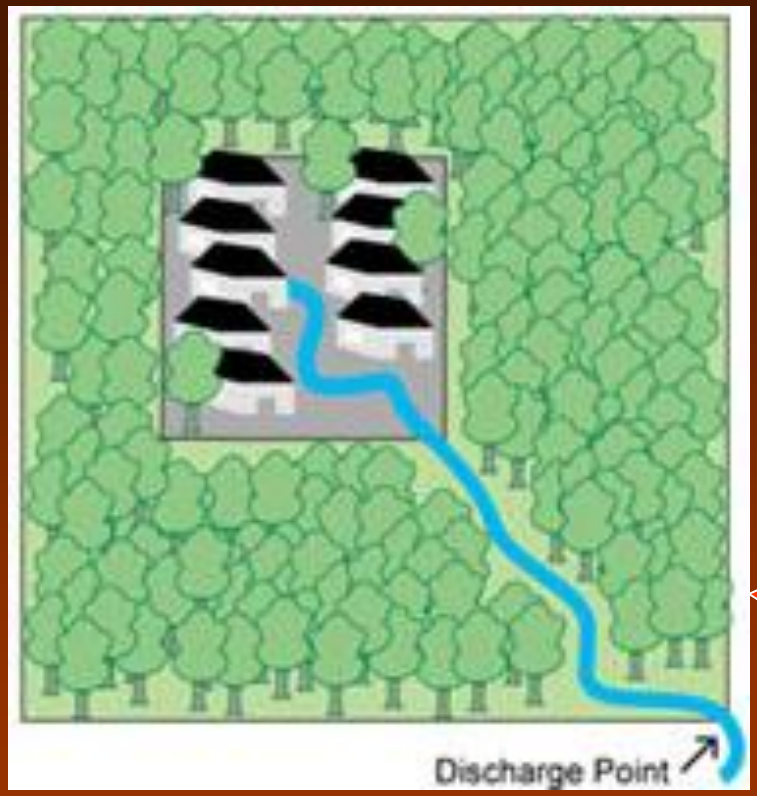
Natural Ecosystem Processes

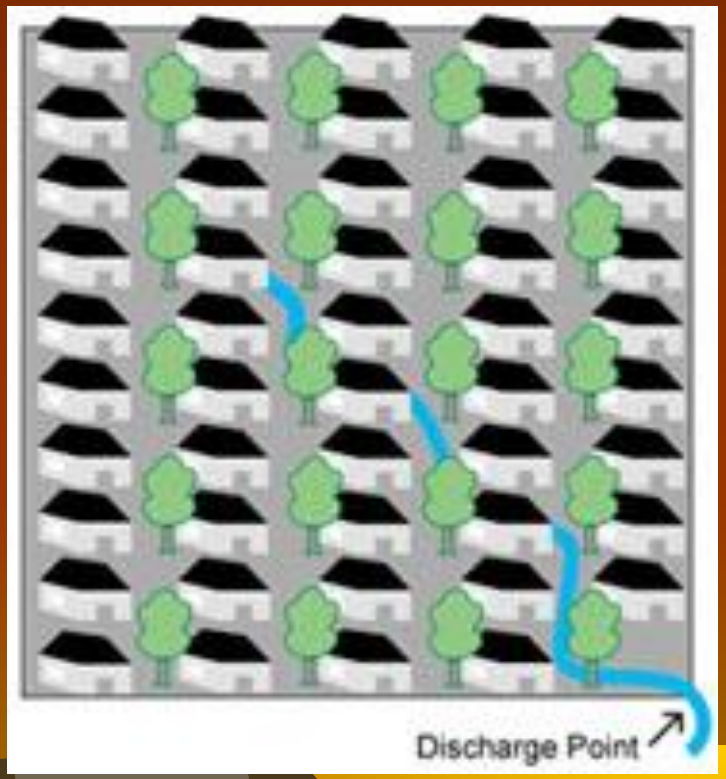
- **Natural ecosystems are involved in a wide variety of natural processes influencing humans and other organisms.**
- **The activities of humans in the environment are changing many of these natural processes in a harmful fashion.**

Maintenance of atmospheric quality

- **Human activities (namely Urbanization & Industrial Growth) have increased the amount of Pollutants in the atmosphere, negatively affecting the environment (acid rain)**



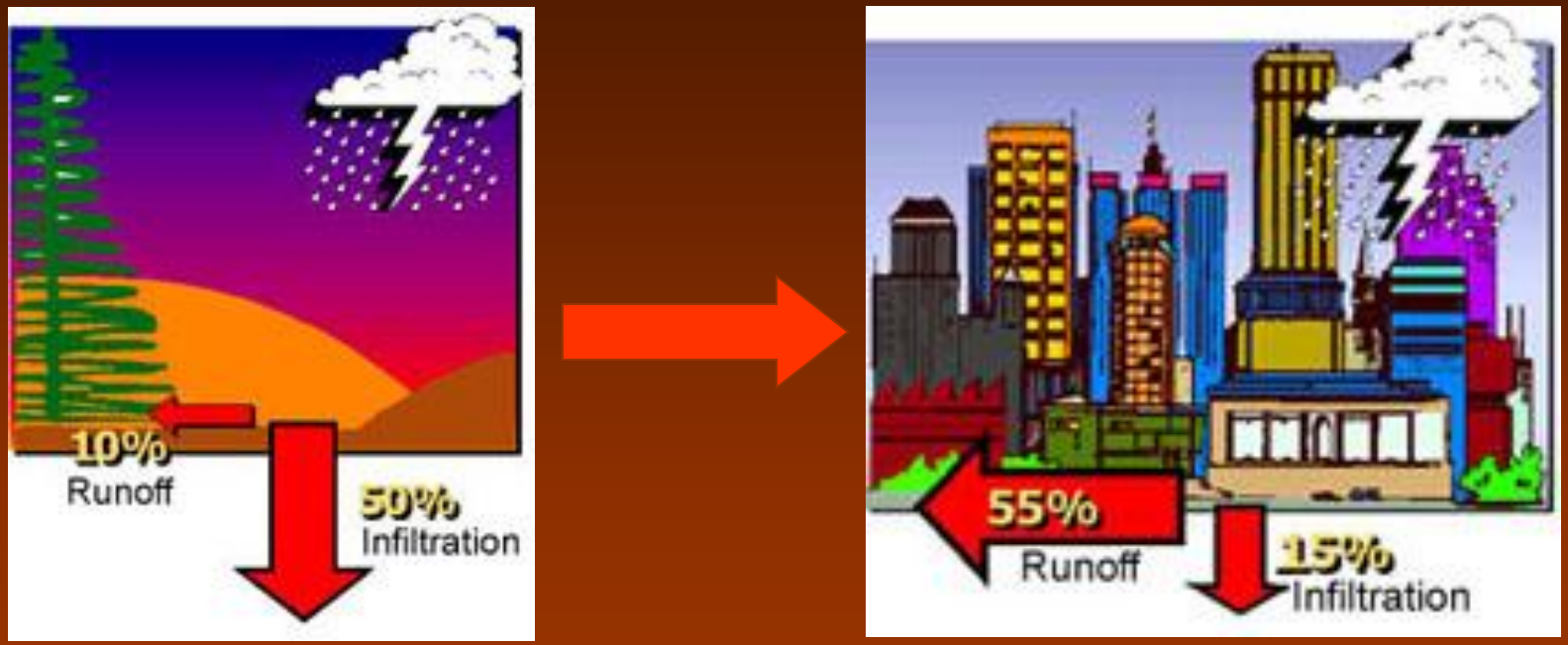

Discharge Point


Discharge Point

Generation of soils

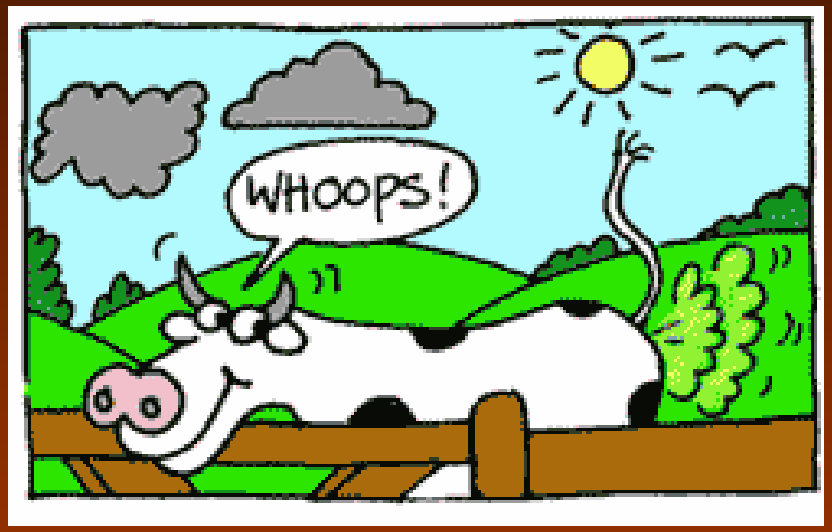
- **Agricultural practices have exposed soil to the weather resulting in great loss of topsoil.**

Control of the water cycle



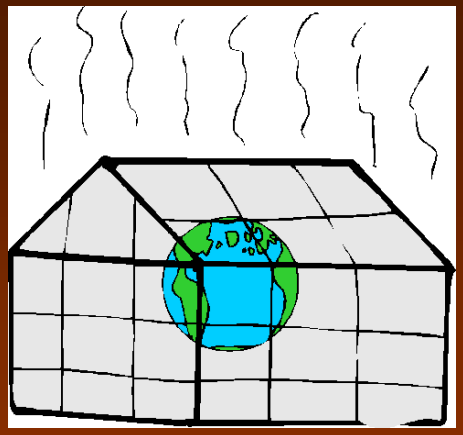
- **The cutting of forests and other human activities have allowed increased uncontrolled runoff leading to increased erosion and flooding.**

Removal of Wastes



- **Untreated sewage wastes and runoff from farms and feedlots have led to increased water pollution.**

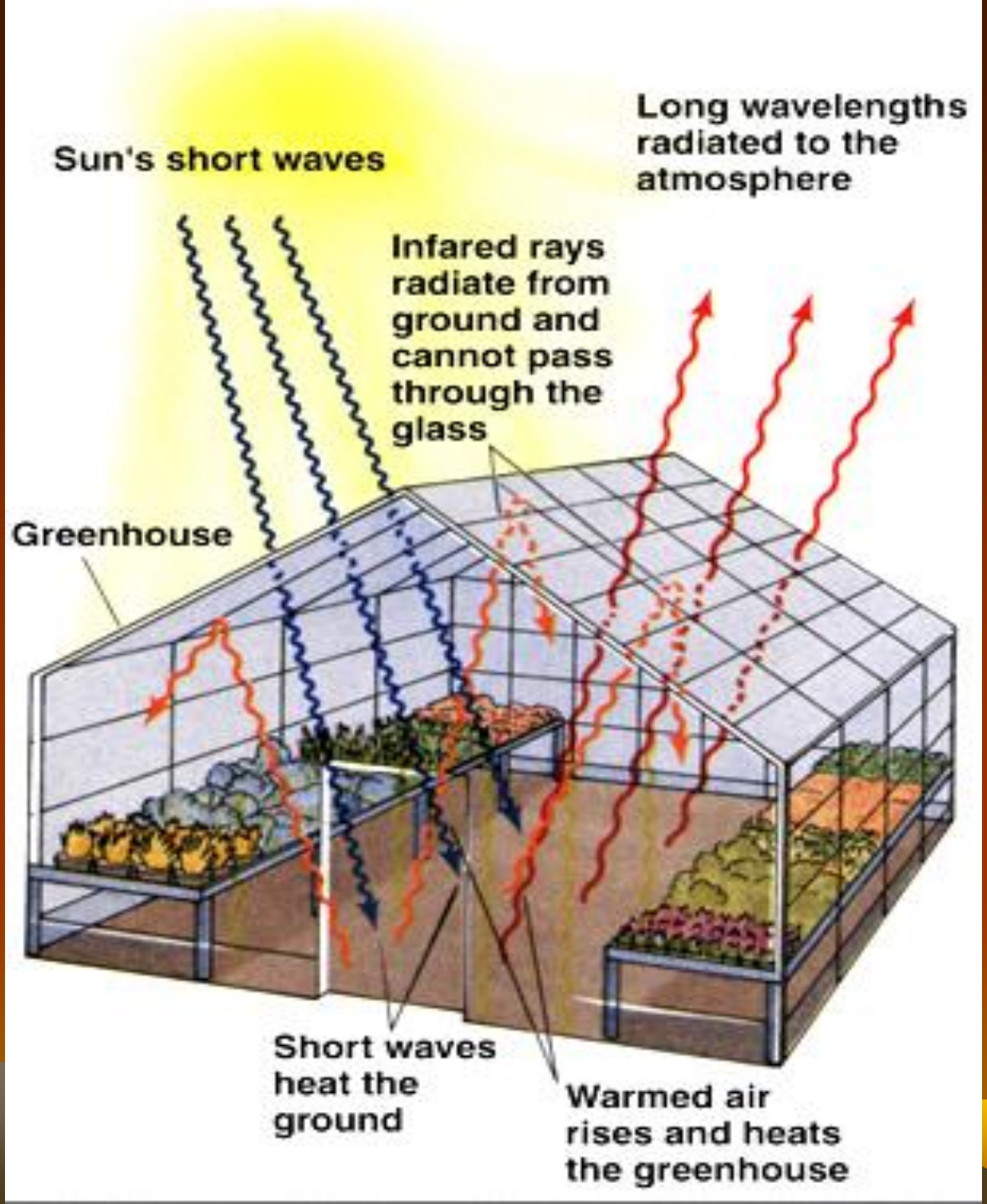
Energy Flow



- Some industries and nuclear plants have added thermal pollution to the environment. The release of some gases from the burning of fossil fuels may be slowly increasing the Earth's temperature.
  -- (Greenhouse Effect)

Major Greenhouse Gases

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Other man-made gases

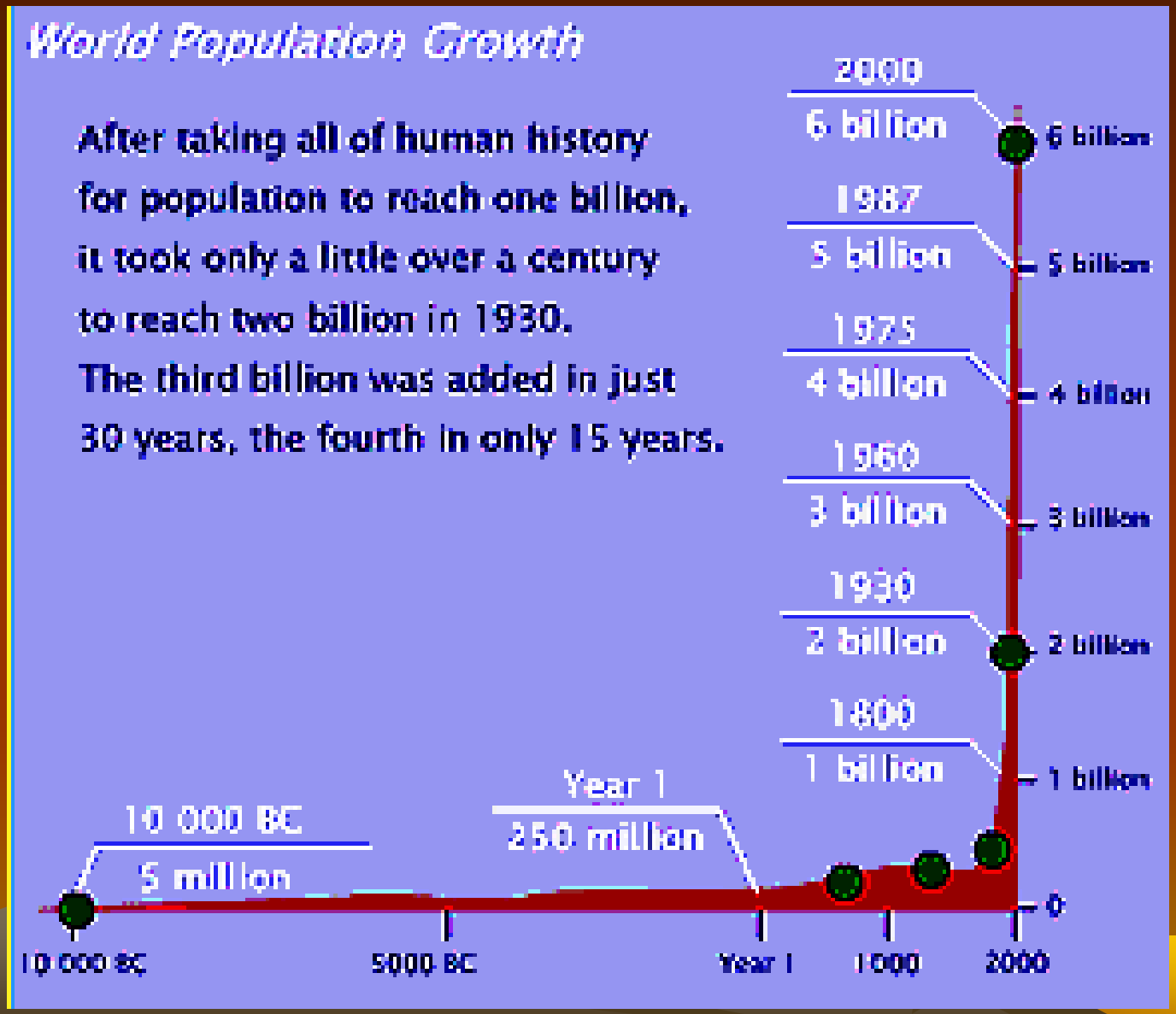

Sun's short waves
Long wavelengths radiated to the atmosphere
Infared rays radiate from ground and cannot pass through the glass
Greenhouse
Short waves heat the ground
Warmed air rises and heats the greenhouse

Nutrient Recycling

- **The use of packaging material which does not break down, burning of refuse, and the placing of materials in landfills prevents the return of some useful materials to the environment.**

- **Humans have changed many of these ecosystem processes -- frequently in a detrimental way**

Human Population Growth



The moral of the story…

Destruction of natural enemies is not always good for a species -- it can lead to its extinction or near extinction. (Will this also happen to Homo sapiens?)

Some specific human influences on Ecosystem Factors

- A. Increasing numbers:
- results from an increased human life span
- health advances largely led to this

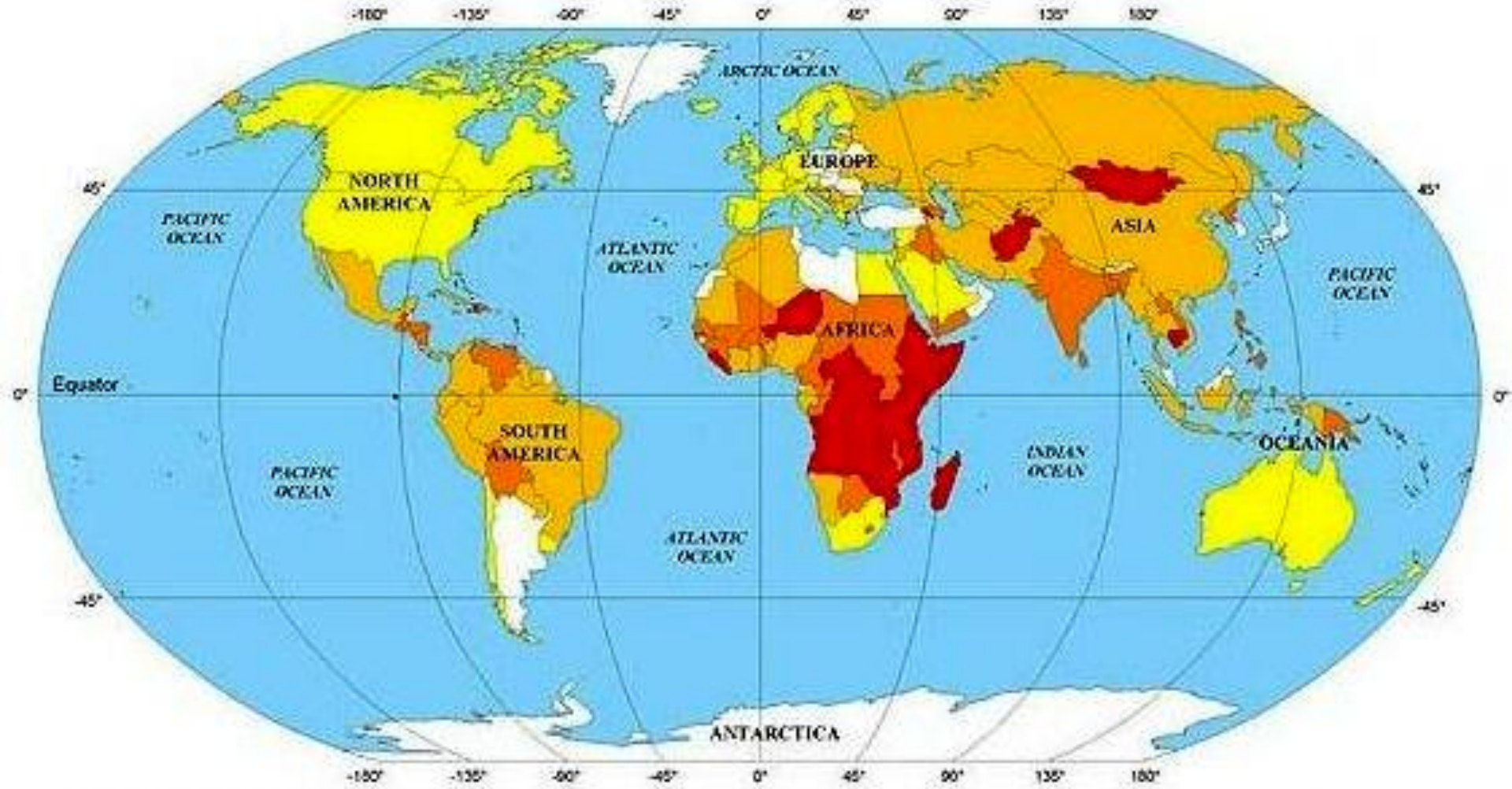
- **B. Food: shortages and inadequate nutrition lead to starvation and malnutrition**

  - population growth is outpacing food production in many world regions

  - starvation: body lacks sufficient calories for maintenance

  - malnutrition: diet lacks specific substances needed by the body

World Starvation % of Population



- **C. Soil: much loss of fertile topsoil due to erosion and poor management**
  - **the use of biocides has contaminated the soil (no prior assessment was taken of their environmental impact)**
  - **some causes of topsoil loss include; cutting forests, farming dry grasslands, damming rivers, draining wetlands, etc.**
  - **much valuable farmland has been lost due to increasing urbanization & suburbanization**

- **4. Water: cutting forests has led to increased, uncontrolled runoff**
  - **water pollution leaves water unfit for use and the living things remaining in it unfit for consumption (typical water pollutants include phosphates, heavy metals, and PCB's)**

Biomagnification

- increase in the concentration of a substance (poison) in living tissue as you move up the food chain
  - (ex. tuna and swordfish, water birds and birds of prey from DDT -- thin shelled eggs)
  - This has particularly hurt the peregrine falcon & bald eagle.





- **5. Wildlife: much destruction and damage has been done to many species (hunting, fishing, etc.)**
  - **ex. passenger pigeon, dodo, great auk, bison, Carolina parakeet**

- ** Other problems include habitat destruction, importation of some organisms have caused problems for native organisms.
- We have alien invasive species which have caused problems for our area in New York. These include the Water Chestnut, E
milfoil, Alewife, Z
Purple Loosestrif

Remember the Simpson episode where Bart calls Australia to see which way the toilet flushes?

He brings with him a frog and it takes over the country and on the way home, a koala hands on to the Simpson's helicopter!

Photo credit: California Energy Commission

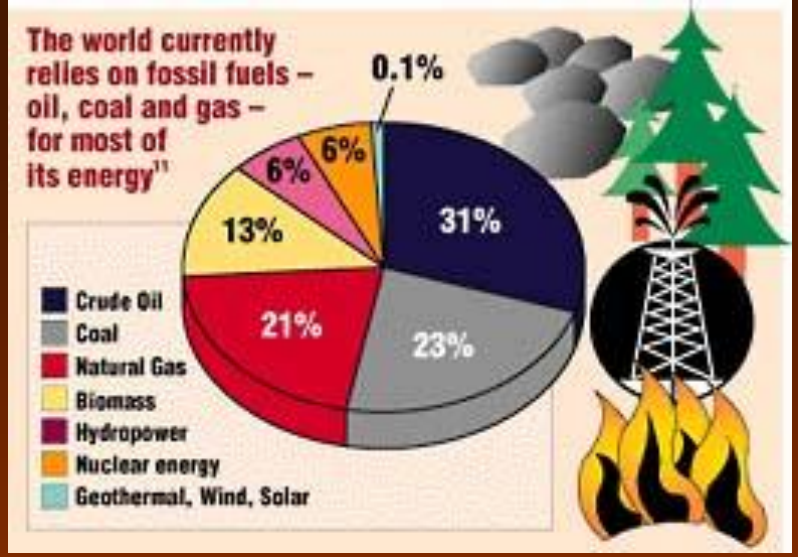
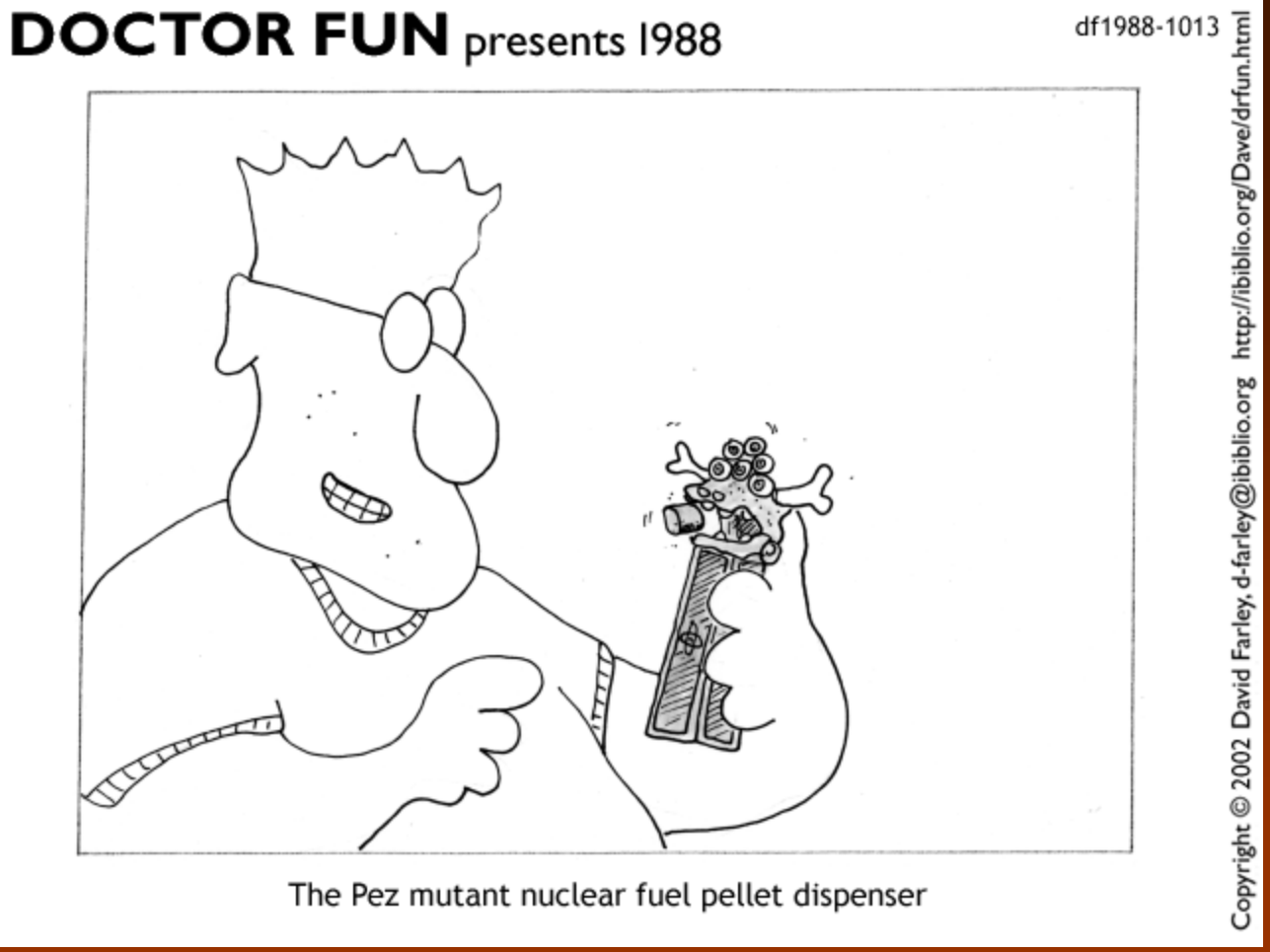
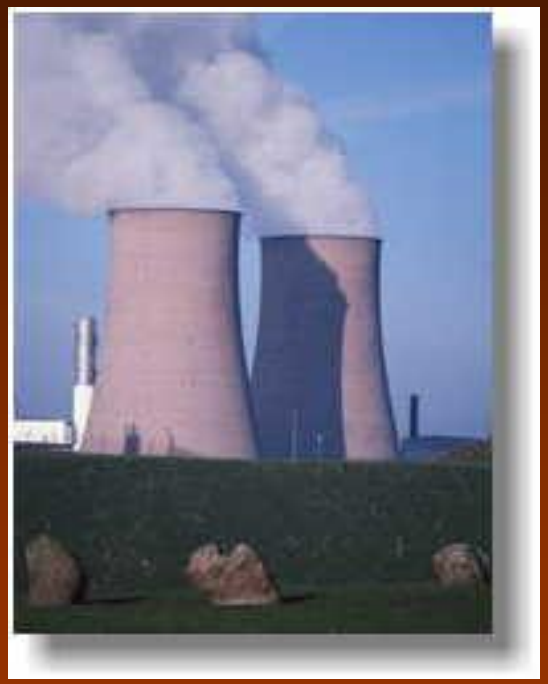


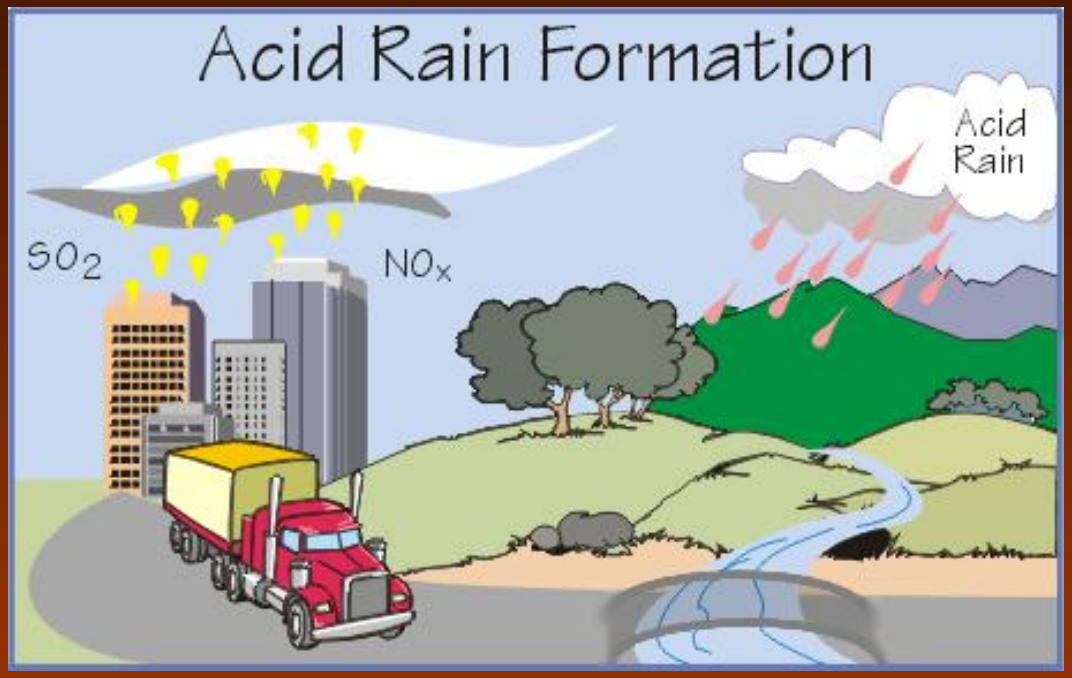
Photo credit:
American Coal Foundation

- 6. **Fossil Fuels**: are becoming rapidly depleted/add to air pollution problems
  - The search and demand for additional energy resources also impact ecosystems in a negative way.
  - Industrialization has brought an increased demand for and use of energy.





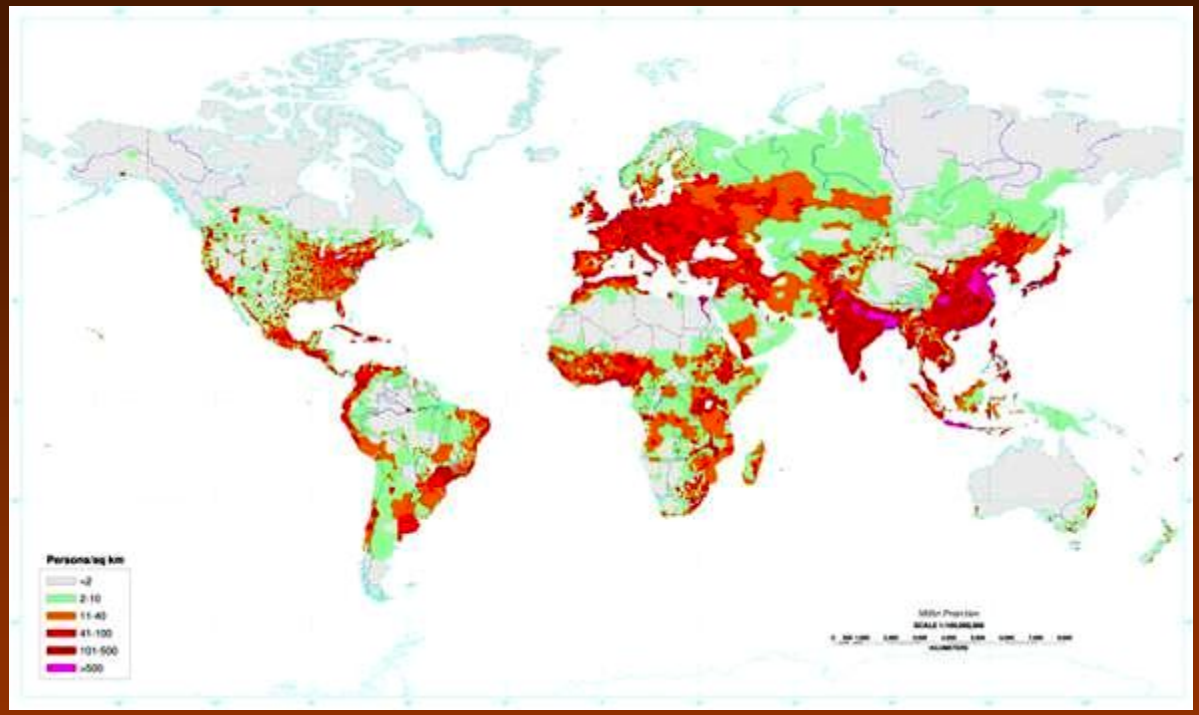
- **7. Nuclear fuels - environmental dangers exist in reference to obtaining, using, and storing the wastes from these fuels**



- **8. Air is becoming increasingly polluted**
  - **Acid Rain -- sulfur dioxide (also nitrogen oxides) from coal burning sources + rain = ACID RAIN**

Problems from Acid Rain:

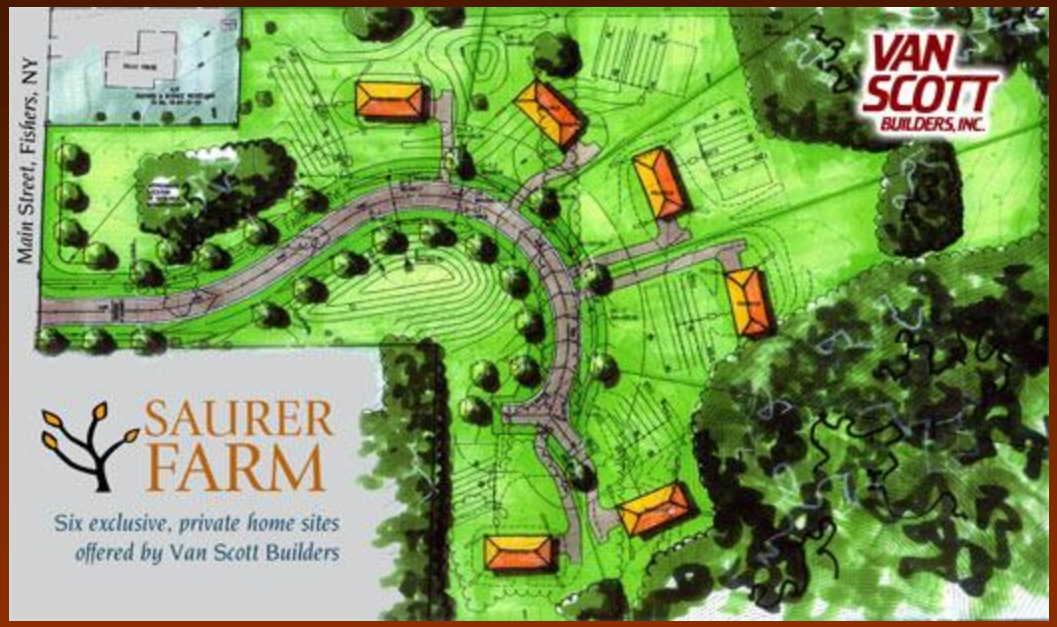
- Destruction of limestone and marble monuments due to increased chemical weathering
- Acidification of aquatic ecosystems destroying the life in them
- Damage forests and other plants in a variety of ways



- **9. Living space/available land: is greatly decreasing as a result of increasing population**
  - **creates increasing stress on individual humans**
  - **we are also taking up living space and**

- **10. Forests: are becoming increasingly depleted as a result of timber needs & the need for more agricultural land**
  - **the direct harvesting of timber has destroyed many forests**
  - **this destruction also impacts land use and atmospheric quality**

- **11. Insects: our chief competitors for food**
  - **we have destroyed many beneficial insects and many enemies of harmful insects with insecticides**



- **12. Land use (includes increasing urbanization and the cultivation of marginal lands)**
  - **this decreases the space and resources available to other species**

Some Other Factors which influence environmental quality

- 1. Population growth and distribution
- 2. Capacity of technology to solve problems
- 3. Economic, political, ethical, and cultural views

Some examples:

- a.) Wealthy people in the developed world tend to have fewer children.
- b.) Some countries like China have laws concerning the number of children a couple may have without penalty.
- c.) In some poor cultures in third world countries, having many children is seen as a means of having economic security in old age.

- **What are some ways we are attempting to deal with environmental degradation?

Species Preservation

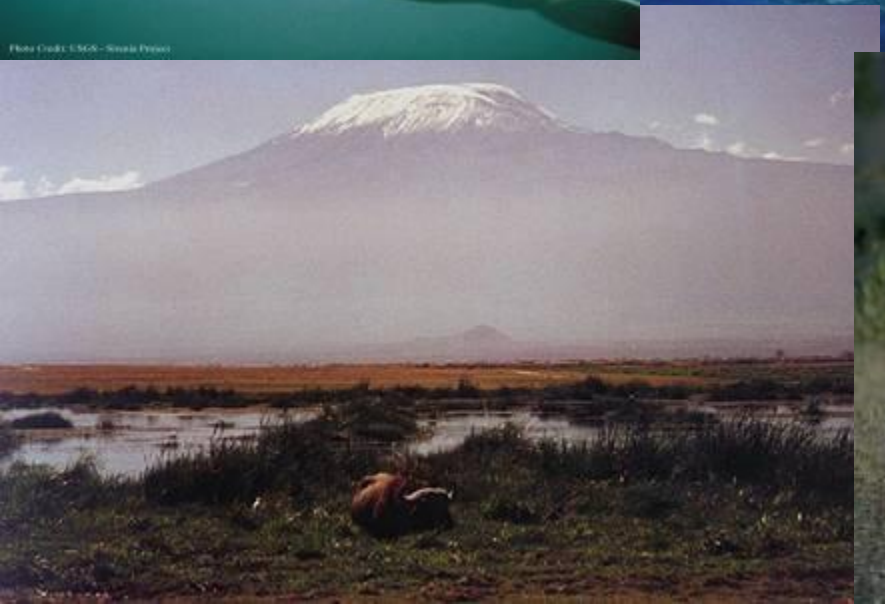
- Some efforts to sustain endangered species have included habitat protection (wildlife refuges and national parks) and wildlife management (game laws and fisheries).

- Animals which were once endangered but are presently successfully reproducing and increasing their numbers are the bison, gray wolves and egrets.









- Endangered animals which are currently responding to conservation efforts and beginning to make a comeback are the whooping crane, bald eagle, and peregrine falcon.
- ** The future of many species remains in doubt.
- Human activities that degrade ecosystems result in a loss of diversity in the living and nonliving environment. These activities are threatening current global stability.

Ways to Reduce Air Pollution

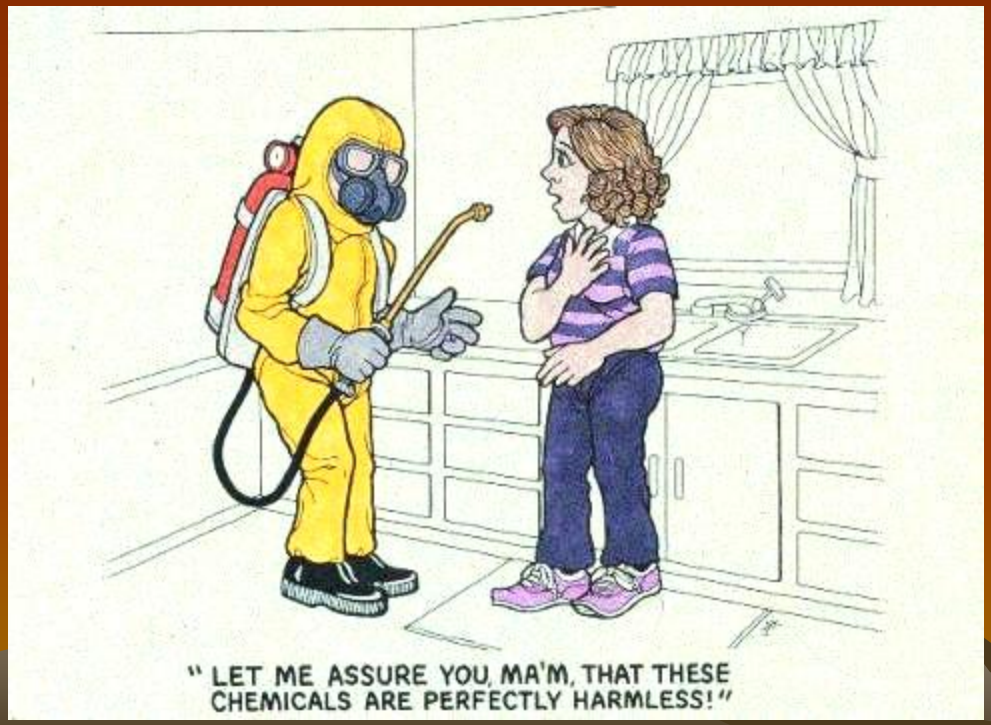
- 1. Use fuels which contain less pollutant, such as low sulfur coal and oil.
- 2. Utilize industrial or energy producing processes which minimize the creation of pollutants.
- 3. Remove pollutants by using such devices as afterburners or catalytic converters before they enter the air.
- 4. Design new products which meet basic needs without generating pollution.

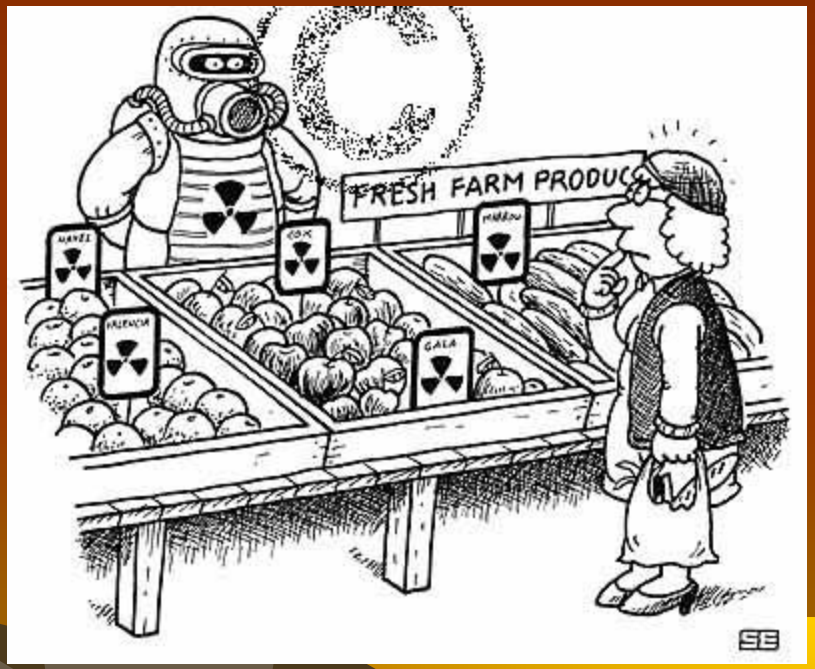
There are laws which regulate and guide the use of natural habitats.

- **SEQR (New York's State Environmental Quality Review Act): A New York State law designed to provide the opportunity for citizen review and comment of the environmental impact of any proposed development that has been determined to have significant impact on the environment.**

Some Methods of Controlling Harmful Insects

- **Chemical controls (insecticides)**
  - **(many drawbacks)**





2. Biological controls:

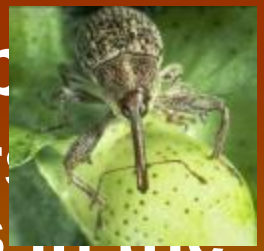
- Introduction of natural enemies
  - (ex. praying mantis)
- Use artificial sex hormones to lure insects to their death (pheromones)
  - (ex. gyplure -- male gypsy moths
- Sterilization and release of ma
  - (ex. irradiation of screwworm fly w/cobalt-60)
  - Note: The screwworm fly only gets to mate once, so she is out of luck if she mates with a sterile male!!

- **Inspection** of all materials before entering the country to prevent pest introduction

- **Destroy** breeding places of insects
  - (may have negative environmental consequences on other species)

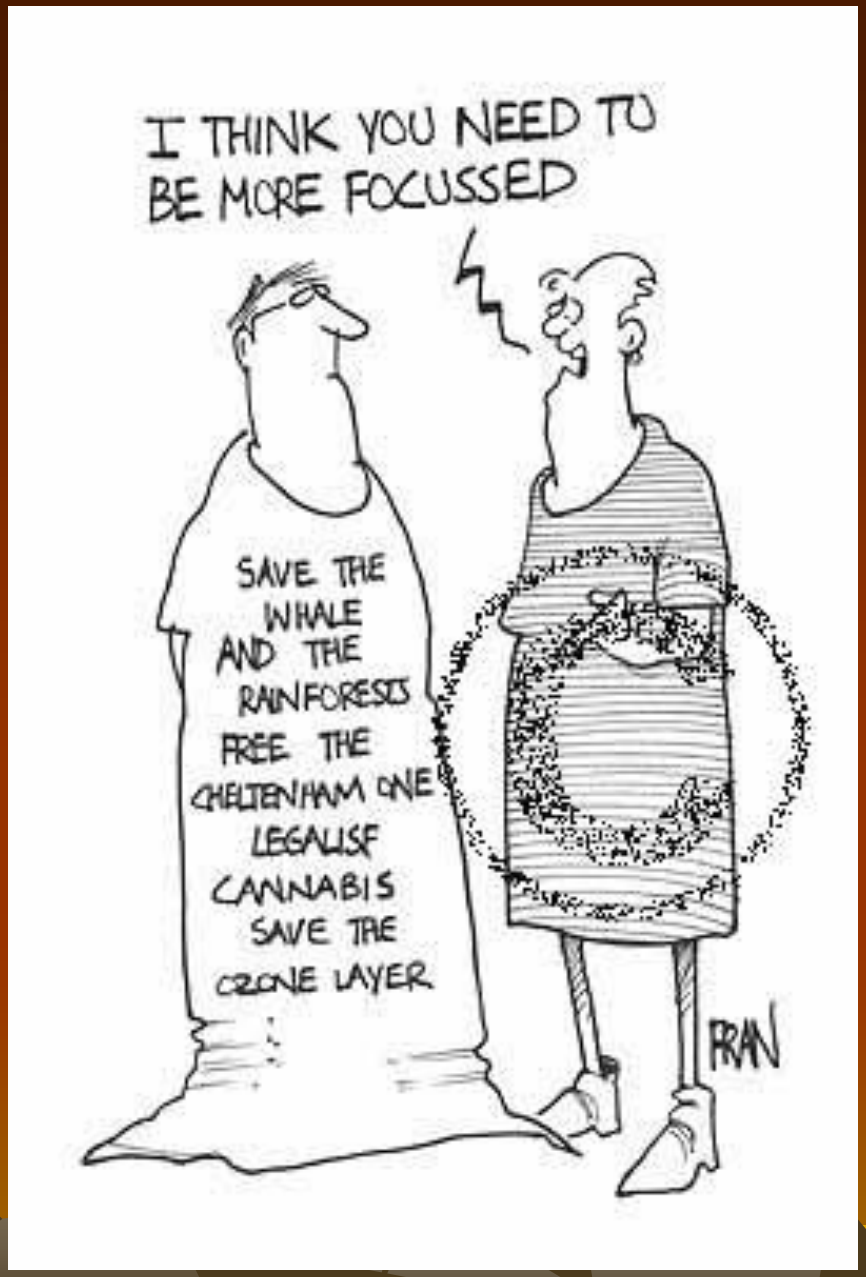
- **Rotate crops** so that harmful ins species can not build in numbers and concentrate on destroying one crop.

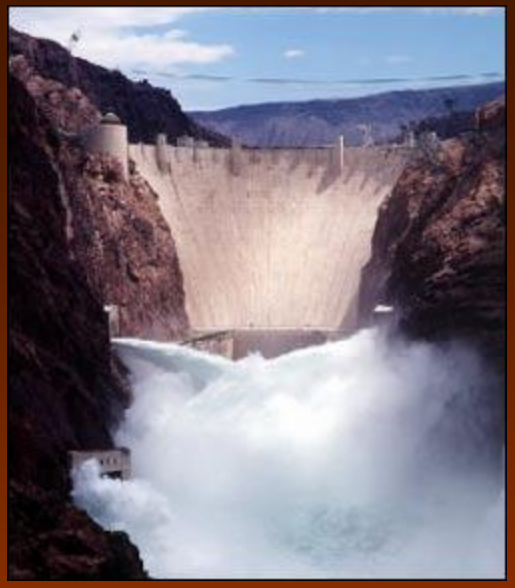
- Plan the time in **planting** certain crop
  - (ex. plant cotton early so that its flowers mature before the boll weevil lays eggs in the cotton)



How can individual and societal choices contribute to improving the environment?

- **1. Through a greater awareness and application of ecological principles, each individual can help to assure that there will be suitable environments for succeeding generations on our planet.**


I THINK YOU NEED TO BE MORE FOCUSSED
SAVE THE WHALE AND THE RAINFORESTS
FREE THE CHELTENHAM ONE
LEGALISE CANNABIS
SAVE THE OZONE LAYER
FRAN



- **2. Individuals in society must decide on proposals which involve the introduction of new technologies.**
- **These decisions must assess environmental risks, costs, benefits, and trade-offs.**