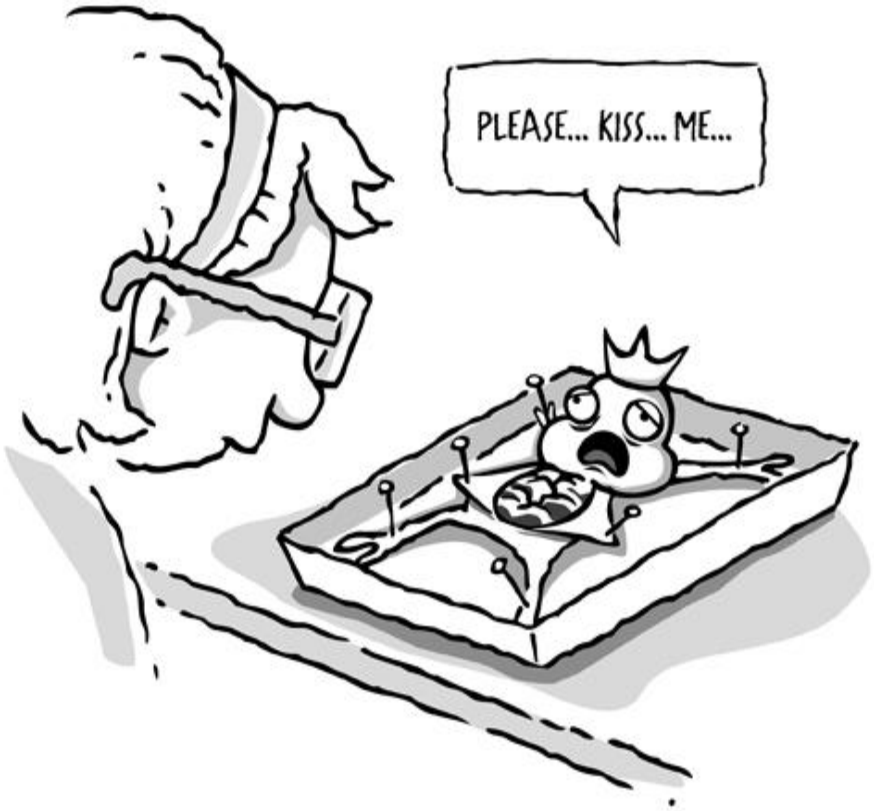


Life Sciences

Sustainability of Ecosystems

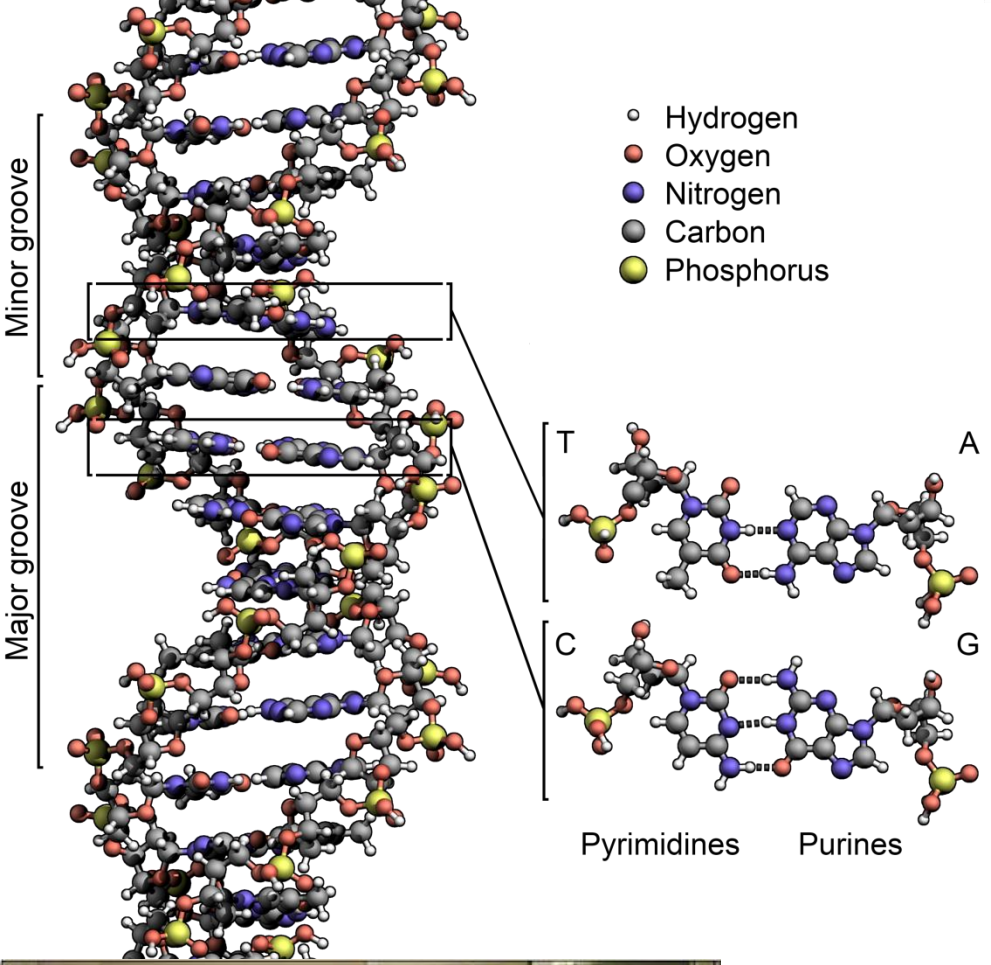
Paradigm-

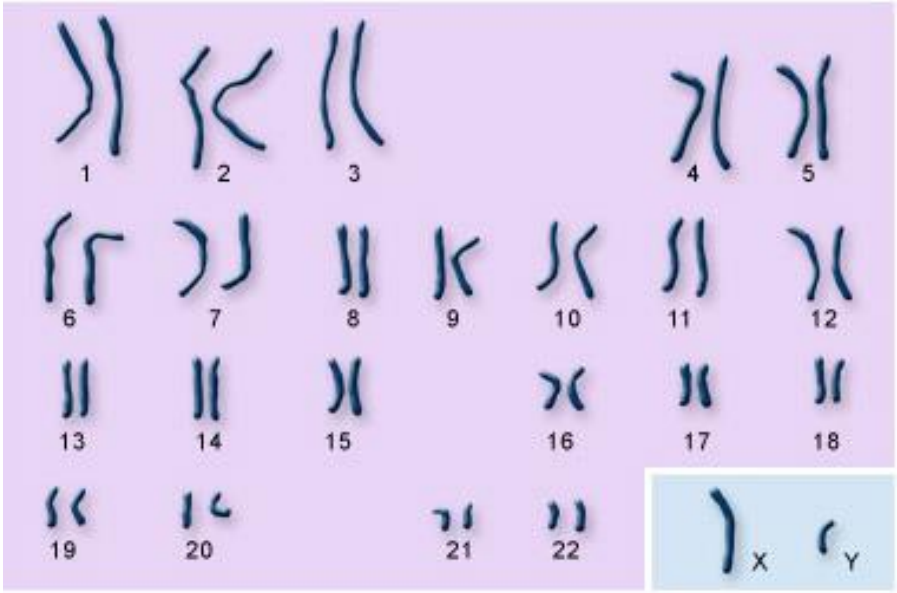
- a thought pattern or way of thinking in any scientific discipline.
- Example- The world is round.

- Paradigm Shift- A radical change in thinking from an accepted point of view to a new belief. (seeing the same information in an entirely different way).

An example of a paradigm shift-

- The Earth is round not flat. Centuries ago people believed that the Earth was flat. Gradually a number of people proposed that the Earth was spherical. (Christopher Columbus proposed to reach India by sailing west from Spain, he too assumed that the Earth was round).
- Due to this voyage and other physical evidence people switched their belief from a flat Earth to a round Earth.
- A PARADIGM SHIFT!


Minor groove
Major groove
Hydrogen
Oxygen
Nitrogen
Carbon
Phosphorus
T
A
C
G
Pyrimidines
Purines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CSI:
CRIME SCENE INVESTIGATION

Paradigms related to our environment-

- <u>Traditional Forestry Methods-</u>
  - Involved usage of axes and saws, horses and sleds.
  - A forester could cut and stack about two cords of wood per day.

Paradigms related to our environment-

- <u>Modern Forestry Equipment-</u>
  - Machinery such a feller-bunchers, skidders, and huge trucks are now used in the forestry industry.
  - Now two cords of wood can be cut and stacked in minutes

Paradigms related to our environment-

- <u>Traditional Fishery Methods-</u>
  - Involved fishing from dories, with jiggers and small nets
  - Those days fishing was confined to the “inshore” regions

Paradigms related to our environment-

- Modern Fishery - Trawlers
  - Involves the use of large trawlers that literally scrape the ocean floor for codfish and other species

Paradigms related to our environment-

- With an increase in the amount of wood being harvested, there became a need for a new way of thinking about the forest resource.

- With recent declines in the fish stocks of the North Atlantic, we have been forced to rethink our ideas about sustainability in the fishery.

Present views-

- Since people have discovered that if resources are not managed they will disappear, scientists and researchers have developed sustainability practices:

- Hunting and fishing licences
- Permits for logging
- Heavy fines and jail time for those who don’t follow these laws.

- A drastic change in way of thinking=PARADIGM SHIFT!!!

Ecology terms

- Ecology- The study of the interaction of living things with each other (biotic factors) and with the abiotic (non-living) factors in their environment.

- Ecosystem- In an area defined by an ecologist, the set of relationships between populations of species and between those populations and the abiotic (non-living) factors in their environment.

Ecology terms

- Habitat- the type of environment in which an organism or group normally lives or occurs.

- Niche- a term describing the position (job/role)of a species in its habitat.

- Biodiversity- the variation of life forms within a given ecosystem, biome, or for the entire Earth. Biodiversity is often used as a measure of the health of biological systems. The more biodiversity, the more stability in a system.

Example of an ecosystem with high biodiversity-

- Ecotone- a transition area between two ecosystems that includes members of the community of both ecosystems, so they often contain greater biodiversity (more species) than either ecosystem.

Intertidal Zone

Desert – Mountain Ecotone

Ecology Terms

- Biotic potential- The maximum number of offspring that a species could produce, if resources were unlimited.

- Population- all of the members of a species living in the same ecosystem or habitat. Example- Simba's pride in the Lion King.

- Community- the collection of all the populations of all the species in an ecosystem; all the organisms in an ecosystem. Example - all of the animals that live within the "Pridelands" in the Lion King.

Biotic factors-

- Living factors:
  - Decomposing animals
  - Disease
  - Predator/prey
  - Competition
  - Symbiosis – a relationship where organisms live together.

Abiotic factors-

- Non-living factors
  - Space
  - Temperature
  - Oxygen
  - Light
  - Water
  - Inorganic and organic soil nutrients

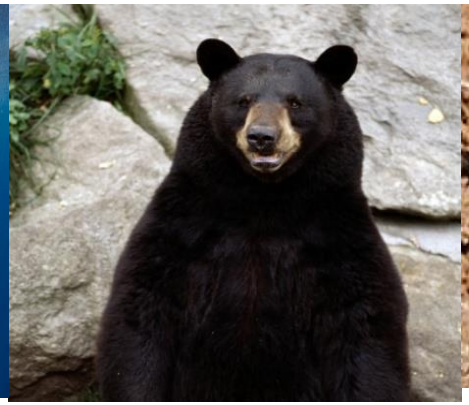
Classification of living things:

- Producer- an **autotroph**- an organism that uses photosynthesis or another form of chemical synthesis to make food. Example: All green plants
- Consumer- a **heterotroph**- an organism that must eat producers or other consumers to survive. Example: Most animals
- Decomposer- A **saprobe**- an organism that feeds on detritus (dead/decaying material), in the process releasing nutrients to the soil and water, where they can be used by other organisms. Example: some insects, fungus, and bacteria

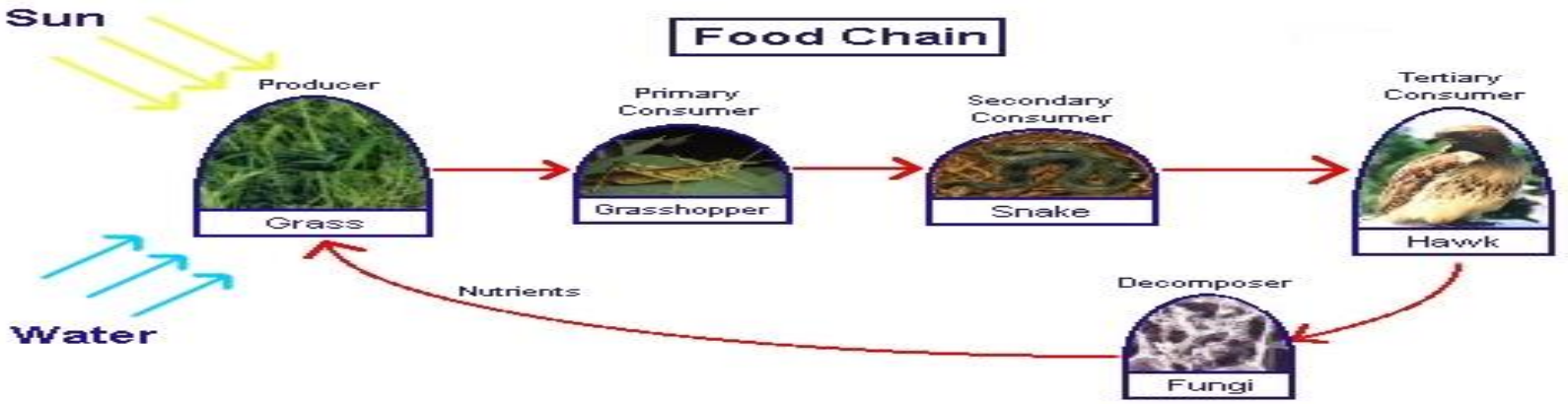



Classification of living things:

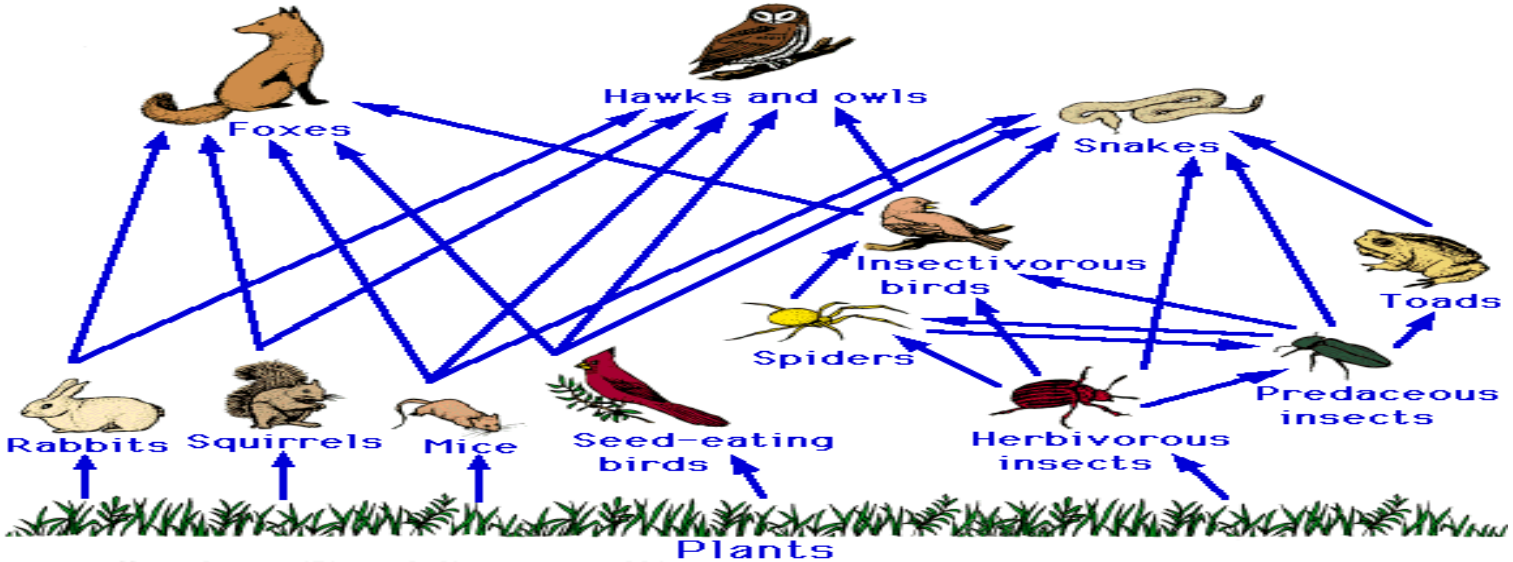
- Herbivore- an animal that eats only plants. Example: rabbit, moose.
- Carnivore- an animal that feeds on other animals. Example: shark.
- Omnivore- an animal that eats both plants and animals. Example: most bears
- Detrivore - an animal that eats detritus.


- **Food chain- a step-by-step sequence linking organisms that feed on each other, starting with a food source, such as a producer, and continuing with a sequence of consumers. See pg 34-35 for pictures**



- **Food web- a pictorial representation of the feeding relationships among organisms in an ecosystem. A complex network of many interconnected food chains and feeding relationships. See pg 34-35 for pictures**



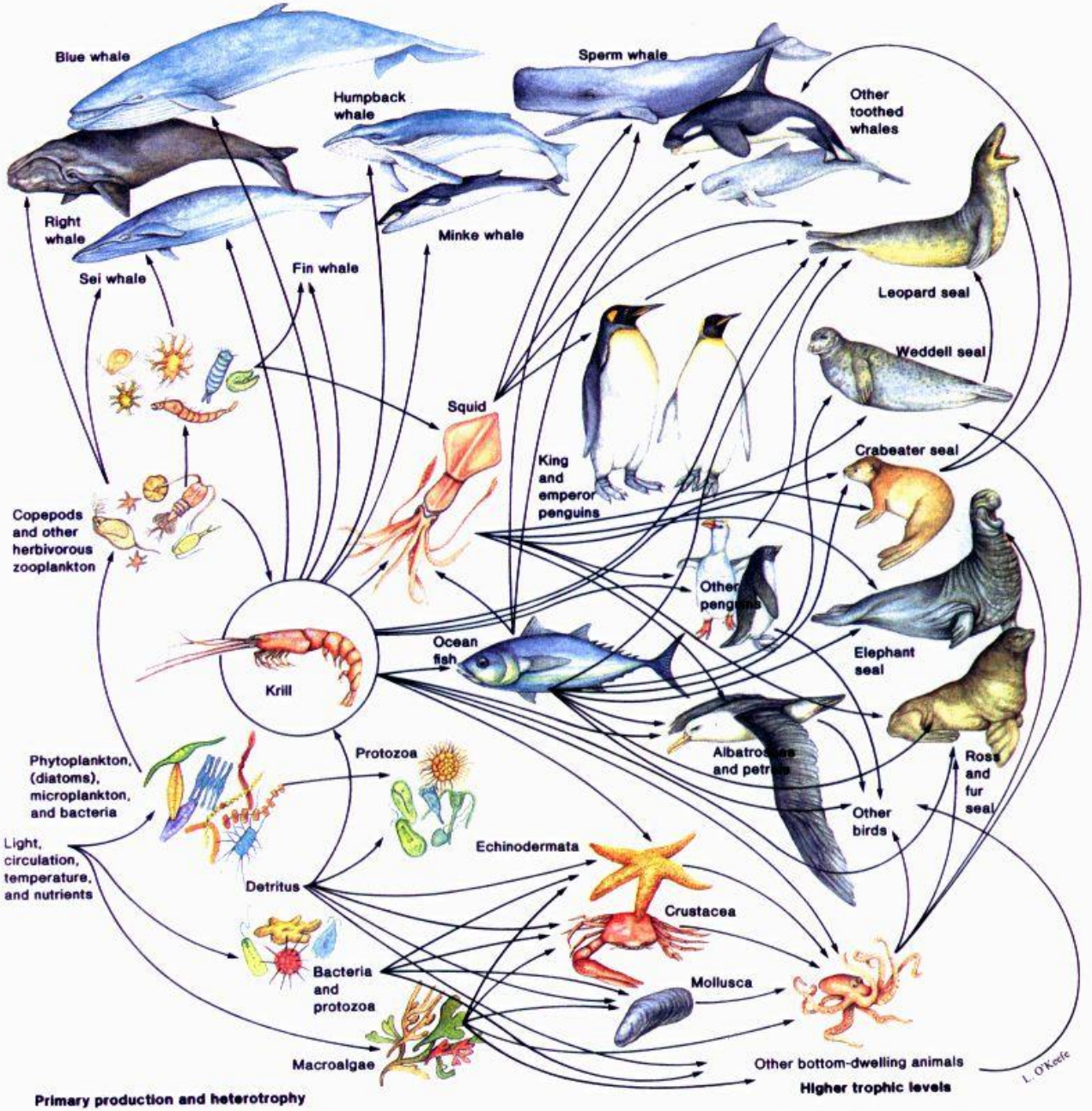


FIGURE 15.3 **Food Webs.** An Antarctic food web. Small crustaceans called krill support nearly all life in Antarctica. Krill are eaten by 6 species of baleen whales, 20 species of squid, over 100 species of fish, 35 species of birds, and 7 species of seals. Krill feed on algae, protozoa, other small crustaceans, and various larvae.

Trophic Level (i.e. *feeding* level)

- a way of categorizing living things according to how they gain their energy. The trophic level is a description of an organism's position in a given food chain. The first tropic level contains autotrophs, and each higher level contains heterotrophs.

1st Trophic Level

- Producer/autotroph- makes their own food

2nd Trophic Level

- Primary consumer- eats autotrophs

3rd Trophic Level

- Secondary consumer- eats primary consumers

4th Trophic Level

- Tertiary consumer- eats secondary consumers

Carnivore

Carnivore

Carnivore

Herbivore

Plant

Quaternary consumers

Tertiary consumers

Secondary consumers

Primary consumers

Primary producers

Carnivore

Carnivore

Carnivore

Zooplankton

Phytoplankton

A TERRESTRIAL FOOD CHAIN

A MARINE FOOD CHAIN

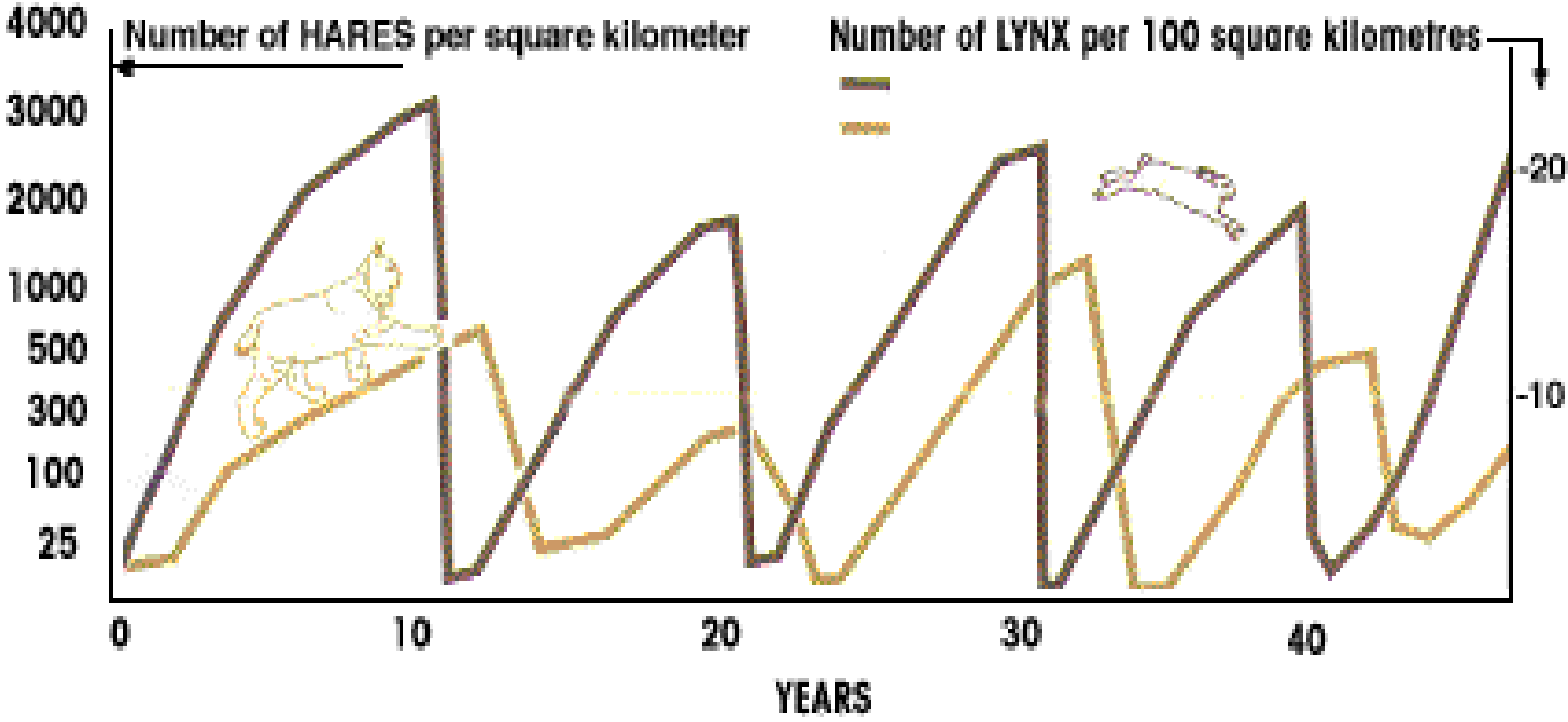
Ecological Relationships

- Predator – Prey Relationship:

  - when a population of one species preys upon another.

  - they limit/control each other's population size

E.g. Lynx and Snowshoe Hare


4000
3000
2000
1000
500
300
100
25
Number of HARES per square kilometer
Number of LYNX per 100 square kilometres
20
10
0
10
20
30
40
YEARS

Ecological Relationships-

- **Competition**- the struggle between individuals for territory or resources. (Examples: food, water, territory, mates). Two types:
- **1)Intraspecific competition-** is a form of competition in which individuals of the ***same*** species compete. Intraspecific competition results in "survival of the fittest". The individual that is best adapted to outcompete the others will survive and pass on its traits to its offspring.
- **2)Interspecific competition-** is a form of competition in which individuals of ***different*** species compete for resources.

Intraspecific Competition

- Wolves fighting for meat- the Alpha male will eat the most

Intraspecific Competition

- Male Big Horned Sheep fighting for mates.

Intraspecific Competition

- Male salmon will compete with other males for mates during the spawning season. The strongest will be successful, ensuring the fittest genes will be passed on. This demonstrates **intraspecific competition.**

Intraspecific Competition

- Bull Moose fighting over territory/mates.

Interspecific competition

Both the lynx and the red fox prey on the snowshoe hare , this is an example of **interspecific competition.**

Interspecific competition

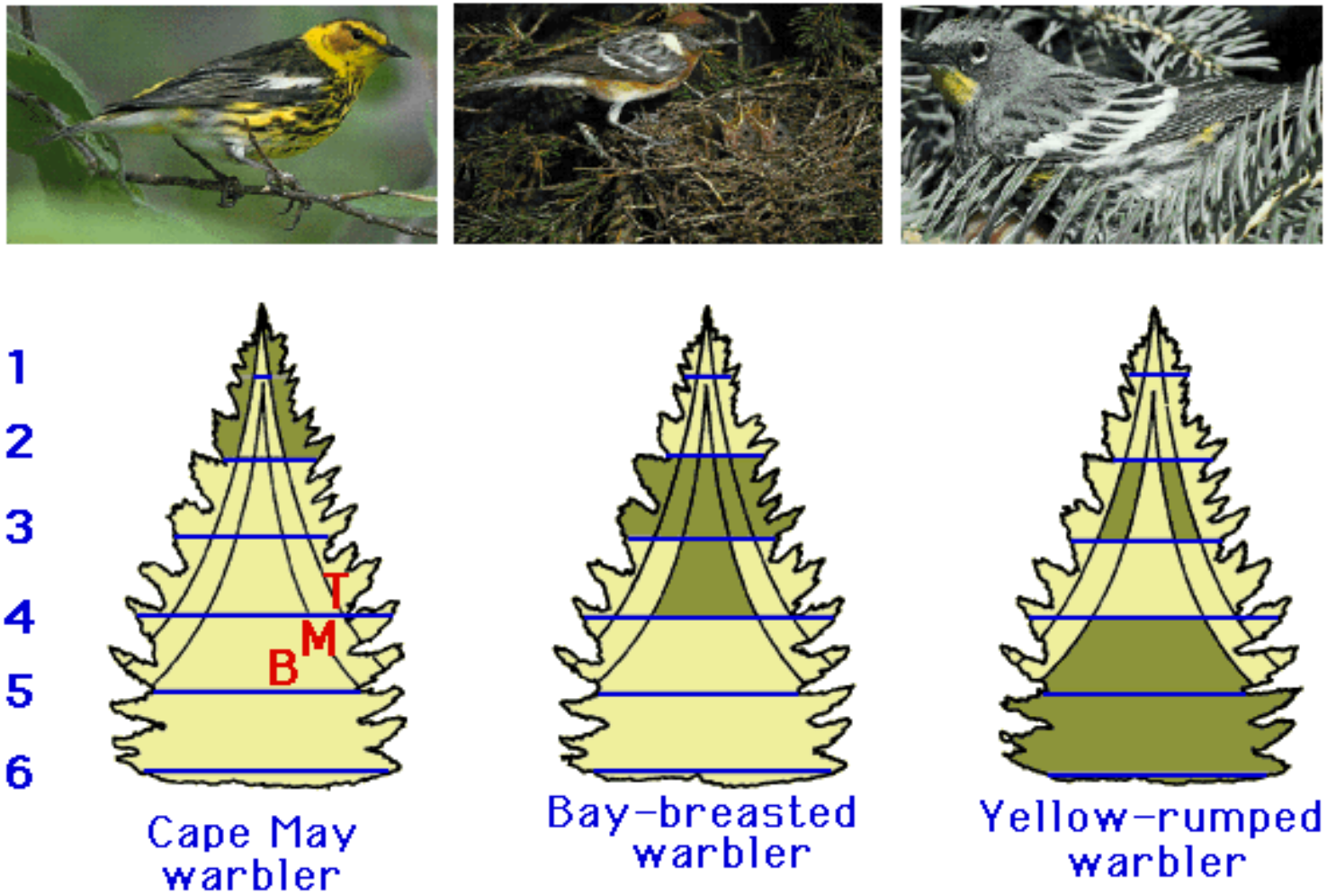
– Warblers –**different species** of small songbirds that occupy similar habitat, compete for the same resources in trees.

Cape May Warbler

Bay-breasted Warbler

Yellow-rumped Warbler

Warblers reduce interspecific competition by spatially dividing up resources. Figure 2, Page 41.



Ecological Relationships- Symbiosis

- **Symbiosis**- means “living together”.
- Three types:
- **Parasitism** –the parasite lives on or in the host. The parasite benefits, host is harmed but not always killed.
- **Mutualism** –both species benefit from the relationship.
- **Commensalism** –one species benefits, the other is neither hurt nor helped.

- Parasitism examples:

Ticks

Lamprey

- Mutualism example:

Clown fish and Sea Anemone

*Benefit to clown fish: protection, eats food caught by anemone's stinging cells

*Benefit to anemone: clown fish keeps anemone clean, provides nutrients in wastes, circulates water

- Mutualism example:

*Flowers and their pollinators both benefit as pollinators eat nectar as they distribute pollen to other plants.

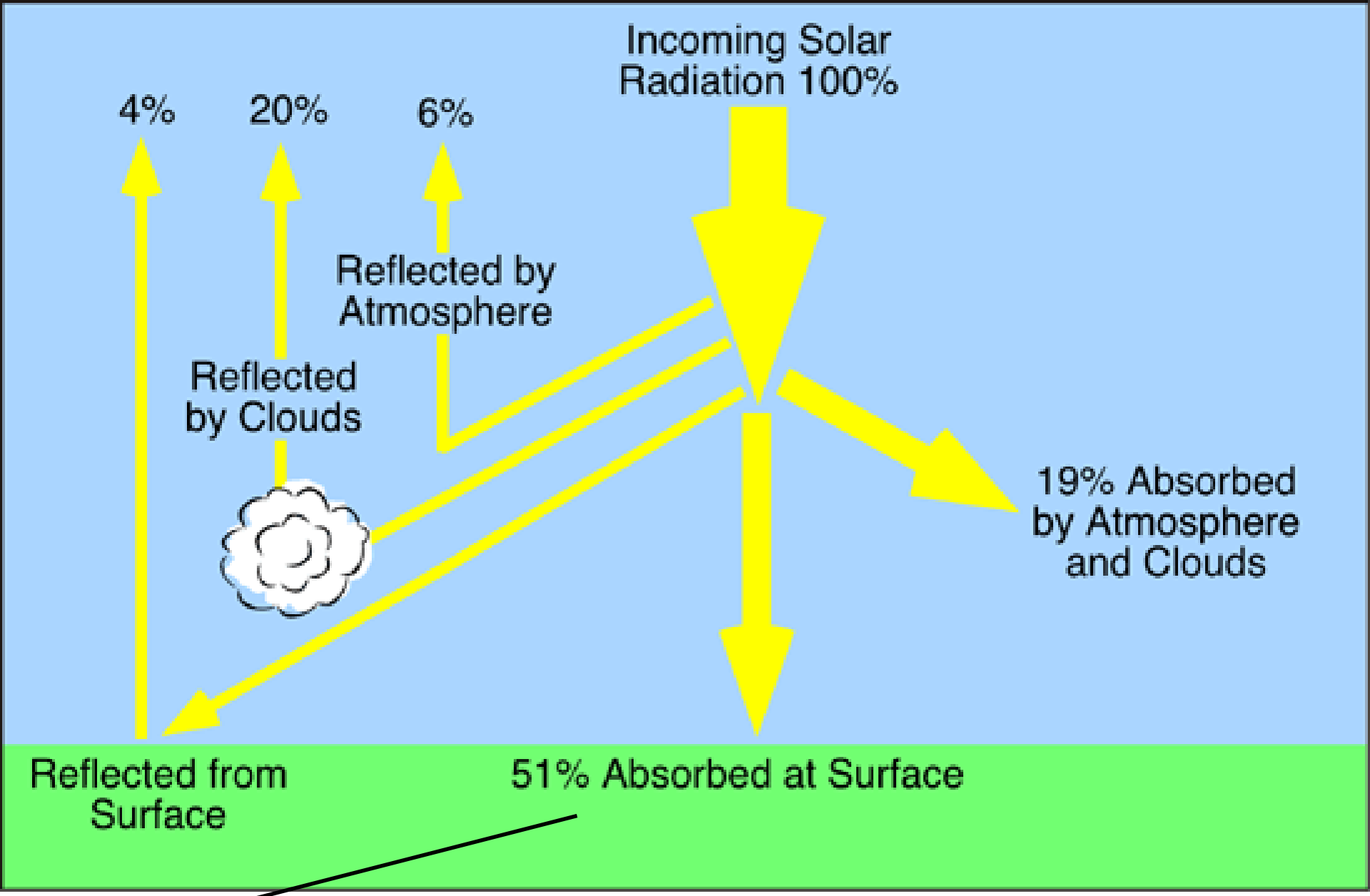
- Commensalism example:

*Cattle egrets eat insects in the grass that are stirred up by the cattle

*Cattle aren't hurt or helped (but egrets may pick off a few parasites)

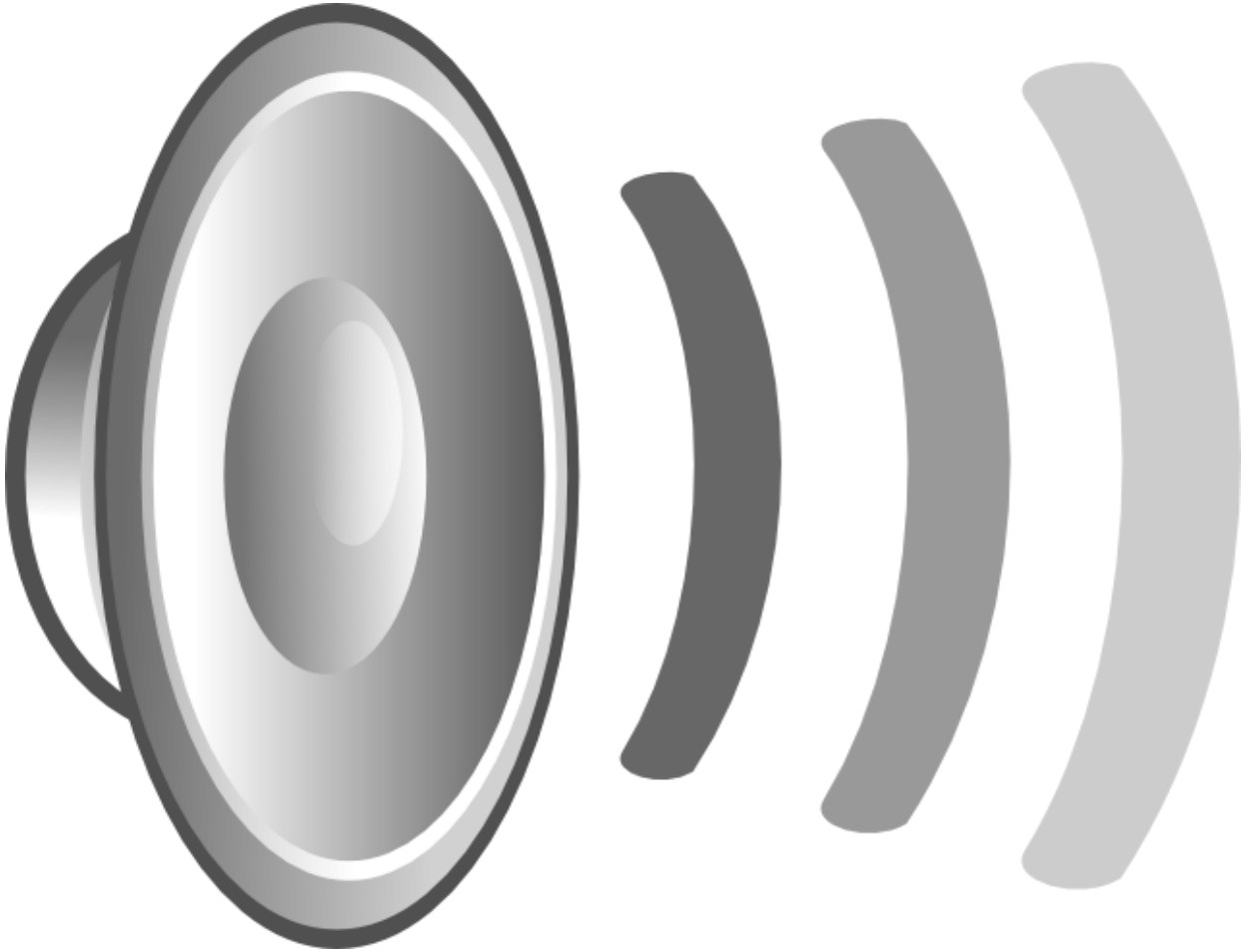
Energy In Ecosystems

- Energy enters the food chains of ecosystems through the process of photosynthesis carried out by producers.
- Only about 0.023% of the sun's total radiant energy reaching the Earth's atmosphere is captured by the process of photosynthesis.



Only 0.023% of incoming solar radiation is captured for photosynthesis

What happens to sound as you move further away from the speaker??



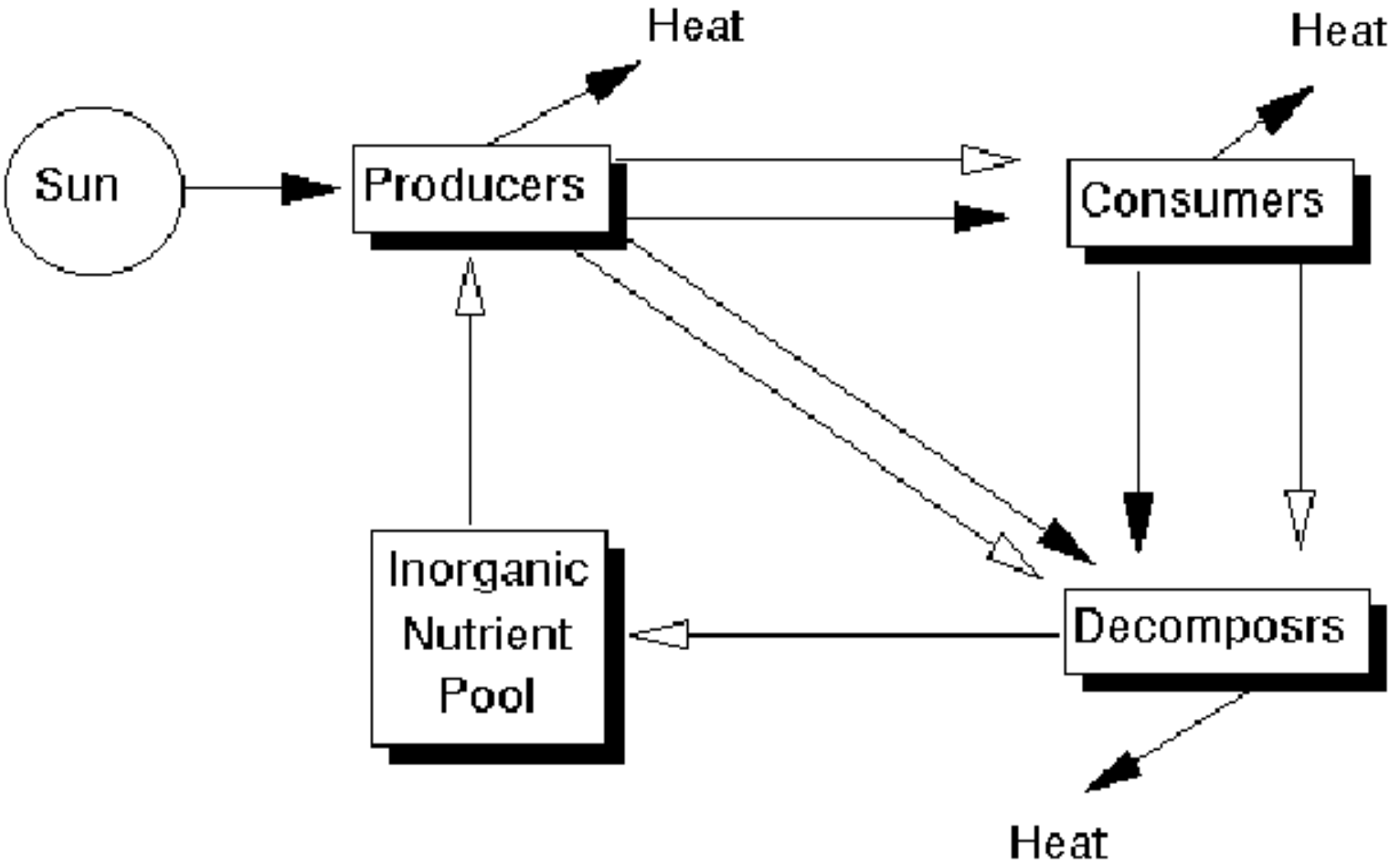
The sound gets lower because there is less energy the further away you go. Eventually it gets lost.

Energy Loss

- As energy moves up through a food chain, large amounts of it are lost due to the following reasons:
- (1) lower order consumer dies before being consumed
- (2) each consumer uses some energy for its own needs before being consumed
- (3) not every part of an individual is consumed
- (4) not every part of an individual is digested
- Only approximately 10% of the energy present at a trophic level is available for the next level

Thermodynamics

- Energy transfer must obey the laws of thermodynamics, which help limit the energy passed between trophic levels.
- **1st Law** - energy can be transformed, but cannot be created or destroyed.
- **2nd Law** - as energy is transformed, some is converted to thermal energy which cannot be passed on. Therefore, some energy is lost during every transfer.


Heat
Heat
Sun
Producers
Consumers
Inorganic
Nutrient
Pool
Decomposrs
Heat

Energy Transfer in a food chain- Example:

Spruce Tree → Deer → Wolf

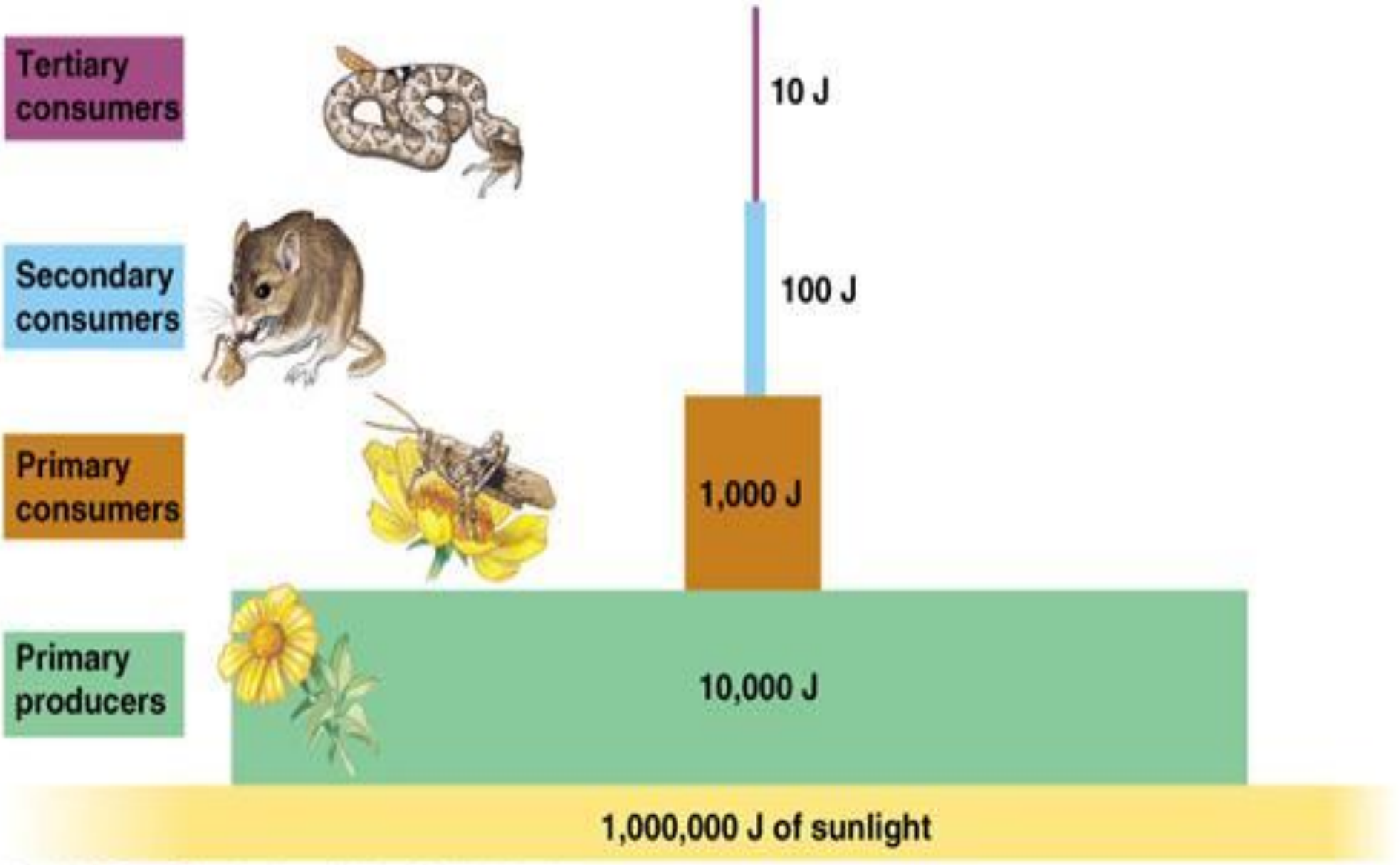
*Deer only eats buds, not whole tree.
*Not all bud digested, some is excreted.
*Energy lost as wasted heat in chemical process of digestion.
*Some energy used to fuel deer's cells.
*Wolf doesn't eat hoofs, bones, and skin so only gets part of energy stored in deer tissue
*Therefore, about 10% of the energy of the plant that was transferred to the deer is available to the wolf.

Pyramids of Energy, Numbers, and Biomass

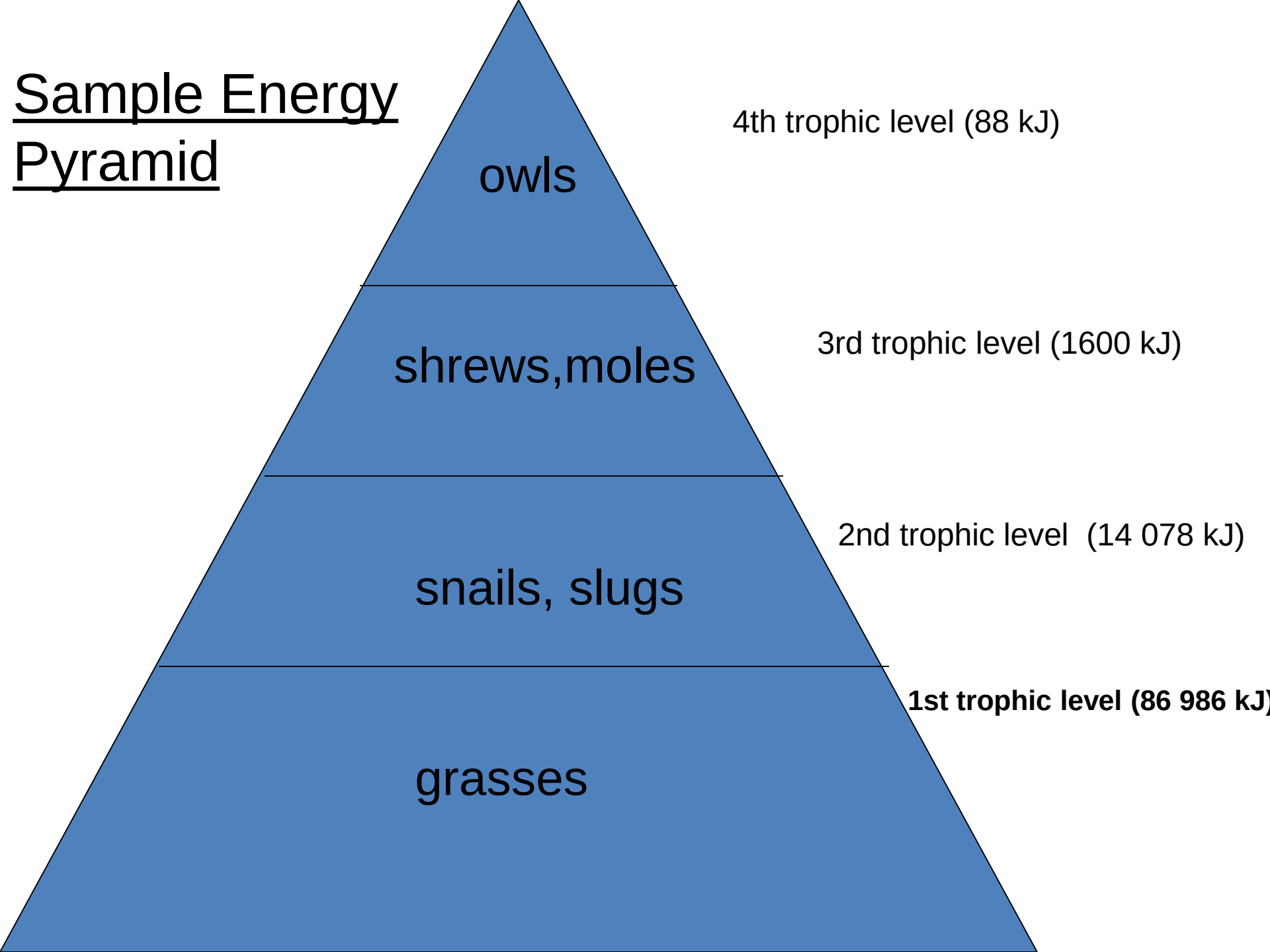
Graphs called pyramids are often used to represent food chains.

Pyramid of Energy - Trophic levels are stacked in blocks with producers forming the foundation of the pyramid. The size of each block is proportional to the amount of energy at that level. (Refer to page 37, figure 6).

Pyramid of Energy



Sample Energy Pyramid



Note:

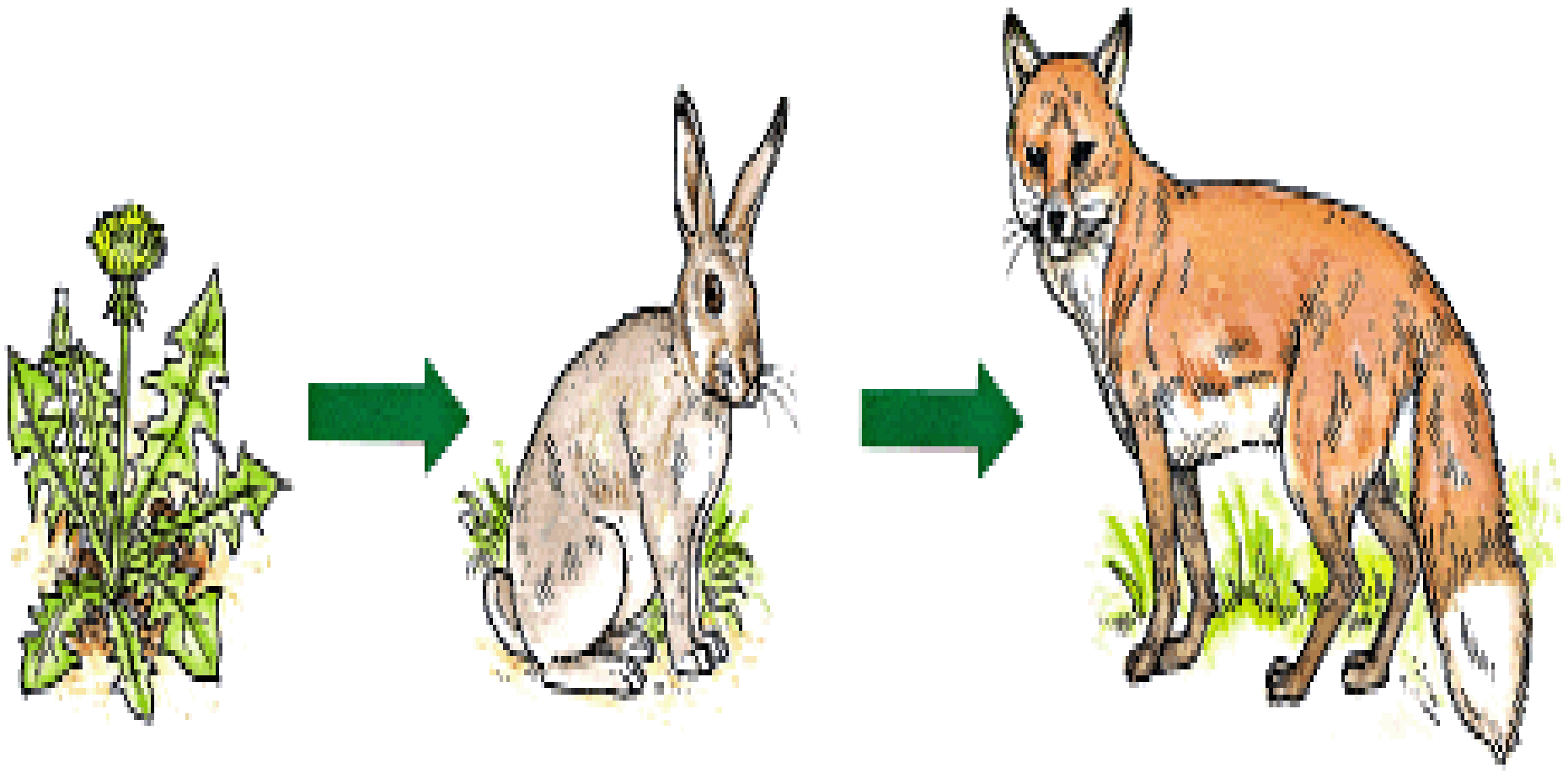
- 14 087 kJ is 16% of 86 986 kJ
- 1600 kJ is 11% of 14 078 kJ
- 88 kJ is 6% of 1600 kJ

(1 kJ = 239 calories)

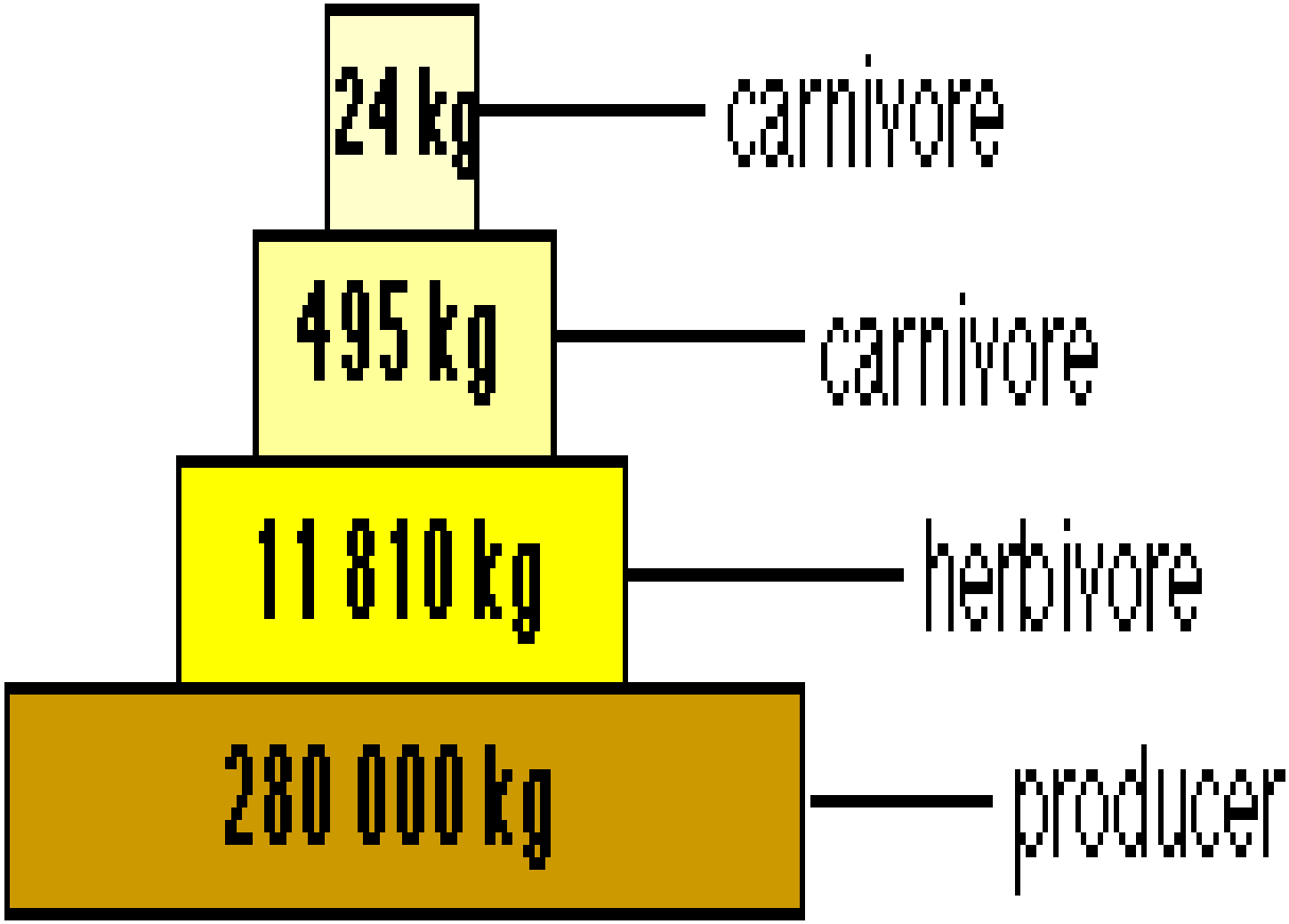
* 88 kJ is 0.1% of 86 986 kJ, or in other words, 1/1000 of the original amount of energy that entered the food chain at the producer level.

An important ecological consequence of decreasing energy transfer through a food chain can be seen in a **Biomass Pyramid.**

Pyramid of Biomass: Each tier represents the standing biomass (total dry weight of all organisms) in a trophic level. Biomass pyramids narrow sharply from producers at the base to top-level carnivores at the apex. (see text page 38, figure 9)


This dandelion
is eaten by
the rabbit
that is eaten by
the fox.

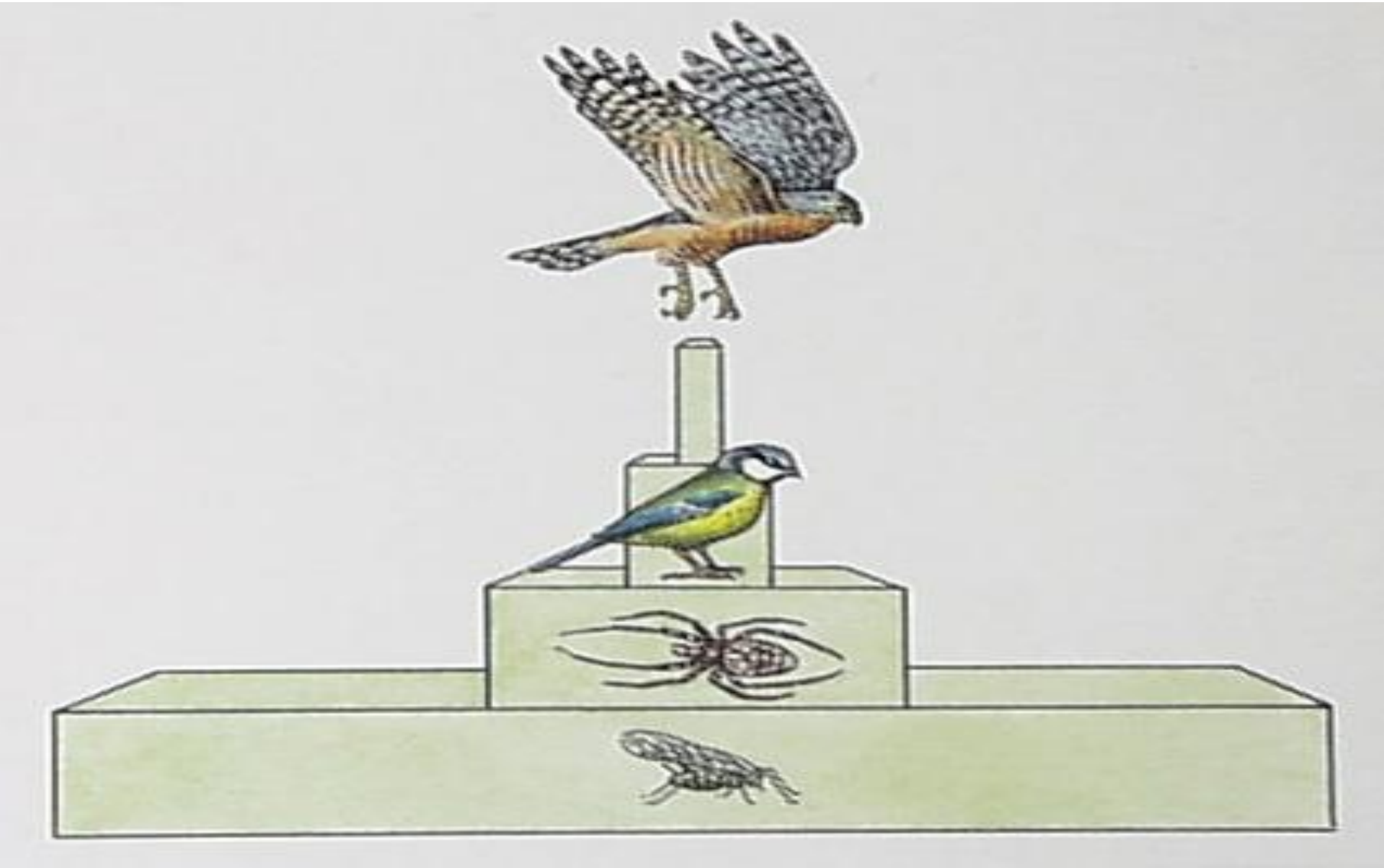
Sample Biomass Pyramid



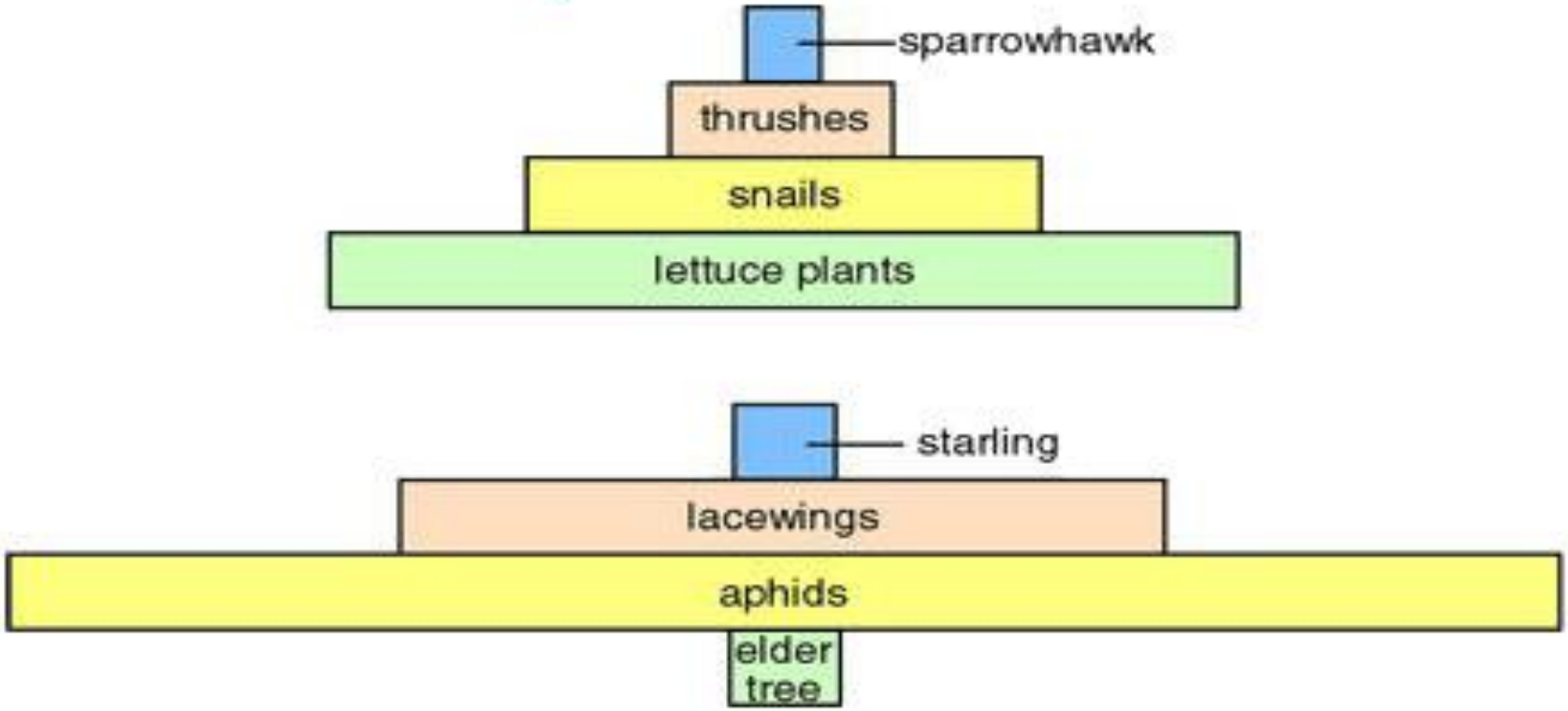
Pyramid of Numbers: The size of each tier is proportional to the number of individual organisms present in each trophic level. Like biomass pyramids, numbers pyramids *usually* narrow sharply from producers at the base to top carnivores at the apex.

**There are many exceptions to the structure of the basic numbers pyramid. This is due to the physical size of members within a food chain. E.g. many tiny aphids (an insect that feeds on the sap of plants) may be found feeding on a single tree. (see text page 37, figure 8)

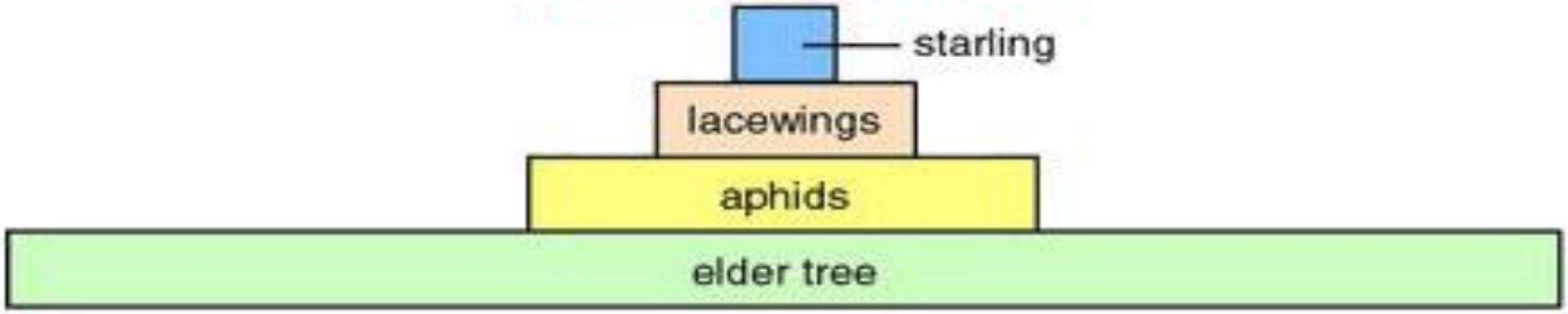
Pyramid of Numbers-



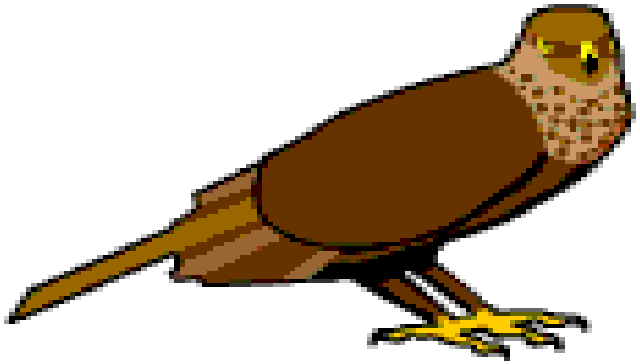
Pyramid of Number



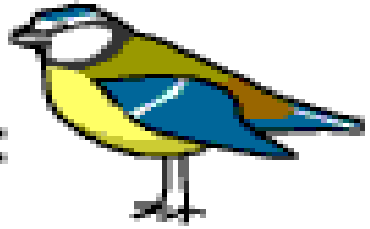
Pyramid of Biomass



Pyramid of biomass-



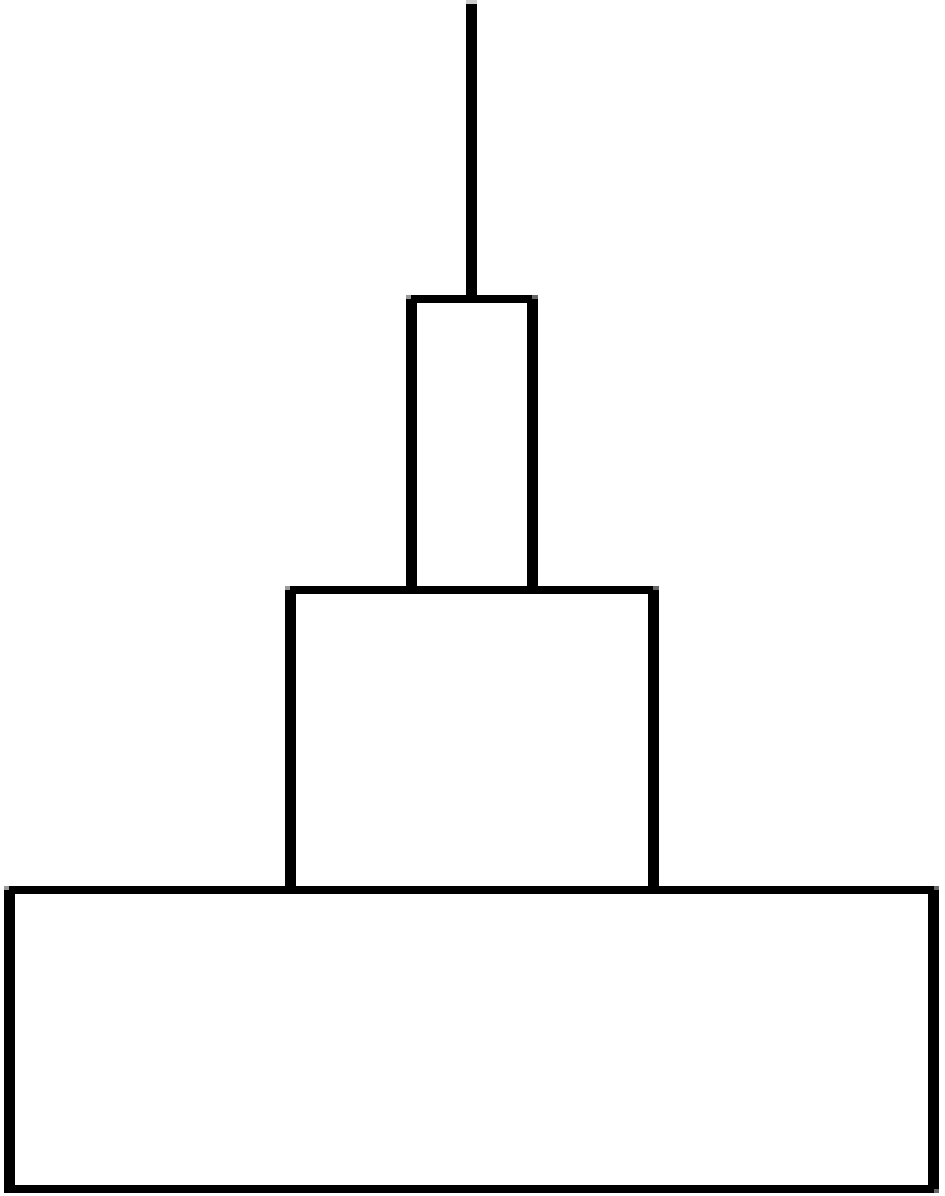
Sparrowhawk



Bluetit

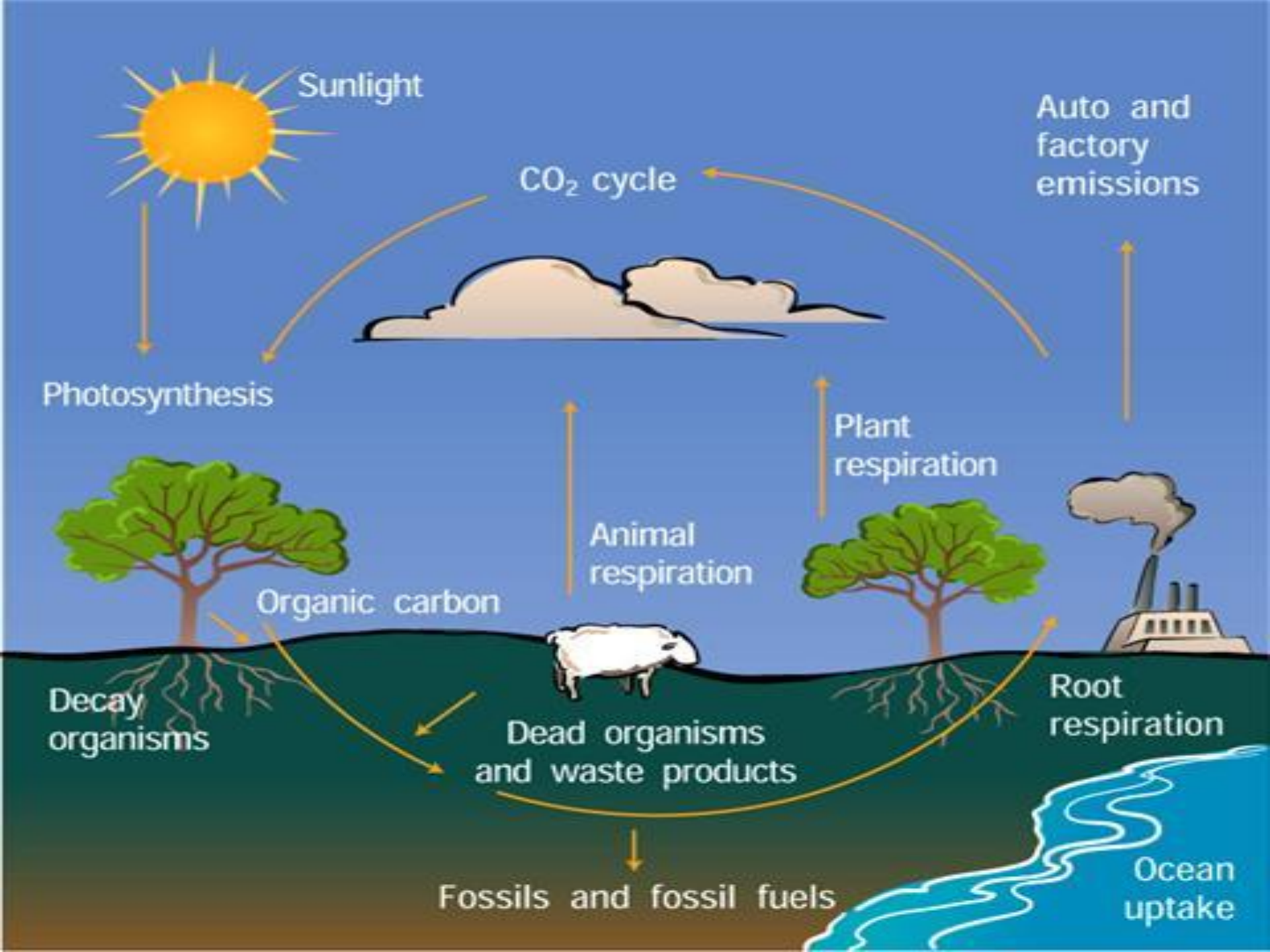
Caterpillar

Oak tree



Cycling of Matter in Ecosystems

- The carbon cycle- the matter in which, through the process of photosynthesis, digestion, cellular respiration, decomposition, and combustion, carbon atoms move from an inorganic form in the air, water, or soil, to an organic form in living things, and then back to an inorganic form; all organic compounds contain carbon.


Sunlight
CO_2 cycle
Auto and factory emissions
Photosynthesis
Plant respiration
Animal respiration
Organic carbon
Decay organisms
Dead organisms and waste products
Root respiration
Fossils and fossil fuels
Ocean uptake

The carbon cycle

- All living things are made of carbon
- Carbon is returned to the atmosphere or water as carbon dioxide from body waste, and decomposing bodies.
- Some is converted to fossil fuels (coal) and must be burned in order to return to the environment.

The carbon cycle

- Reservoirs for Carbon:

- Inorganic (not containing a combination of carbon, hydrogen, and oxygen):
  - Atmosphere- carbon dioxide
  - Oceans- dissolved carbon dioxide, and calcium carbonate in shells.
  - Earths crust- carbon in sediments, in the ocean, are heated to form rocks.

- Organic (containing a combo of carbon, hydrogen, and oxygen):
  - Bodies of living things
  - Bogs- peat
  - Coal- compressed peat

The carbon cycle

- Humans increase the amount of carbon in the Carbon Cycle:
  - Mining and burning fossil fuels
  - Burning forests
  - Cleaning vegetation (less vegetation=less use of CO_2)

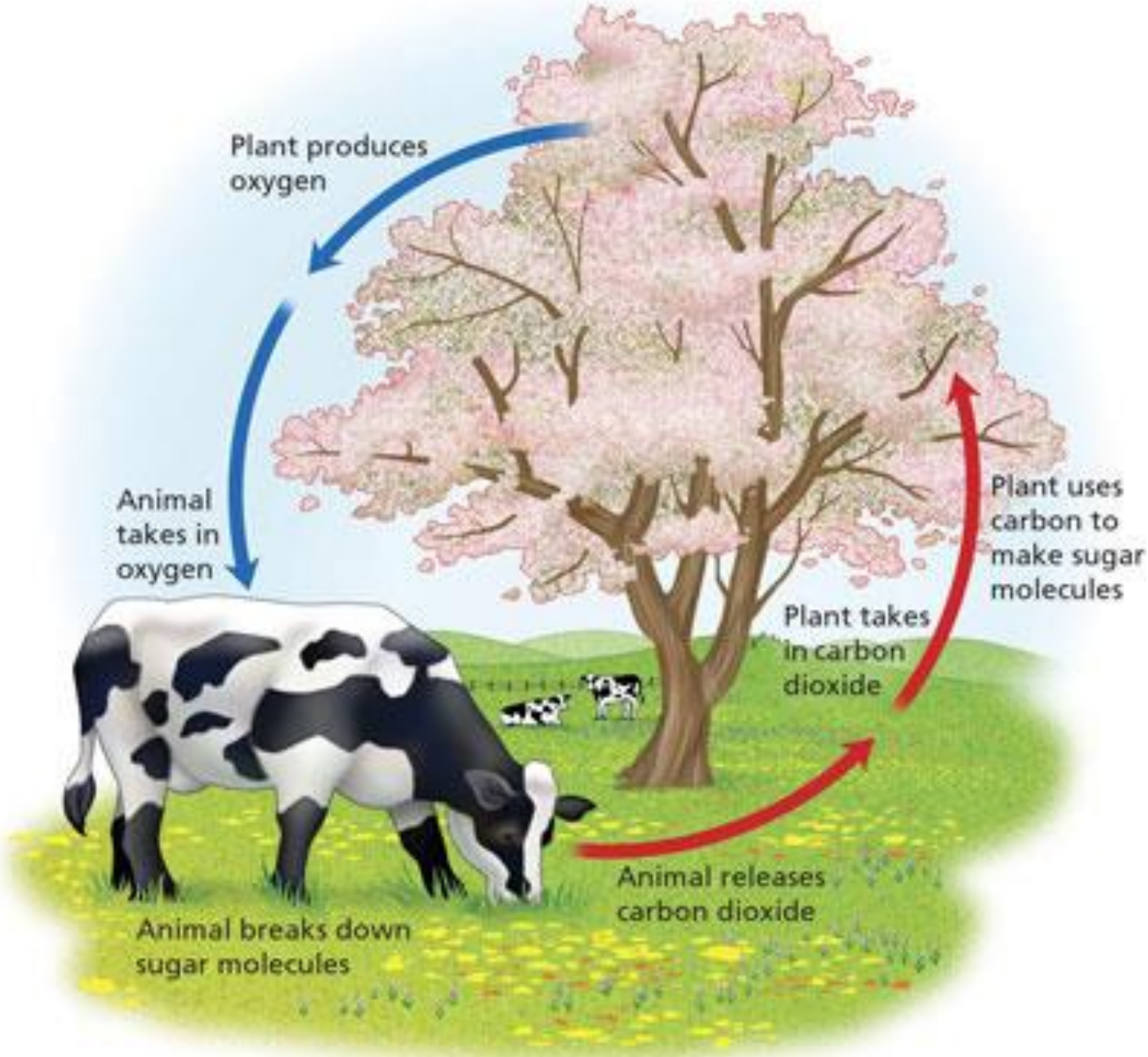
Photosynthesis

- The process by which green plants and some other organisms use sunlight energy, carbon dioxide, and water to produce carbohydrates (sugars) and oxygen.

- Chemical formula:

$6CO_2 + 6H_2O + \text{Light} \rightarrow C_6H_{12}O_6 + 6O_2$

- Carbon dioxide + Water + Light → Sugar + Oxygen


Plant produces oxygen
Animal takes in oxygen
Plant uses carbon to make sugar molecules
Plant takes in carbon dioxide
Animal releases carbon dioxide
Animal breaks down sugar molecules

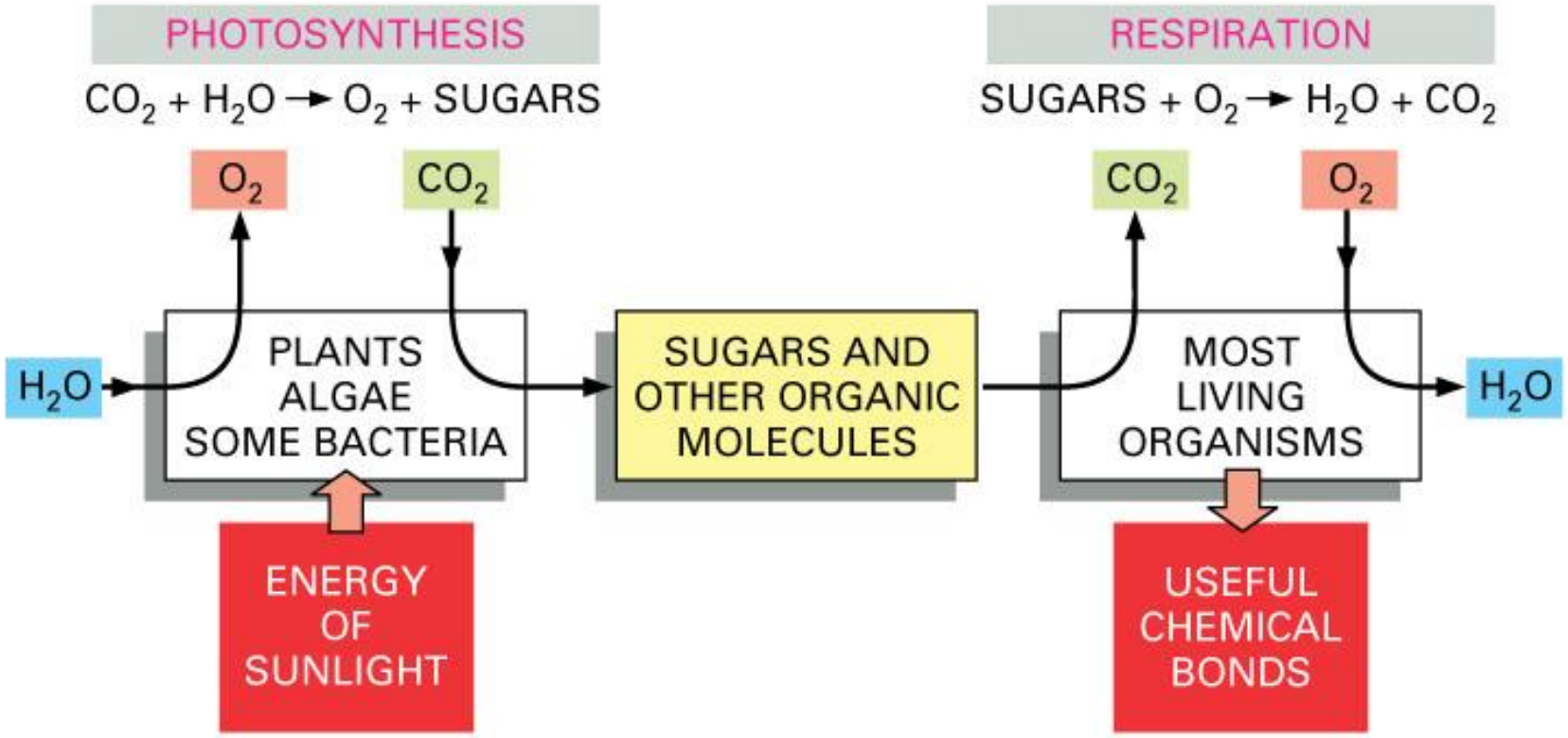


Figure 3-10 Essential Cell Biology, 2/e. (© 2004 Garland Science)

Cellular Respiration

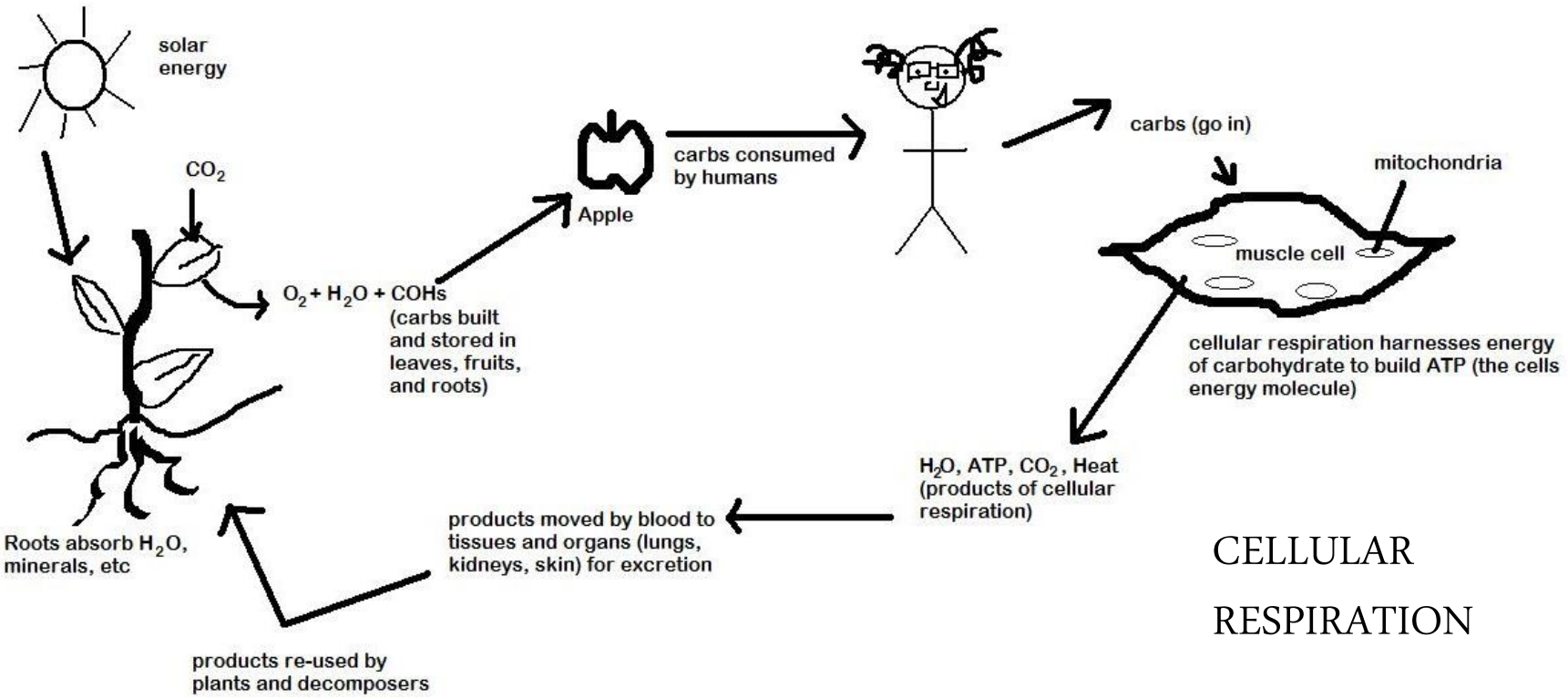
- The process by which most living things generate useful energy, by combining sugars and oxygen to produce carbon dioxide and water.

- Chemical formula:

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6H_2O + 6CO_2$

- Sugar + Oxygen $\longrightarrow$ Water + Carbon dioxide

Photosynthesis and Cellular Respiration are complementary



CELLULAR RESPIRATION

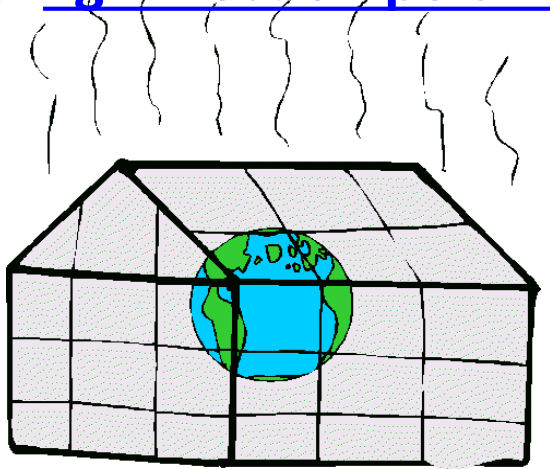
PHOTOSYNTHESIS

The Greenhouse Effect

- The process by which gases build up energy in the form of warmth in the atmosphere by absorbing infrared radiation from the Earth's surface (just like a greenhouse)

- Greenhouse gases: water vapour, carbon dioxide, ozone, and methane.

- Effects: Melting ice caps, increase in sea levels, extinction of plants and animals. **Eg. Effect on polar bears.**



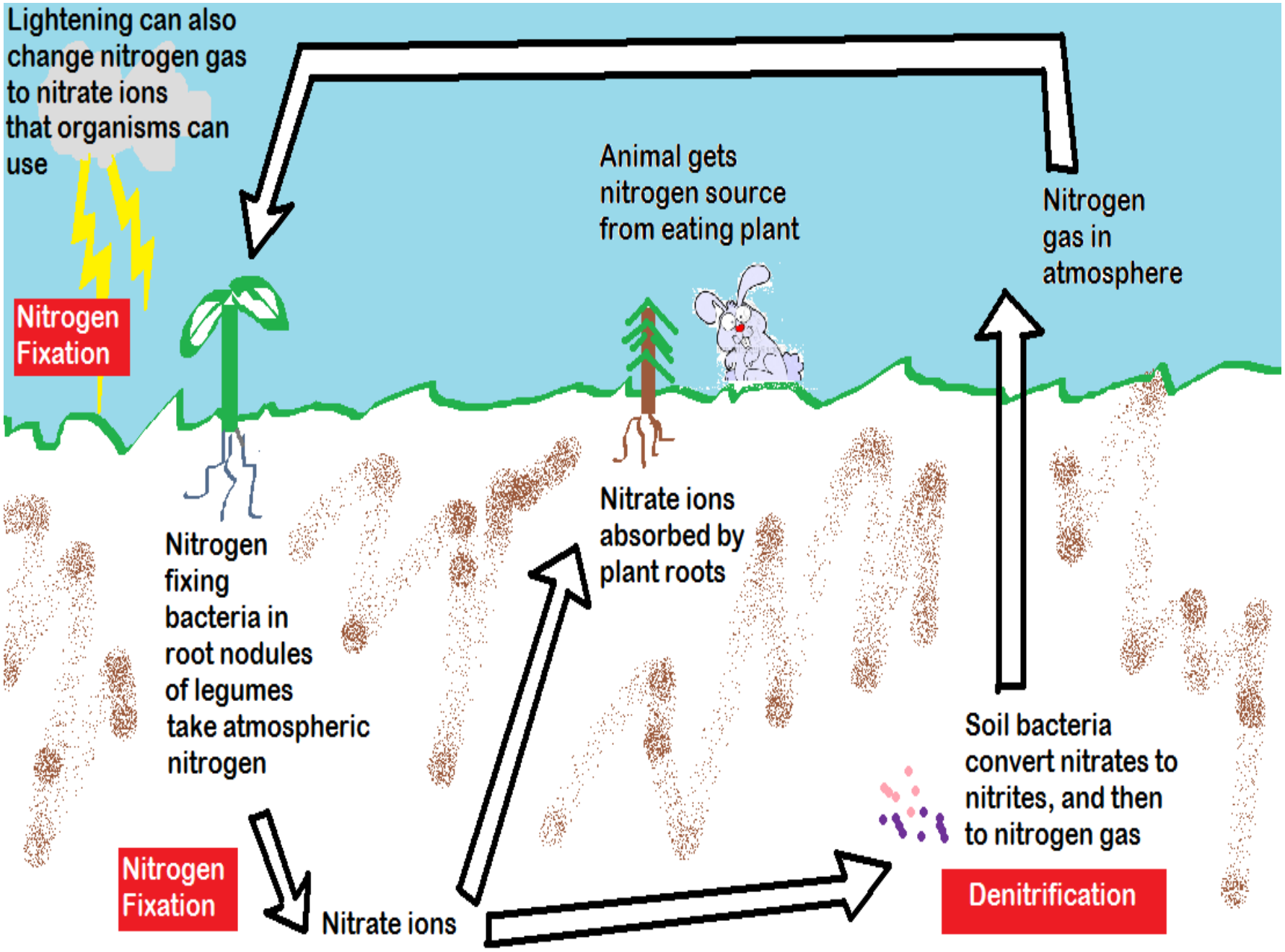
Cycling of Matter in Ecosystems

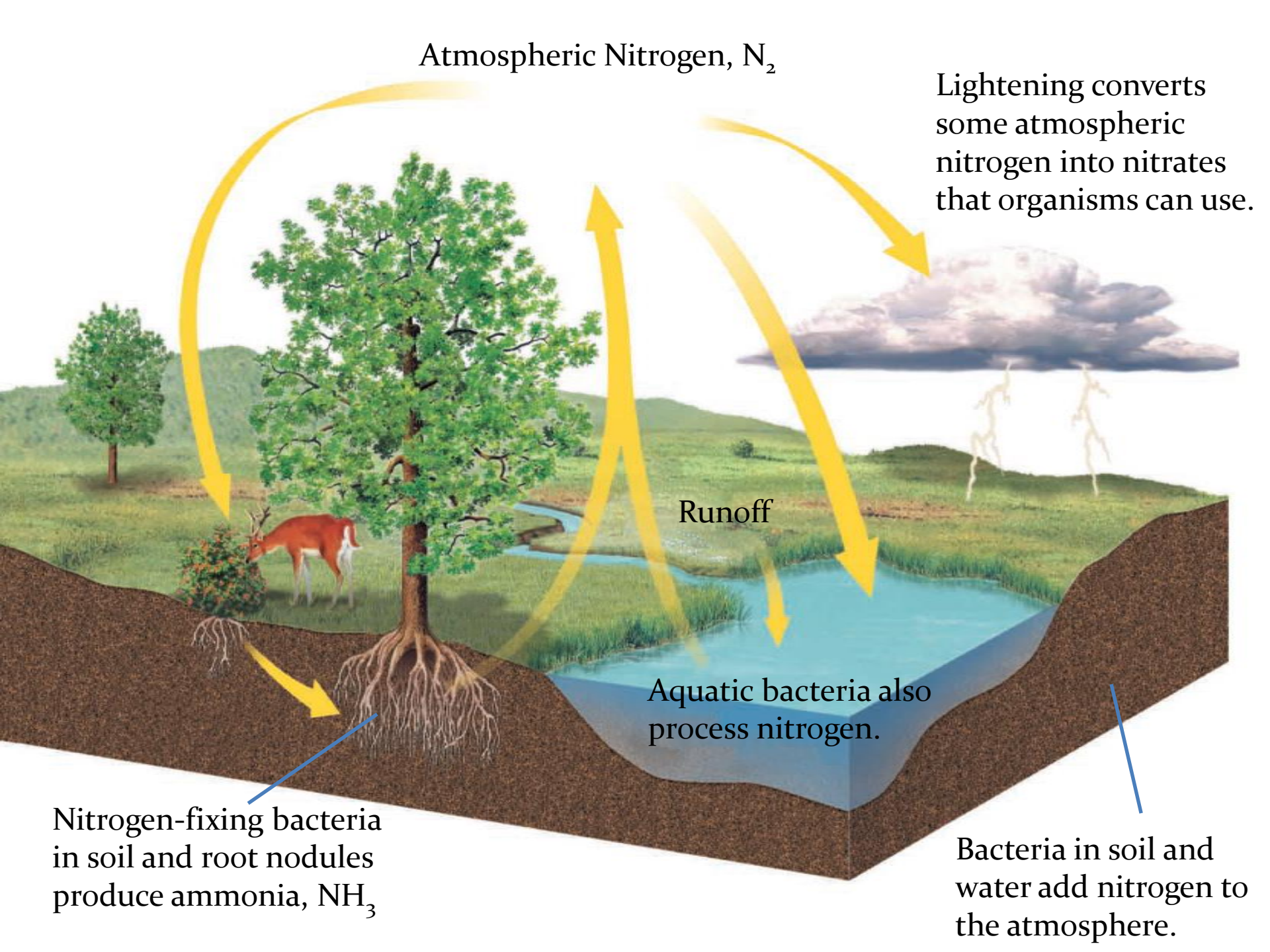
- **<u>The nitrogen cycle</u> :**
- Nitrogen atoms move from nitrogen gas (N_2)in the atmosphere, to inorganic forms in the soil, to organic forms in living things, and then back to inorganic forms in the soil and N_2 gas in the atmosphere
- Processes within the cycle include nitrogen fixation (including ammonification), synthesis, decomposition, assimilation and denitrification
- Organic compounds that contain nitrogen include amino acids, proteins, and DNA.

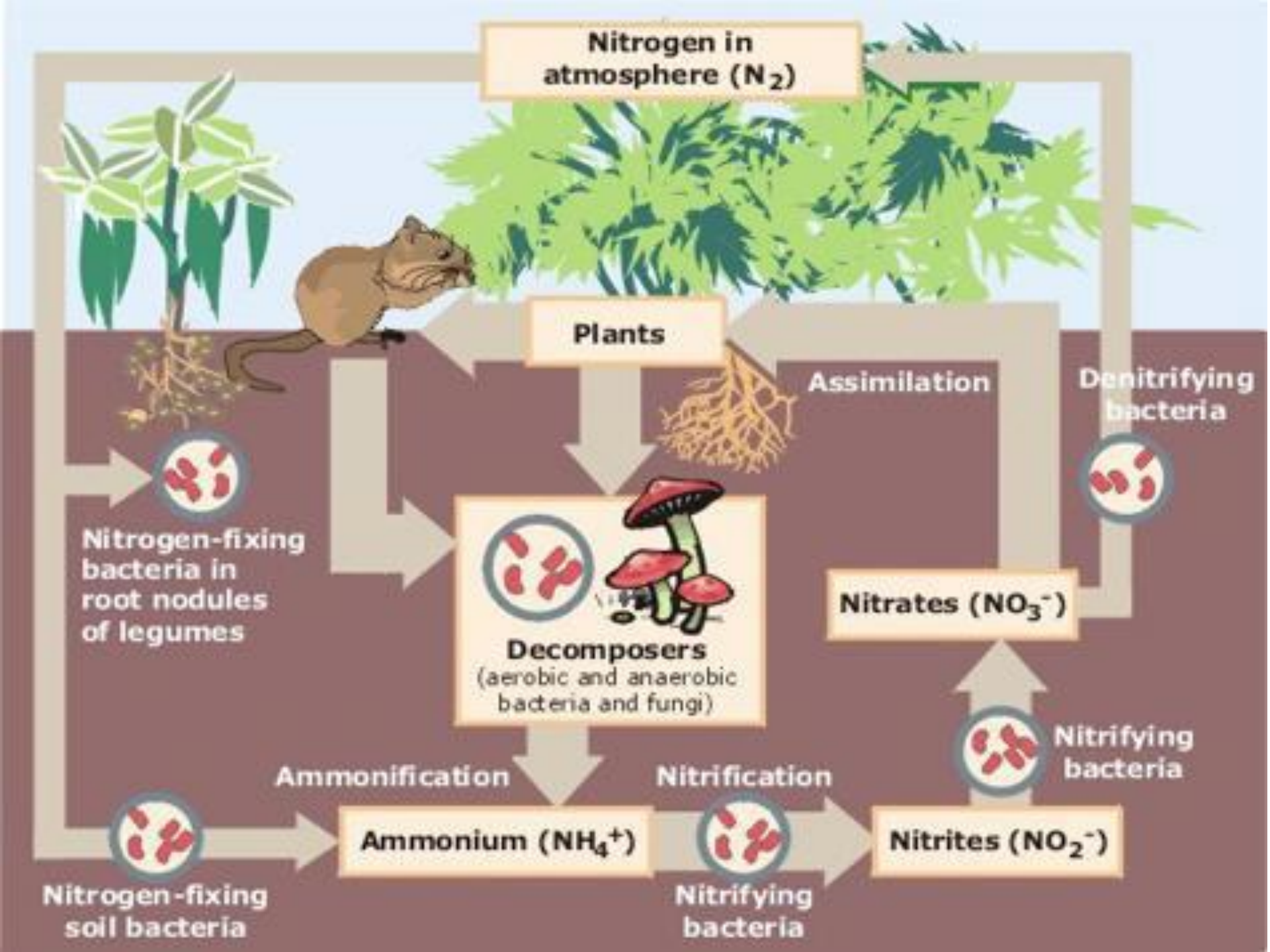
The nitrogen cycle

- Nitrogen fixation- two processes in which atmospheric or dissolved nitrogen is converted into nitrate ions; both lightning and some soil bacteria can fix nitrogen

- Denitrification- the process preformed by some soil bacteria, in which nitrates are converted to nitrites, and then to nitrogen gas.


Lightening can also change nitrogen gas to nitrate ions that organisms can use
Nitrogen Fixation
Animal gets nitrogen source from eating plant
Nitrogen gas in atmosphere
Nitrate ions absorbed by plant roots
Nitrogen fixing bacteria in root nodules of legumes take atmospheric nitrogen
Soil bacteria convert nitrates to nitrites, and then to nitrogen gas
Nitrogen Fixation
Nitrate ions
Denitrification


Atmospheric Nitrogen, N_2
Lightening converts some atmospheric nitrogen into nitrates that organisms can use.
Runoff
Aquatic bacteria also process nitrogen.
Nitrogen-fixing bacteria in soil and root nodules produce ammonia, NH_3
Bacteria in soil and water add nitrogen to the atmosphere.


Nitrogen in atmosphere (N_2)
Plants
Assimilation
Denitrifying bacteria
Nitrogen-fixing bacteria in root nodules of legumes
Decomposers
(aerobic and anaerobic bacteria and fungi)
Nitrates (NO_3^-)
Nitrifying bacteria
Ammonification
Nitrification
Ammonium (NH_4^+)
Nitrites (NO_2^-)
Nitrogen-fixing soil bacteria
Nitrifying bacteria

The nitrogen cycle

- Nitrogen is required by all cells to make proteins
- Also required by living things to make DNA.

- Nitrogen Gas-
  - Composes 79% of the atmosphere

Fertilizers

- Fertilizers- materials used to restore nutrients and increase production from land.
  - Contains nitrogen and phosphates.

- Can cause environmental problems:
  - Nitrogen can cause trouble with blood cells, reducing the ability to carry oxygen to tissues. And…

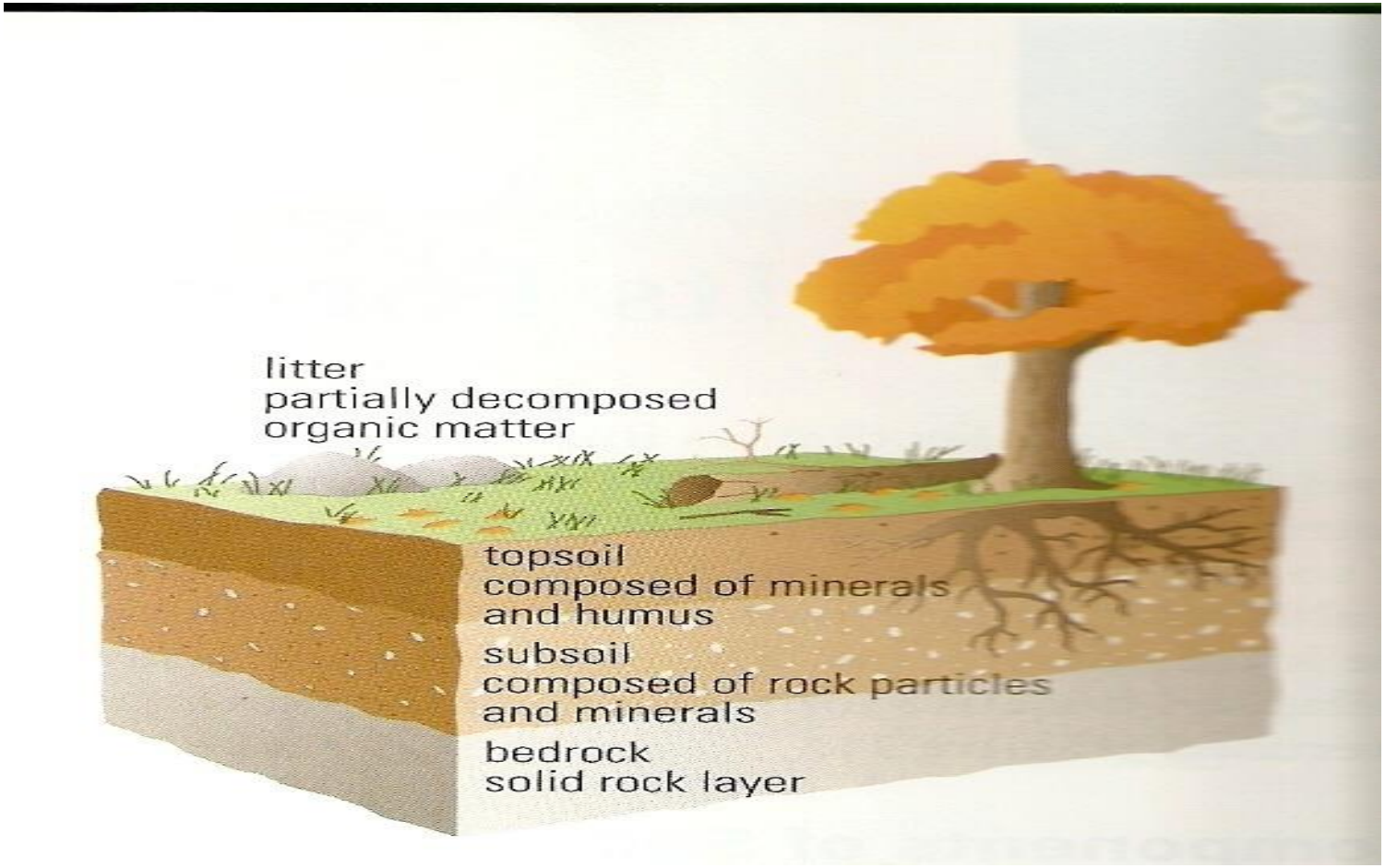
Fertilizers

- Spring run-off carries the fertilizers to ponds and lakes.
- The nutrients allow algae in the water to grow more rapidly.
- Increase of food for the algae = lots of algae.
- Lots of algae = less oxygen in lake = dead fish.

Before

After

Soil



- Figure 2, Page 98

Components of Soil :

- **Litter** – upper layer, composed of partially decomposed plants
- **Topsoil** – small rock particles and decaying plant and animal material (***humus***)
- **Subsoil** – rocky, very little organic matter
- **Bedrock** – solid rock

Soil Formation:

- Bedrock is broken down by weathering.
- Lichens also secrete acids which erode rock, and add nutrients to developing soil when they decompose.
- New plants grow as the soil becomes thicker, then die and add to the soil.

Water Beneath the Soil:

- **Surface water** – precipitation collects and flows above ground
- **Ground water** – surface water seeps into the soil (**percolation**)
- The upper level of ground water is called the **water table**, which rises and falls with precipitation levels.
- Some organic matter and minerals dissolve in ground water (**leaching**) and are carried away.

Sustainable system-

- A system that survives and functions over time. A system that meets the needs of present and future generations.

Short term vs. Long term change

- Short term stresses: (Sustainable ecosystems will bounce back)
  - Seasonal peaks in temperature
  - Changes in water supply
  - Sudden but limited human impact

- Long term changes: (Ecosystems may not be able to survive)
  - Climate change
  - Permanent human influence
  - Infestation by exotic plants and animals

Deforestation

- Clear cutting- the removal of all trees in an area. Normally followed by replanting the dominant species.
  - Result is closer to a farm than a natural ecosystem.
  - If only one species lives there, they're more susceptible to disease than natural forest.
  - Soil run off increases → algal blooms
  - Loss of forest plants=loss in forest animals

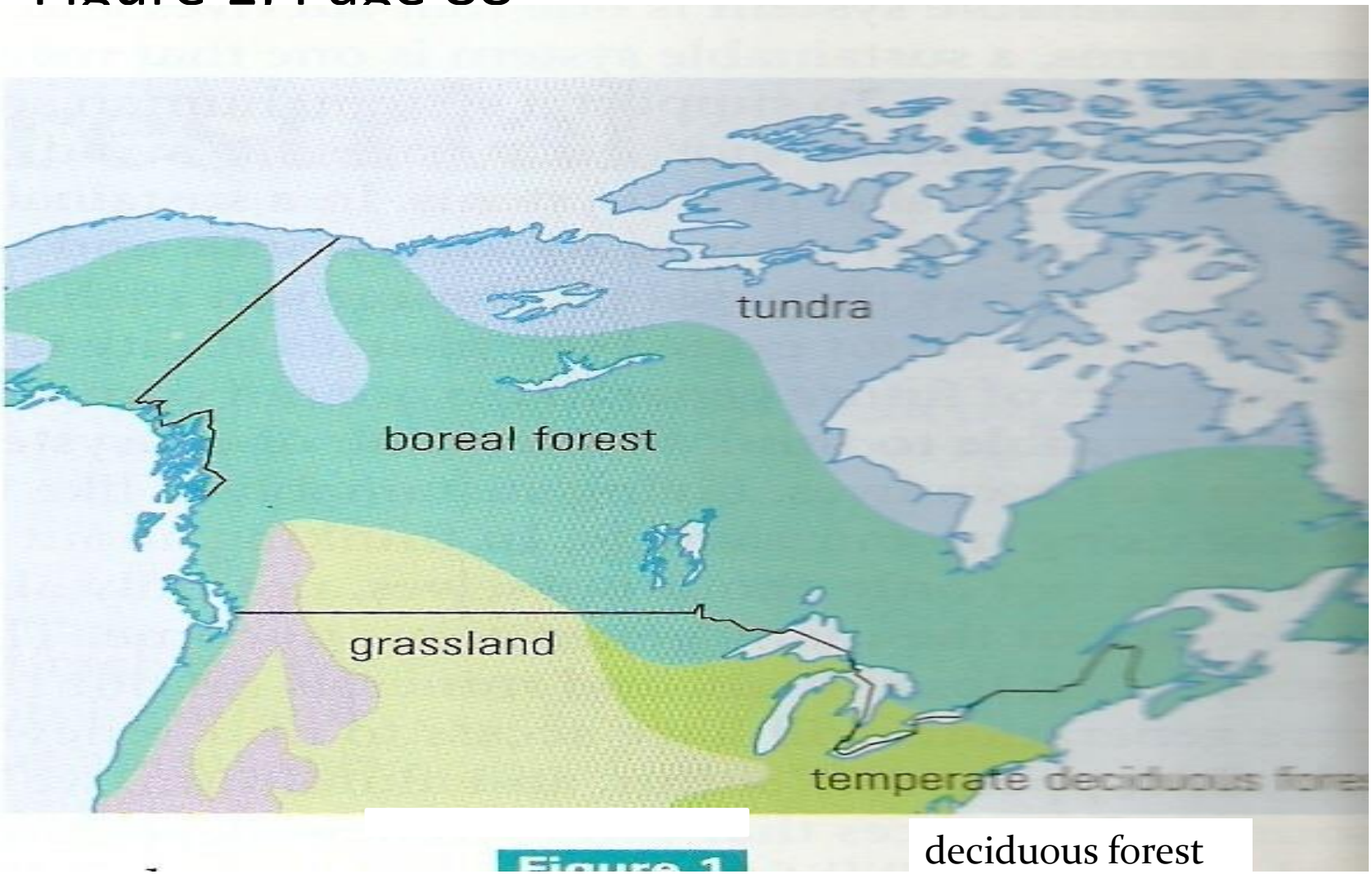
- Selective cutting- only certain trees are harvested from an area, usually the largest and most valuable.
  - More expensive
  - Leaves a healthier forest

Canadian Biomes

- Biome- a collection of ecosystems that are similar or related to each other, usually in the type of plant life they support.
- There are 4 Canadian Biomes: (Page 88-93)
  - The Tundra Biome- most North
  - The Boreal Forest Biome- all over Canada
  - The Temperate Deciduous Forest Biome- most South
  - The Grassland Biome- out West

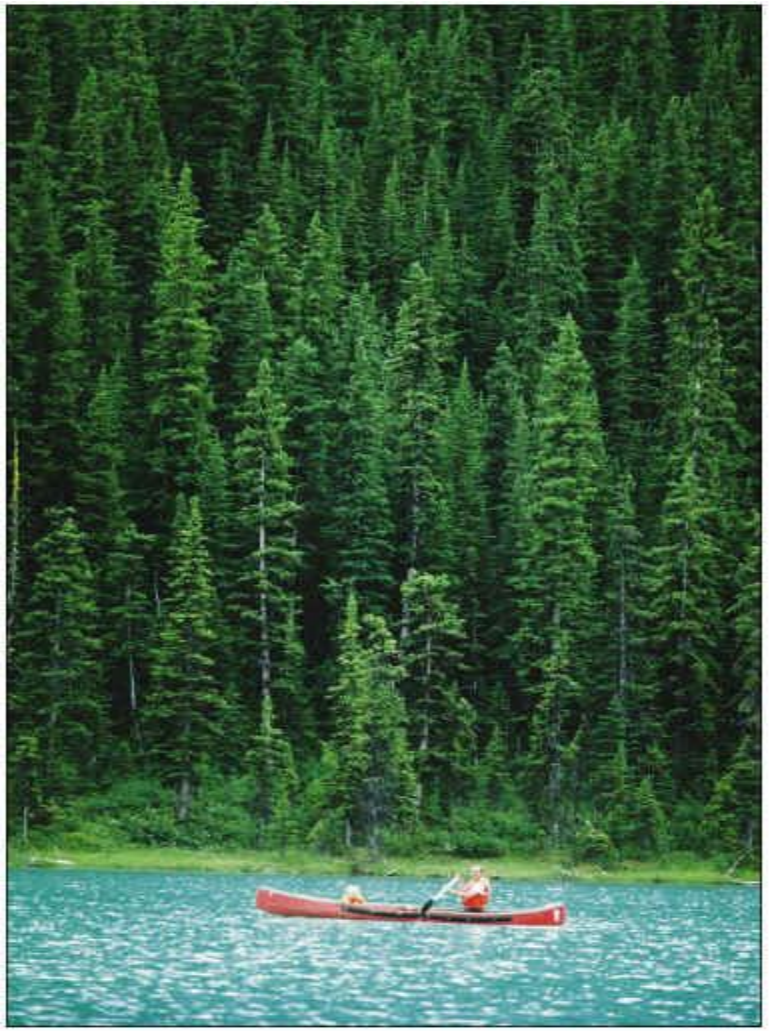
Canadian Biomes

- Figure 1. Page 88



The Boreal Forest Biome

- South of Tundra, found in every province
- More precipitation than tundra, and higher temps.
  - Higher temp, so organic matter can decompose more rapidly, therefore better soil.



The Boreal Forest Biome

- Dominated by ***coniferous (evergreen) trees***, seed eating birds, deer, small rodents, snowshoe hares, and grey wolves.





The Boreal Forest Biome

- Table 2, Page 90

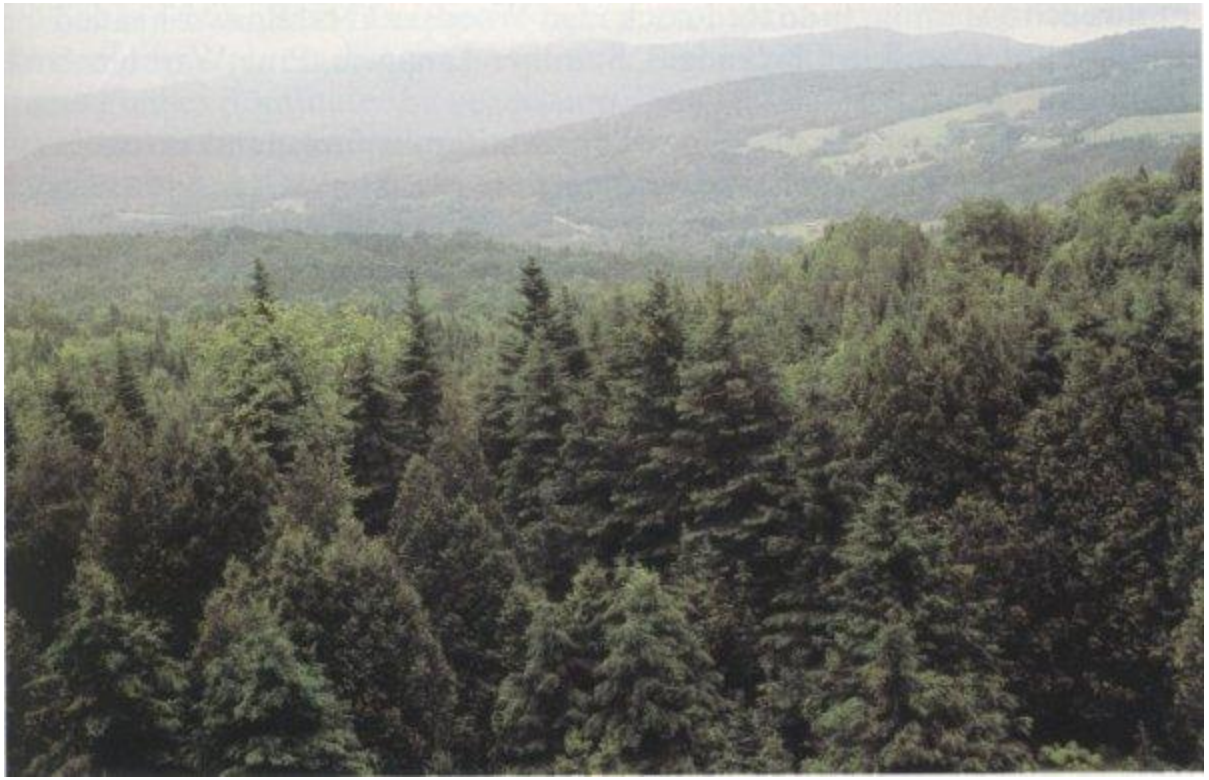
Table 2 **The Boreal Forest Biome**

Abiotic factors	Community
• warmer than tundra (no permafrost) • changeable weather • soil contains some water and is acidic • precipitation 40 cm/a or more	• coniferous trees (Figure 9) • seed-eating birds • squirrels • voles • snowshoe hares • deer • pine martens (Figure 9) • grey wolves

The Boreal Forest Biome

The Newfoundland Pine Marten

The Boreal Forest Biome



Coniferous trees

The Boreal Forest Biome

Grouse

Crossbill

The Boreal Forest Biome

Grey Squirrel

Crazy man-eating squirrel

The Boreal Forest Biome

Vole

Deer

The Boreal Forest Biome

The grey wolf

The Tundra Biome

- Northernmost biome- COLD!
- Little precipitation (10-12 cm per year)
- Small number of organisms
  - caribou, mosses/lichens, ptarmigan, lemmings, arctic foxes, wolverines, rapid-flowering plants.

The Tundra Biome

- Very short growing season- plants need to grow quickly, flower, and seed before winter returns.

- Plants need to deal with:
  - Permafrost- a layer of soil that never thaws
  - Active layer- (above permafrost) thaws in the summer to permit uptake of water and minerals by plant roots.

The Tundra Biome

- Table 1, Page 89

Table 1 The Tundra

Abiotic factors	Communities
• very low temperatures for most of the year • short growing season • permafrost layer beneath soil • low precipitation • poor soil quality	• rapid-flowering plants (Figure 4) • mosses and lichens • caribou • ptarmigan (Figure 4) • lemmings • arctic foxes • wolverines

The Tundra Biome

Lichens

Mosses

The Tundra Biome

Fireweed

Blueberries

The Tundra Biome

Ptarmigan in the winter and in the summer

The Tundra Biome

An arctic fox in winter and summer

The Tundra Biome

Wolverine

The Tundra Biome

Caribou

The Tundra Biome

An arctic lemming in the winter and summer

The Temperate Deciduous Forest Biome

- South of boreal forest, in Eastern and Central Canada
- Dominated by deciduous trees (maple, oaks)
- Large ecotone between boreal forest and temperate deciduous forests.
- Very rich soil

The Temperate Deciduous Forest Biome

- Light can reach forest floor, so more plants grow underneath large trees.
- Precipitation up to 100 cm a year; moderate temperatures
- These factors support many species of birds and mammals.
  - Insects, rodents, deer, black bear, woodpeckers,




The Temperate Deciduous Forest Biome

- Figure 10, Page 91

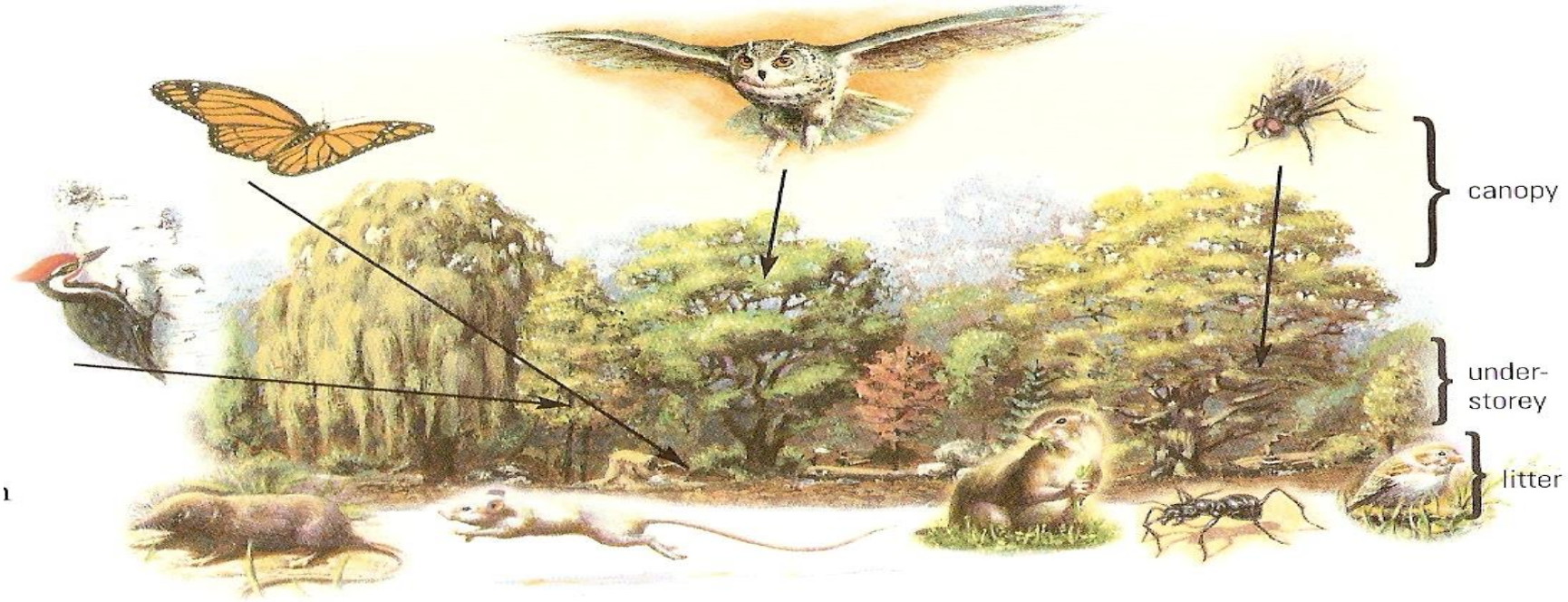


Figure 10

Among Canada's biomes, the deciduous forest contains the greatest biodiversity because it can support organisms in three different layers.

The Temperate Deciduous Forest Biome

- Table 3. Page 92

Table 3 **The Deciduous Forest Biome**

Abiotic factors	Community
• longer growing season than boreal forest • higher temperatures than tundra or boreal forest • fertile soil • precipitation up to 100 cm/a	• deciduous trees (Figure 13) • many shrubs, ferns • tree and ground squirrels • many insects (Figure 13) • shrews, mice • deer • black bears • woodpeckers • weasels • wolves

The Temperate Deciduous Forest Biome

Deciduous Trees

Autumn

Spring

Winter

Summer

The Temperate Deciduous Forest Biome

Ferns

Shrubs

The Temperate Deciduous Forest Biome

Shrew

Mouse

The Temperate Deciduous Forest Biome

Weasel

The Temperate Deciduous Forest Biome

Black Bear

The Grassland Biome

- Found at same latitude of Temperate Deciduous Forest therefore similar abiotic factors.

- Ecotone exists between boreal forest and grassland.

- The most fertile soil in the world.

The Grassland Biome

- Precipitation fairly low, from 25 to 75 cm a year.

- Dominated by grasses, grasshoppers, bison, voles/mice, snakes, hawks, wolves.

The Grassland Biome

- Table 4, Page 93

Table 4 The Grassland Biome

Abiotic factors	Community
• longer growing season than boreal forest • higher temperatures than tundra or boreal forest • rich, fertile soil • precipitation from 25 to 75 cm/a	• fescue grasses (Figure 16) • grasshoppers • bison • voles, mice • snakes (Figure 16) • hawks • wolves

The Grassland Biome

Photo: C. Wallis

Fescue grasses

The Grassland Biome

Grasshoppers

The Grassland Biome

Bison

The Grassland Biome

Hawk

The Grassland Biome

Prairie rattlesnake

BIOME	ABIOTIC FACTORS	COMMUNITY
Tundra		
Boreal Forest		
Temperate Deciduous		
Grassland		

Succession

- Natural process by which the vegetative makeup of an ecosystem changes over time.
- The first (pioneer) species in an area will have certain characteristics: fast growing, well dispersed, little need for a large amount of nutrients. As succession proceeds, and the area becomes replenished, these species will tend to be replaced by more competitive species.
- Eventually, a climax community will be established. A climax community is the dominant *stable* vegetation in an ecosystem.
- 2 Types of Succession:

1. Primary Succession

- An ecosystem is completely transformed.
- Can occur on land or in water.
- On land – known as “bare-rock” succession.
- An area of newly exposed or formed rock that has not been previously occupied or experienced any growth.
- **Extremely** gradual.

Primary Succession – Pond Succession (aka. Eutrophication)

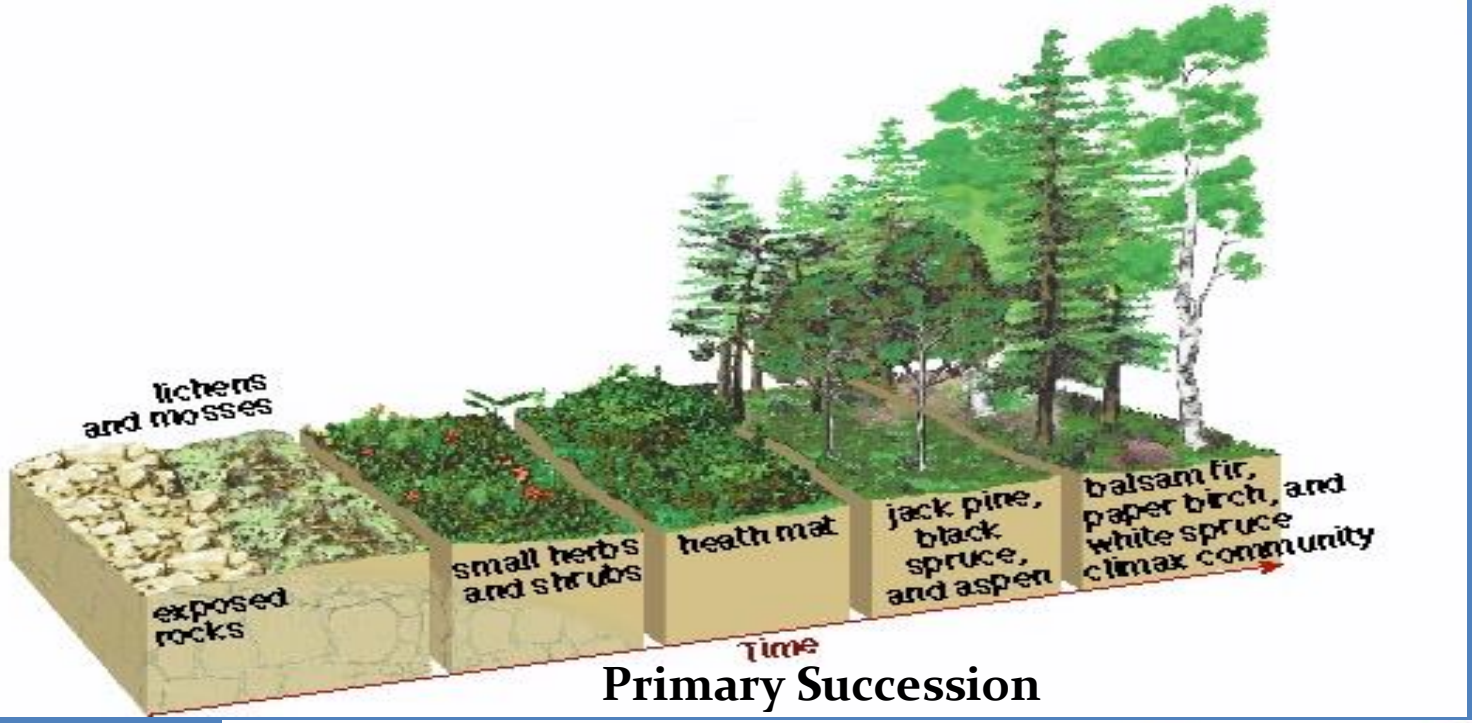
- Step 1- a pioneer community inhabits the pond. Ex: Algae, bacteria
- Step 2- sediment deposits build up on the bottom of the pond, making it more shallow. Ex: small invertebrates, soil.
- Step 3- a marsh forms as the pond fills in. Ex: cattails, bulrushes, etc.
- Step 4- A climax community forms as a terrestrial community replaces an aquatic one. Ex: shrubs, trees.

2. Secondary Succession

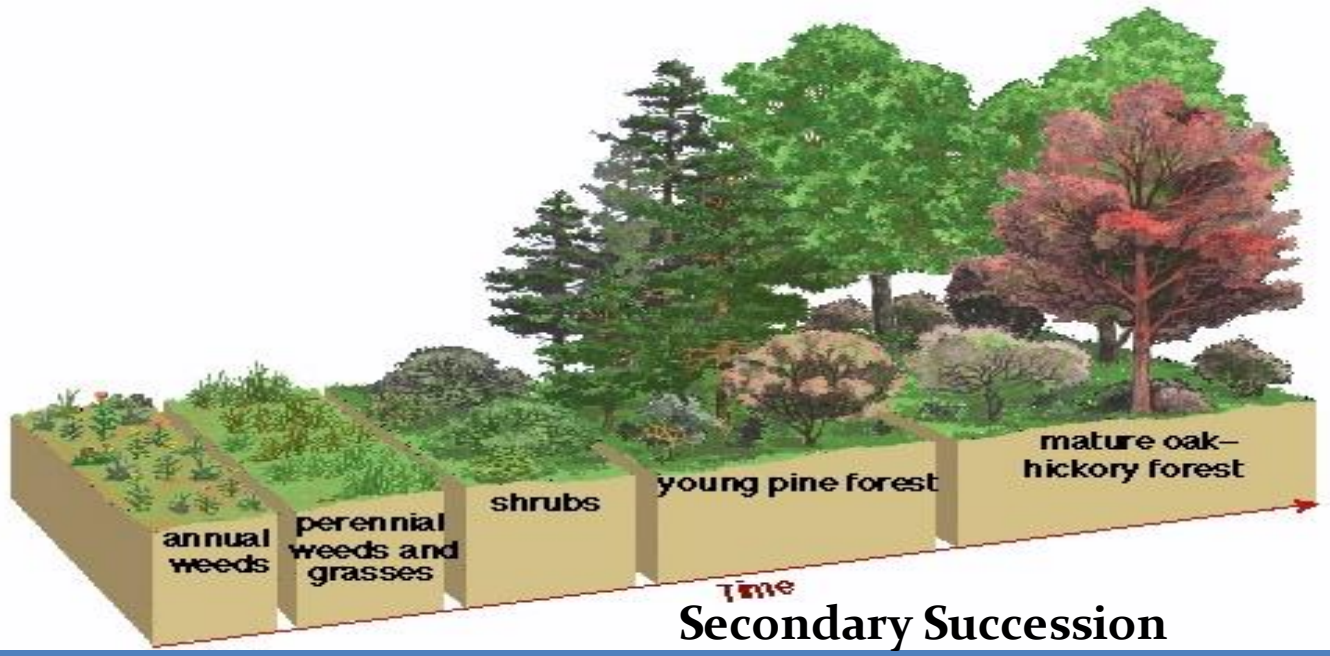
- Takes place when a community has been removed; i.e. there is a disturbance.
- Examples: forest fire, tsunami, flood, etc.
- Occurs **much** more rapidly than primary succession.

Climax Community-

- is a community of plants which, through the process of succession has reached a steady state. This equilibrium occurs because the climax community is composed of species best adapted to average conditions in that area.



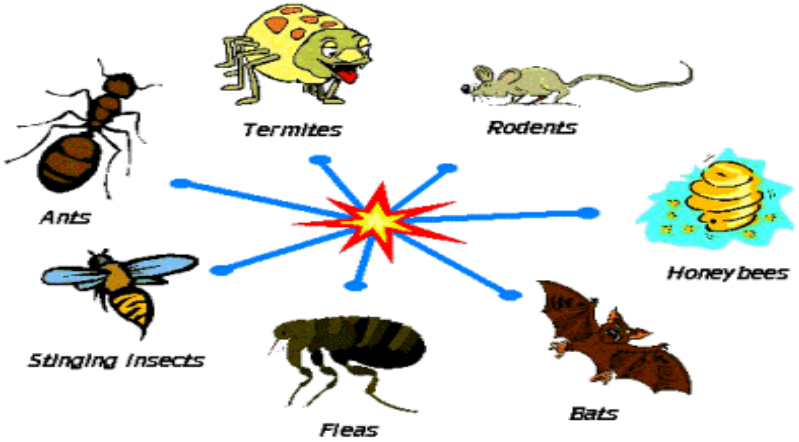
Primary Succession



Secondary Succession

Pests and Pesticides:

- Pest- an organism that people consider harmful or inconvenient.



Pesticides- Chemicals designed to kill pests.

Pests and Pesticides:

- Different categories of pesticides have changed and evolved over time:
- 1st Generation: Pure metals: arsenic, lead, mercury. Harm to people and pests.
- 2nd Generation: The first chemical pesticides made in a lab. They are fat soluble but not water soluble, so they stored in fat tissue and did not get broken down. (e.g. DDT)
- 3rd Generation: Water soluble (not stored in fats)Animals can excrete them. Used more frequently now.

DDT

- A person-made pesticide. Swiss chemist Paul Muller was awarded a Nobel Prize in 1948 "for his discovery of the high efficiency of DDT as a contact poison against several arthropods."

- DDT is toxic to a wide range of animals in addition to insects.

- It is a reproductive toxicant, and it is a major reason for the decline of many birds of prey.

- DDT causes the eggshells to thin, leading to less chicks and a decline in the population.

- In humans: has been known to cause headache, nausea, vomiting, confusion, and tremors. DDT has also been linked to cancer.

- Banned in US in 1972.

- PARADIGM SHIFT!!!!!

"DDT is good for me-e-e!"

The great expectations held for DDT have been realized. During 1946, exhaustive scientific tests have shown that, when properly used, DDT kills a host of destructive insect pests, and is a benefactor of all humanity.

Pennsalt produces DDT and its products in all standard forms and is now one of the country's largest producers of this amazing insecticide. Today, everyone can enjoy added comfort, health and safety through the insect-killing powers of Pennsalt DDT products . . . and DDT is only one of Pennsalt's many chemical products which benefit industry, farm and home.

GOOD FOR FRUITS—Bigger apples, juicier fruits that are free from unsightly worms . . . all benefits resulting from DDT dusts and sprays.

GOOD FOR STEERS—Beef grows meatier nowadays . . . for it's a scientific fact that—compared to untreated cattle—beef-steers gain up to 50 pounds extra when protected from horn flies and many other pests with DDT insecticides.

Knox Out FOR THE HOME—helps to make healthier, more comfortable homes . . . protects your family from dangerous insect pests. Use Knox-Out DDT Powders and Sprays as directed . . . then watch the bugs "bite the dust"!

Knox Out FOR DAIRIES—Up to 20% more milk . . . more butter . . . more cheese . . . tests prove greater milk production when dairy cows are protected from the annoyance of many insects with DDT insecticides like Knox-Out Stock and Barn Spray.

KILLING SALT

CHEMICALS

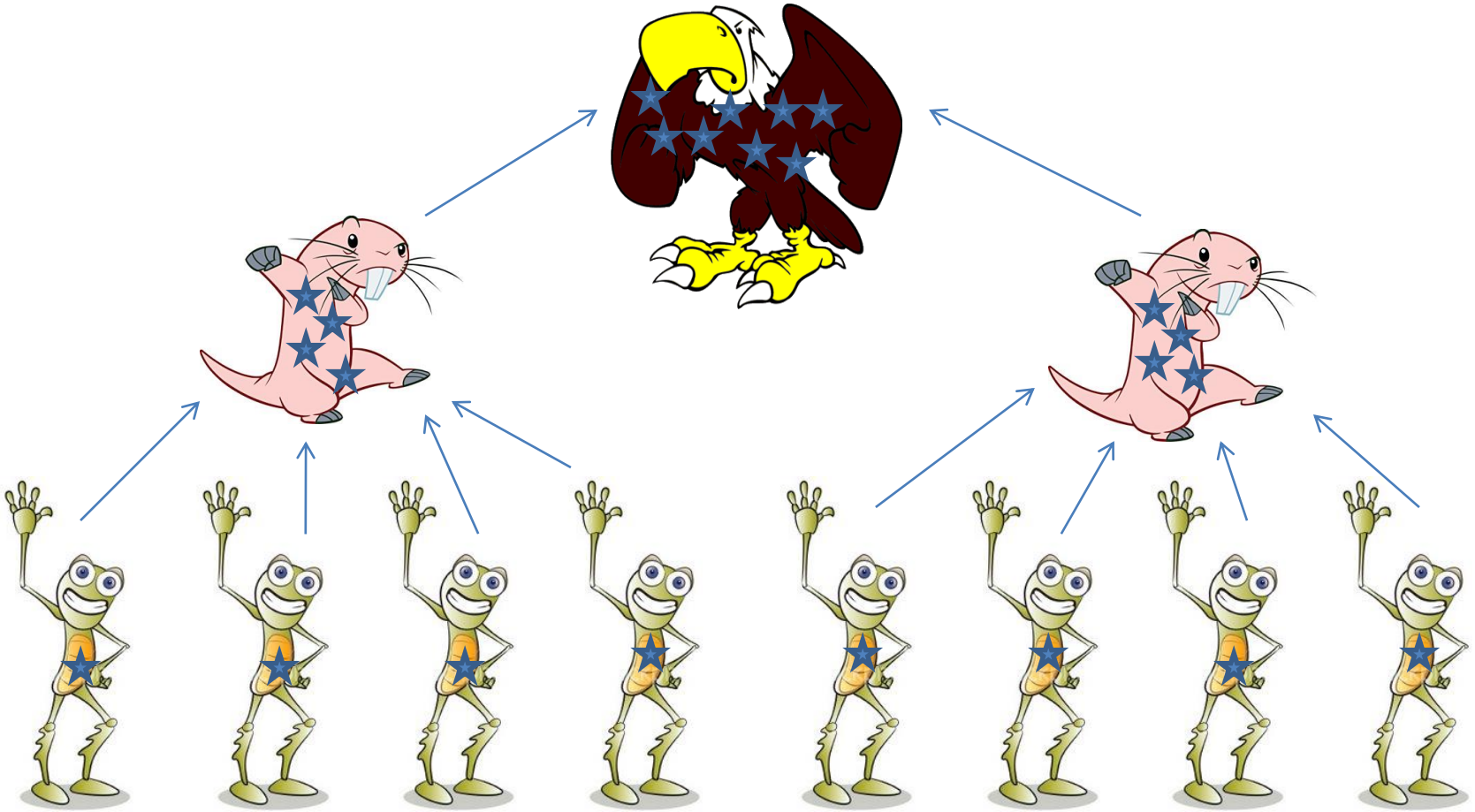
97 Years' Service to Industry • Farm • Home

GOOD FOR ROW CROPS—*25 more barrels of potatoes per acre* . . . actual DDT tests have shown crop increases like this! DDT dusts and sprays help truck farmers pass these gains along to you.

Knox Out FOR INDUSTRY—Food processing plants, laundries, dry cleaning plants, hotels . . . dozens of industries gain effective bug control, more pleasant work conditions with Pennsalt DDT products.

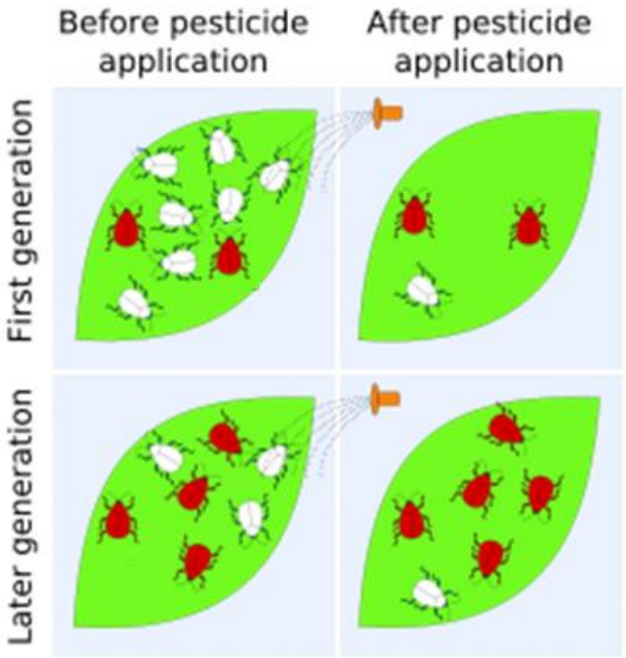
Bioamplification (aka. Biomagnification)

- The increased concentrations of toxin as it is consumed on the way up the food chain. (See Fig. 4 page 54)
- Especially evident with the use of 2nd generation pesticides (e.g. DDT) which are not water soluble and store in fat tissue.

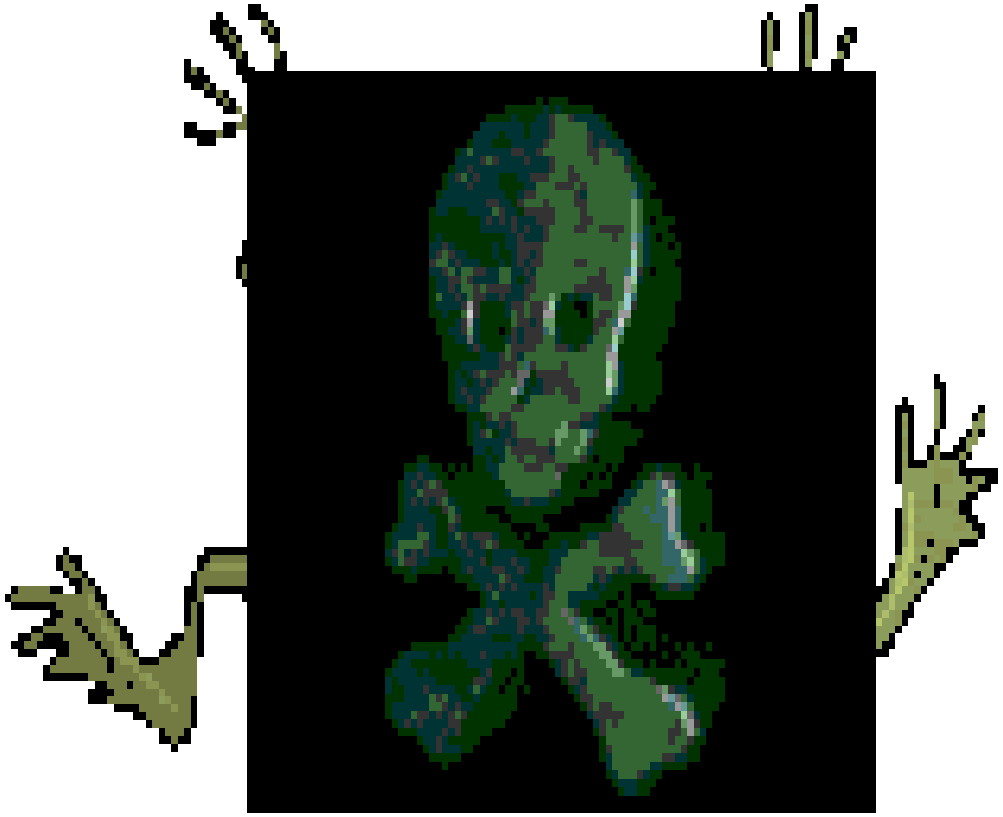


Pests and Pesticides:

- Continued applications of the same pesticide allow insects populations to gradually become resistant. See Fig. 5 page 55



The Disappearance of Frogs



- Ecologists are constantly concerned about changes within ecosystems, and the effects humans have on their stability.
- Certain organisms may act as ***bioindicators*** by revealing changes within an ecosystem.
- Frogs are good bioindicators due to their two life cycles:
- (i) eggs and tadpoles live in ponds
- (ii) adults live in forests and grasslands
- They are exposed to the hazards of **both** ecosystems, so a decline in the health of either environment will impact frogs.

Frogs have been disappearing worldwide for a variety of possible reasons:

- 1. Loss of Habitat
- 2. Pollution
- 3. Ultraviolet Radiation
- 4. Climate Change (Global Warming)

1. Loss of Habitat

- wetlands and ponds are needed to breed and lay eggs
- forests and fields are needed for feeding and growth
- humans destroy frog habitat by draining wetlands, logging, building roads, etc.

2. Pollution

- Frog's have thin, moist skin through which pollutants can pass through easily (e.g. acid rain)
- Acid rain can also affect reproduction.

3. Ultraviolet Radiation

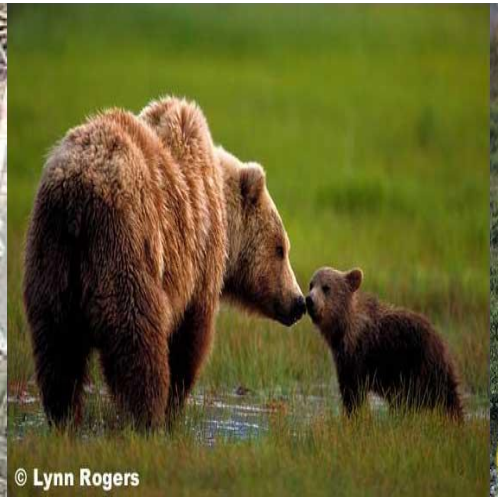
- Increase in UV radiation is caused by damage to the ozone layer.
- A frog's thin skin makes it highly susceptible.
- UV radiation has also caused an increase in human skin cancer.

4. Climate Change

- Global warming is caused by the release of greenhouse gases, especially carbon dioxide.
- These gases cause an excess of radiant heat to be trapped within our atmosphere, resulting in a rise in the Earth's overall surface temperature.
- Higher temperatures cause aquatic ecosystems to dry up - this affects all stages of the frog's life cycle.

Classification of At-Risk Species:

- **Endangered- a species that is close to extinction. Example: Newfoundland Marten.**
- **Extirpated- a species that no longer exists in one part of its range. Example: Canadian Grizzly bears. The grizzlies once lived as far east as the Red River of Manitoba, but were extirpated at the time of human settlement.**
- **Threatened – a species likely to become endangered if current factors persist. Example: Woodland Caribou**
- **Vulnerable (Special Concern) – a species with declining numbers in a part of its range. Example: Harlequin Duck.**
- **Extinct- a species that no longer exists anywhere on Earth.**

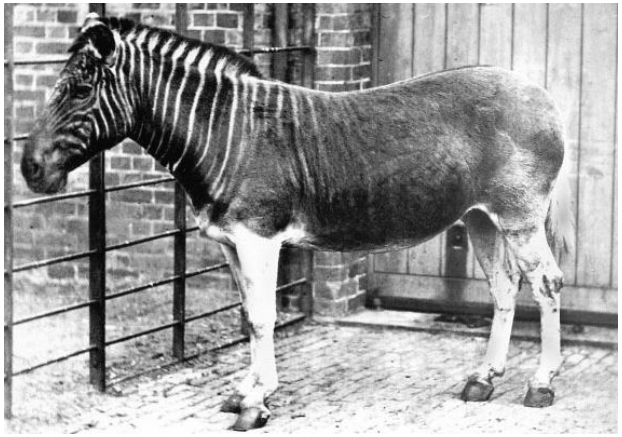


Extinct animals

- Tasmanian Tiger was hunted to extinction in the 19th century by settlers on the Australian island state of Tasmania. The last known one died at Hobart Zoo in 1936.

Extinct animals

- The *Quagga*. Went extinct in 1883. The quagga had been hunted to extinction for meat, hides, and to preserve feed for domesticated stock. The last wild quagga was probably shot in the late 1870s, and the last specimen in captivity, a mare, died on 1883 at the Artis Magistra zoo in Amsterdam.



Extinct animals

- Passenger pigeon- Some reduction in numbers occurred as a result of loss of habitat when the Europeans started settling further inland. The primary factor emerged when pigeon meat was commercialized as a cheap food for slaves and the poor in the 19th century, resulting in hunting on a massive scale. There was a slow decline in their numbers between about 1800 and 1870, followed by a catastrophic decline between 1870 and 1890."Martha", thought to be the world's last passenger pigeon, died on Sept. 1, 1914.

Extinct animals

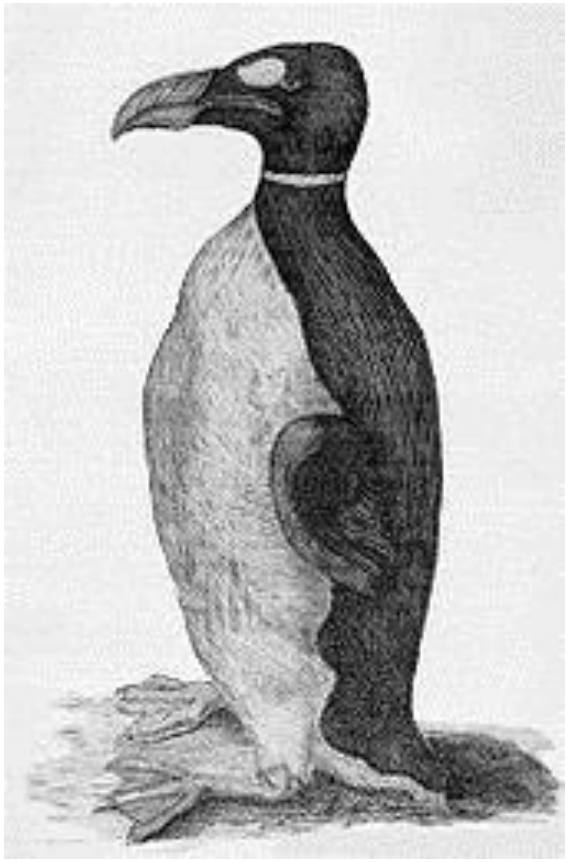
- Newfoundland Wolf- Extinct around 1930. It was hunted or trapped out of existence; partly because of its fearsome reputation as a livestock killer, partly because of the bounty on its head, and partly just for sport.

The Newfoundland Pine Marten

- There are many issues facing the Newfoundland Pine Marten today:

- Clear cutting
- Increased development
- More humans in the forest (ATVs, snowmobiles)
- Accidental trapping/sneering

The Great Auk



Exotic Species

- Describes a species which enters an ecosystem in which it did not previously exist. This may or may not occur naturally.
- This new species may then compete for a niche of an already existing species. If more competitive, it may overrun the system and disrupt the balance of the entire ecosystem.
- It may also introduce a foreign disease.
    - Ex: The Simpsons (Bart Vs. Australia)- Bart leaves his pet frog at the airport, at the end of the episode frogs are taking over Australia !

Caribou brain worm

Case Study 2.4- page 60-61

- Biosphere 2 – Columbia University http://www.b2science.org/