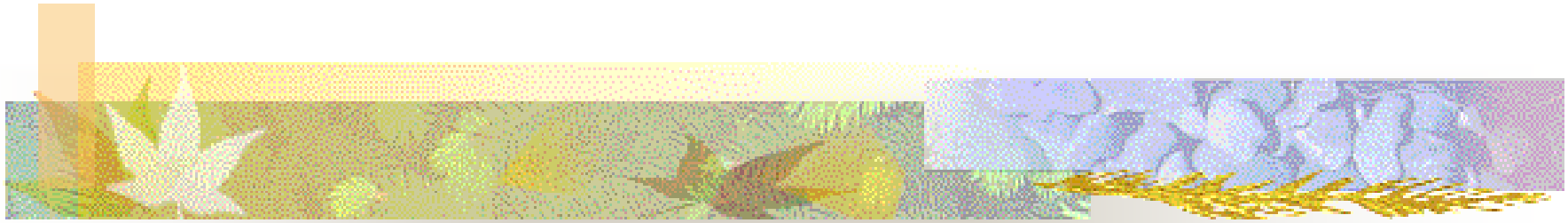
Science 1206



Unit 1: Diversity in Ecosystems

Paradigms and Paradigm Shifts

Paradigm - a belief held by society, based on general beliefs, such as morals, values and evidence.

Paradigm shift - rare and significant changes in the way humans view the world. Very controversial at first then more excepted as scientific knowledge.

Defintions Cont'd

Sustainability - the wise use of our renewable resources today so that both the resources and the environment will be there for use by future generations.

“What Is the Value of Wolves”

Textbook Page 20-21

Ecology – Chapter 1

Ecosystem – The term used to describe the relationships between organisms in a community and the abiotic/biotic factors in their environment.

Ecology – The study of the interactions between organisms and their environment (ecosystems).

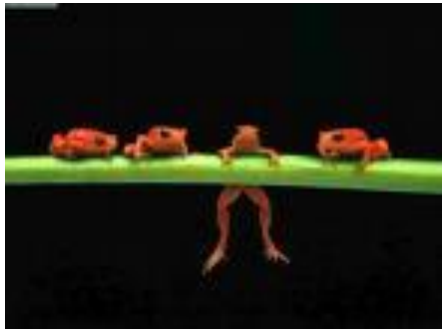
- **Abiotic Factors** – Anything nonliving in an ecosystem such as amount of sunlight, temperature, direction and strength of wind, etc.

- **Biotic Factors** – **Anything that is created by living things or is living (disease, competition for food, predator/ prey relationships, competition, etc.)**

"Amphibians as Bio-indicators of the Health of an Ecosystem" – p.10- p.13

FYI: Amphibians have two distinct stages in their life cycle.

1. Tadpoles: Found in the water
2. Adults: Found in damp environments on the land



Why can frogs be used?

1. Frogs are exposed to hazards to both aquatic and terrestrial ecosystems and a decline in the health of either ecosystems will have an impact on the frogs.
2. Frogs are also part of two FOOD CHAINS.

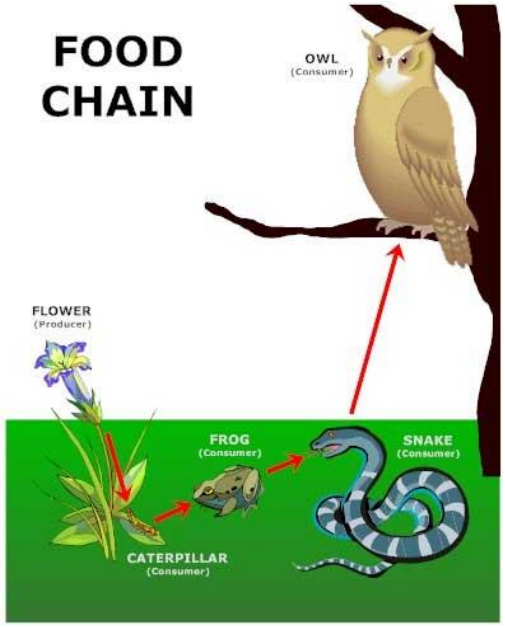
The main reasons why frogs are disappearing are:

- 1. Loss of Habitat
- 2. Pollution
- 3. Ultraviolet Radiation
- 4. Climate Change

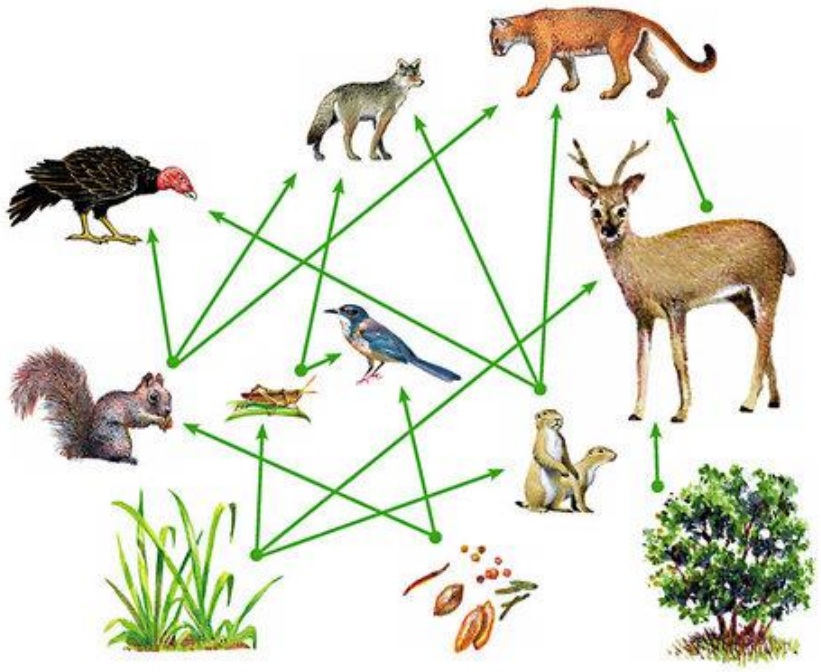
- Be sure you are able to explain at least 2 of these!

FOOD CHAINS & FOOD WEBS

- **Food Chain – a step by step sequence linking organisms that feed on each other and through which energy and nutrients are transferred.**



FOOD WEB – a diagram that tries to show the energy transfer relationship between many organisms in an ecosystem



- **Biodiversity** – The number of species in an ecosystem.

There are two main groups of living organisms (biotic factors) in a food chain or web:

1. **Producers** - Organisms that make their own food through photosynthesis. Also called AUTOTROPHS.

2. **Consumers –** Any organism which must eat (consume) other organisms for food. Also called HETEROTROPHS. E.g. rabbits eat plants, fox eats a rabbit

The types of consumers are:

1. **Herbivores** – consumers that eat only plants. E.g. moose
2. **Carnivores** – consumers that eat other consumers. E.g. fox, owl, lion
3. **Omnivore** – consumers that eat both plants and animals. E.g. Humans & Bears

?

4. **Saprophytes** – Also called **Decomposers**. Organisms that break down detritus to get nutrients for their own use but also release nutrients back in soil for producers.

Note: Detritus - Organic waste such as feces or fallen leaves and the remains of dead organisms from all trophic levels.

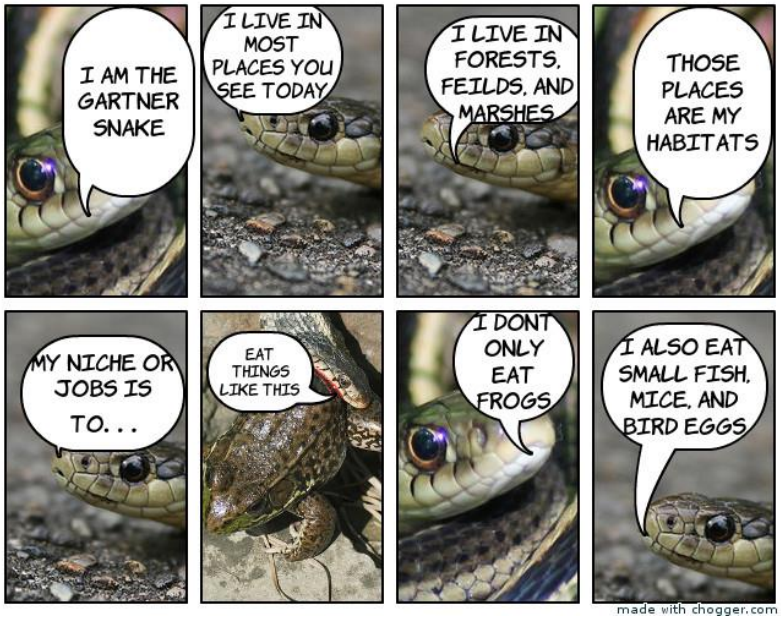
1.8 Case Study- Comparing Ecosystems Pages 28-29

- Read and complete the following questions: a, b,c,d,e,f,g,h,i,j, m
- Complete on loose leaf
- To be passed in for assignment marks

Habitat versus Niche

Habitat

- The place where an organism lives



Niche

- An organism's place in the food web, its habitat, its breeding area, etc. It includes everything that it does to survive and reproduce.
- Each species in an ecosystem tends to have a different niche to reduce competition between species. e.g. owls and hawks

https://www.youtube.com/watch?v=pX433QZD77Y

Competition

- When organisms compete with each other and other species for resources such as food, space, mates.

Types of Competition

1. Intraspecific competition – When members of the *same* species compete for the same resource in an ecosystem.

2. Interspecific competition - When different species compete.

Exotic Species/ Invasive Species

- When a new species is introduced to an area
- Can have both positive and negative effects on the ecosystem

Read Page 42 and 43 and create a pro/con chart on the zebra mussel

- Watch the following:

https://www.youtube.com/watch?v=Gtqb41CjQfc

Energy Flow in Ecosystems – (read pp. 32- 39).

• The source of all energy for ecosystems is the **sun**. It provides energy for producers to make food by photosynthesis.

• **Photosynthesis -** the process by which green plants use sunlight, water and carbon dioxide to produce oxygen and carbohydrates (sugars).

• Only 0.023% of the sunlight reaching the earth gets used by plants.

• **Albedo -** a measurement of the % of light that an object reflects.

• Each higher feeding level population only receives **10%** of the energy present in the lower trophic level.

Otter

Gets 10% of energy trout had

Trout

Gets 10% of energy tadpole had

Tadpole

Gets 10% of energy algae had

Algae

Some reasons why energy is lost between trophic levels are:

1. Food eaten cannot be fully digested and absorbed so it passes out in the feces.

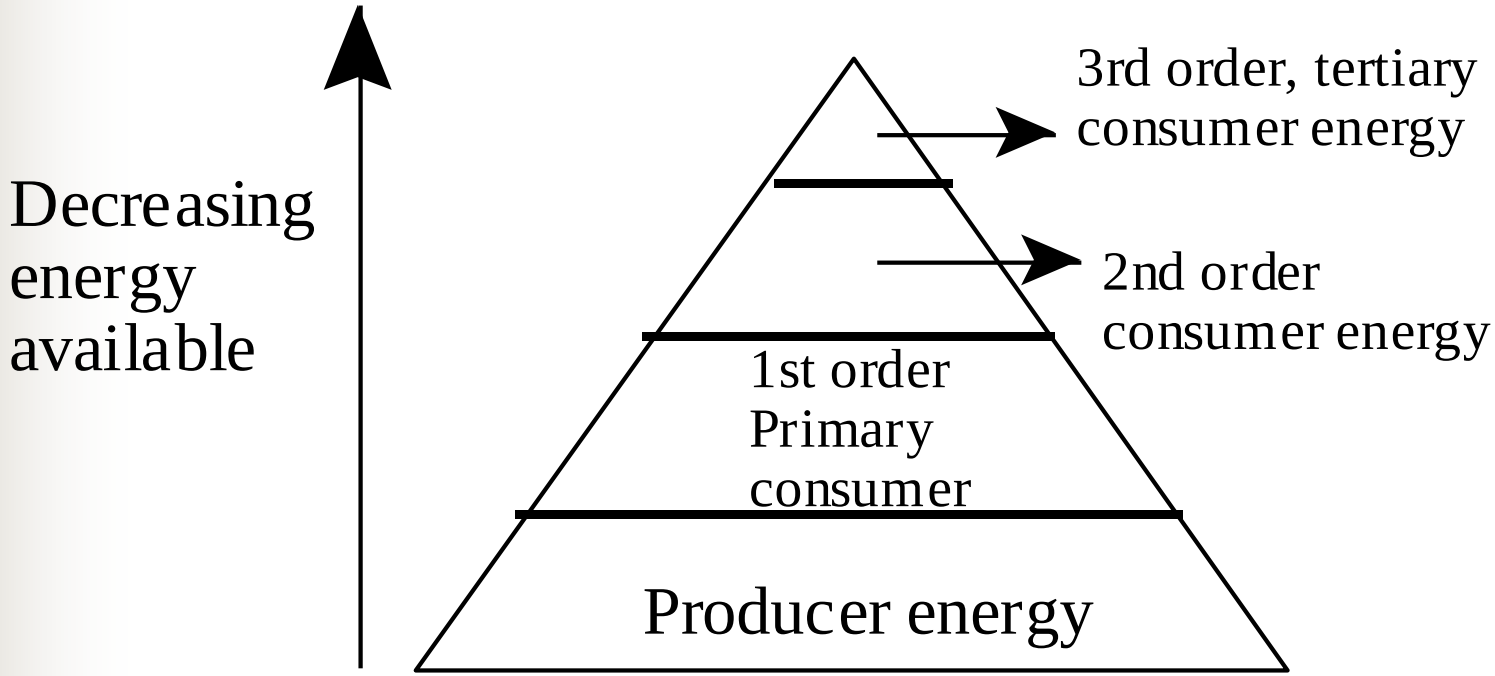
2. Not all of the food gets eaten e.g. bones, ligament, etc.

3. Used for body processes such as cell repair

4. Energy lost as heat from the body

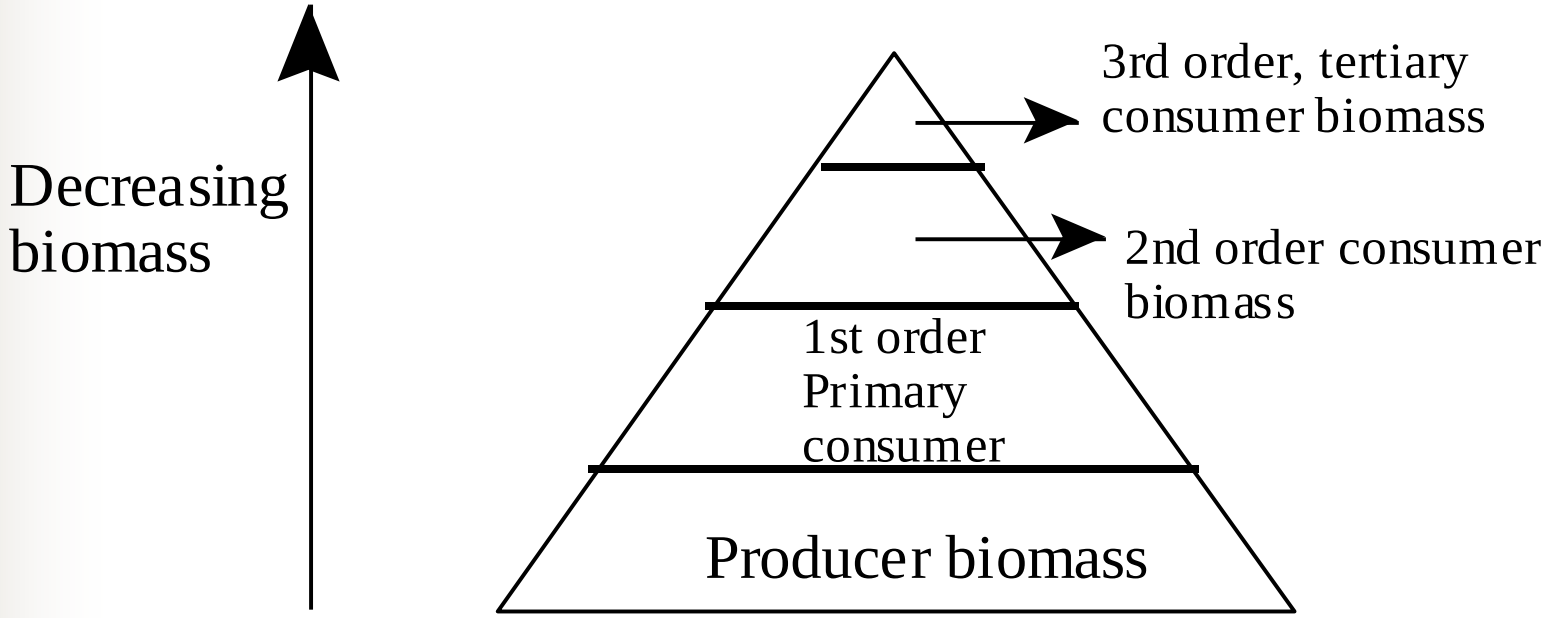
The Pyramid Models:

Pyramid of Energy



Biomass - the total dry mass of living organisms in a habitat. (calculated) Measured in Kilograms (kg).

Pyramid of Biomass



Bioamplification - p. 54

bioamplification - a process that results in increasing concentrations of a toxin in the bodies of consumers at each higher trophic level. (also called Bioaccumulation).

- Refer to the pesticide Powerpoint for further detail

How Ecosystems Can Change Over Time

- **Ecological succession** - a natural process of a gradual change in an environment (abiotic and biotic factors)

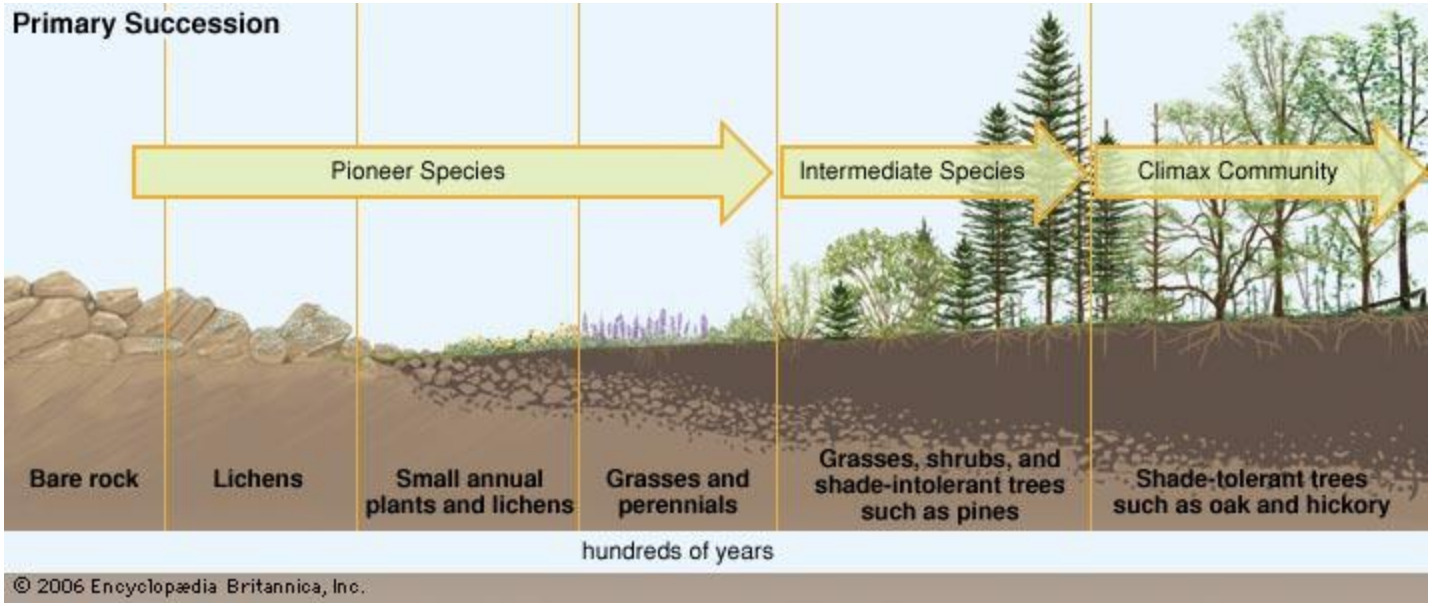
- This leads to a stable **climax community**

- **Climax Community** - the final, stable stage in any ecological succession.

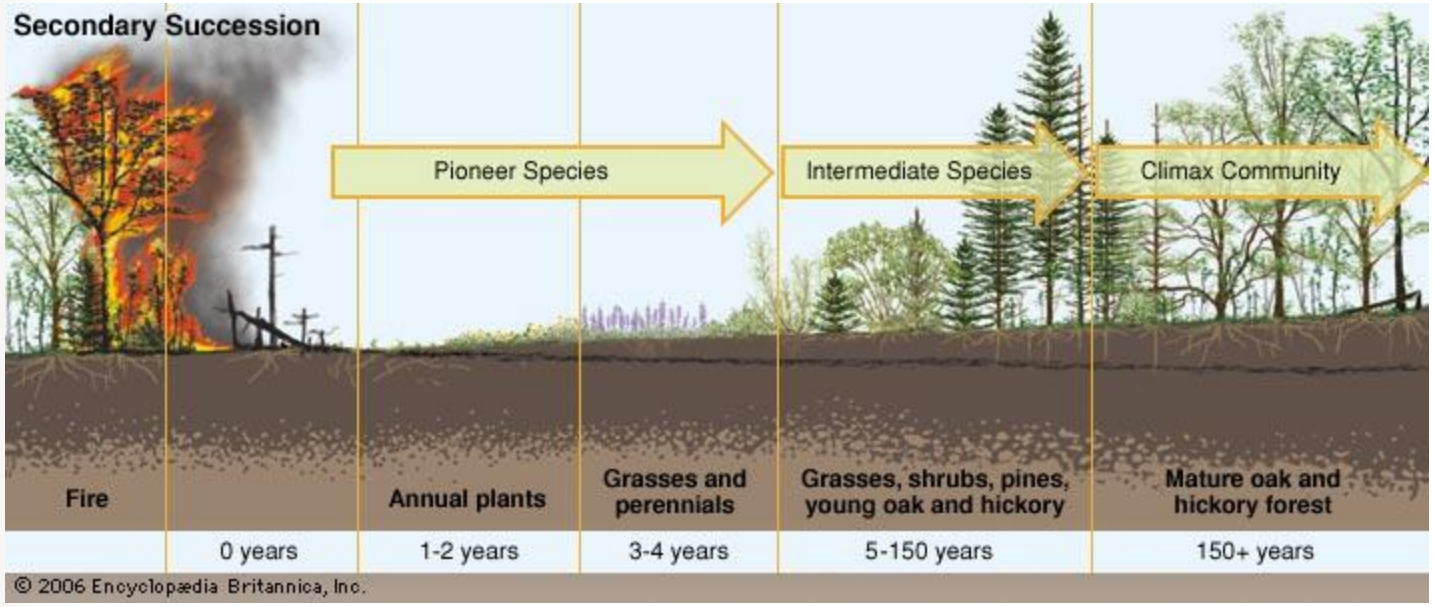
- What causes it? A change in soil composition, soil depth, decomposition of dead organisms, available light and competition.

Two types of succession:

Primary succession – gradual change in an ecosystem that starts from a bare rock.



Secondary succession – gradual change of an ecosystem after a disturbance or natural disaster (ex: fire, flood, earthquake, etc.)



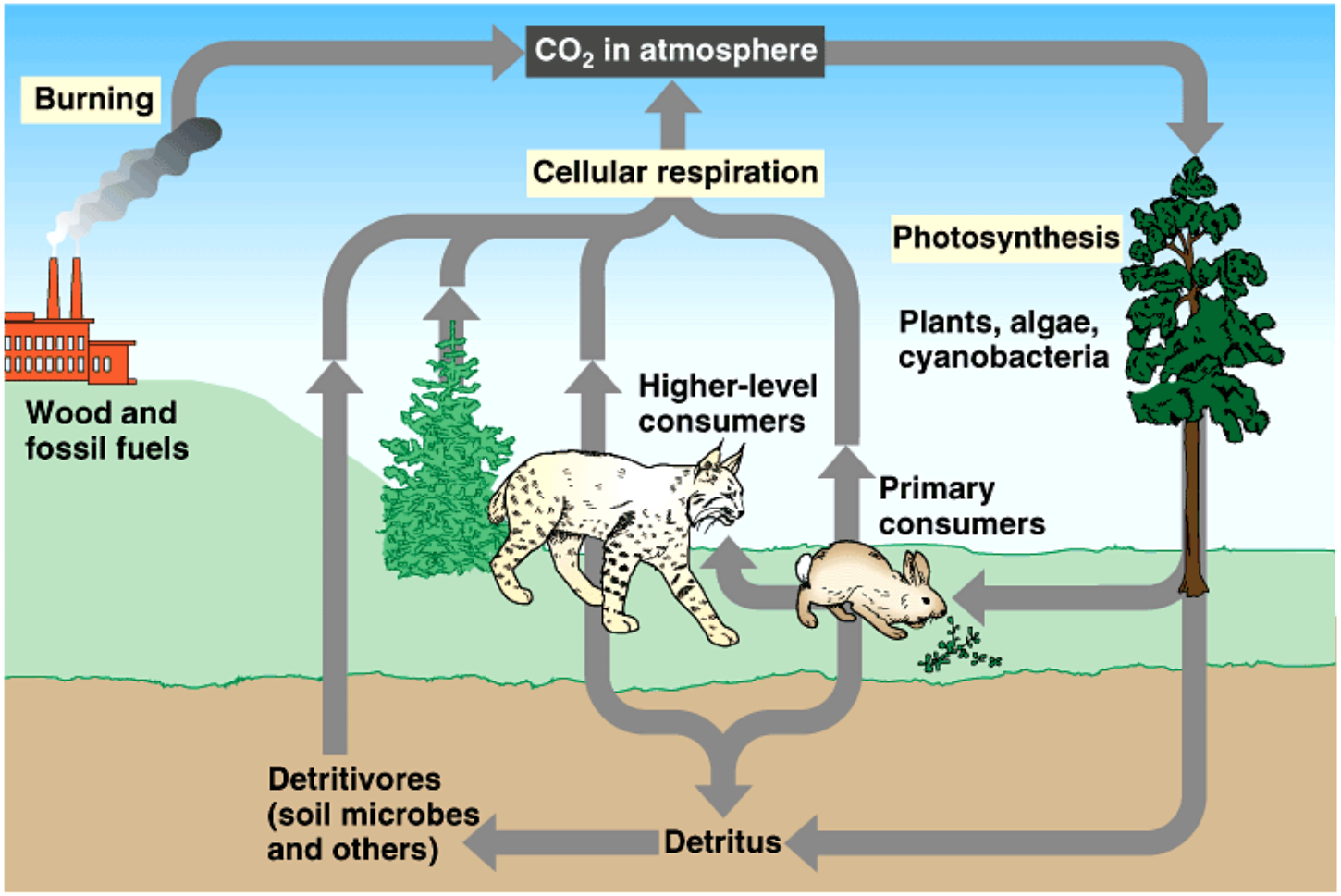
**Both take 100s of years!!!!!

The Cycling of Matter - read pp. 50 -51, 60 - 71.

organic substance- compound that always contains carbon and hydrogen atoms, and often oxygen and nitrogen atoms. e.g. proteins, sugars, fats e.g. $C_6H_{12}O_2$, CH_4

inorganic substance - compounds that don't contain a combination of hydrogen and carbon. e.g. CO_2 , H_2O

The Carbon Cycle - read p. 62 - 64



Why are photosynthesis and cellular respiration ***complementary processes***?

The products of photosynthesis are the reactants of cellular respiration and vice versa.

photosynthesis

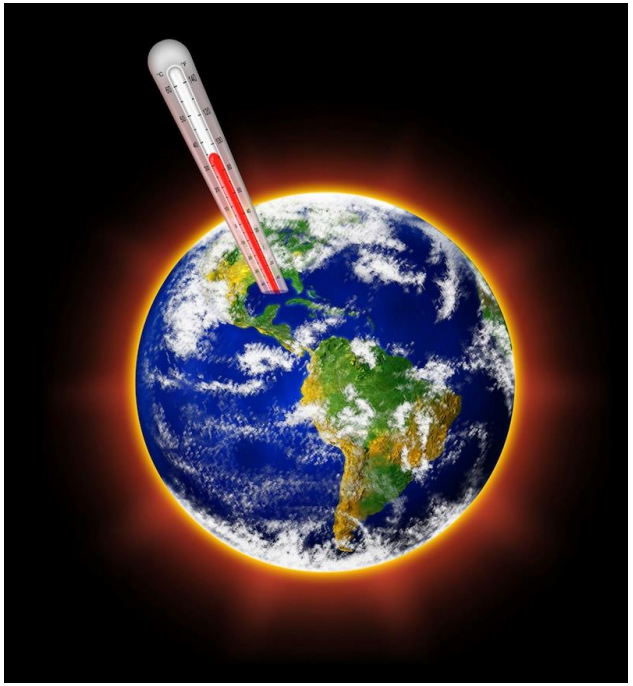
$$6CO_2 + 6H_2O + \underbrace{\text{energy}}_{\text{energy in}} \longrightarrow \boxed{C_6H_{12}O_6} + 6O_2$$

aerobic respiration

$$\boxed{C_6H_{12}O_6} + 6O_2 \longrightarrow 6CO_2 + 6H_2O + \underbrace{\text{energy}}_{\text{energy out}}$$

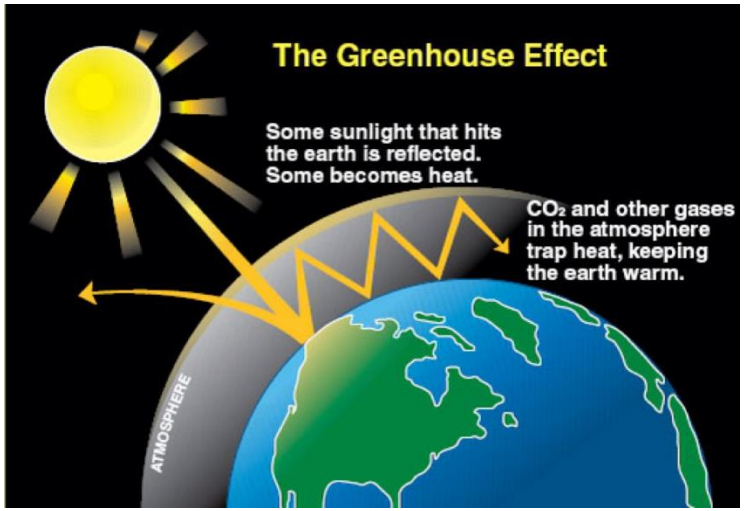
Global Warming

- The increase in Earth's average surface temperature due to rising levels of greenhouse gases.

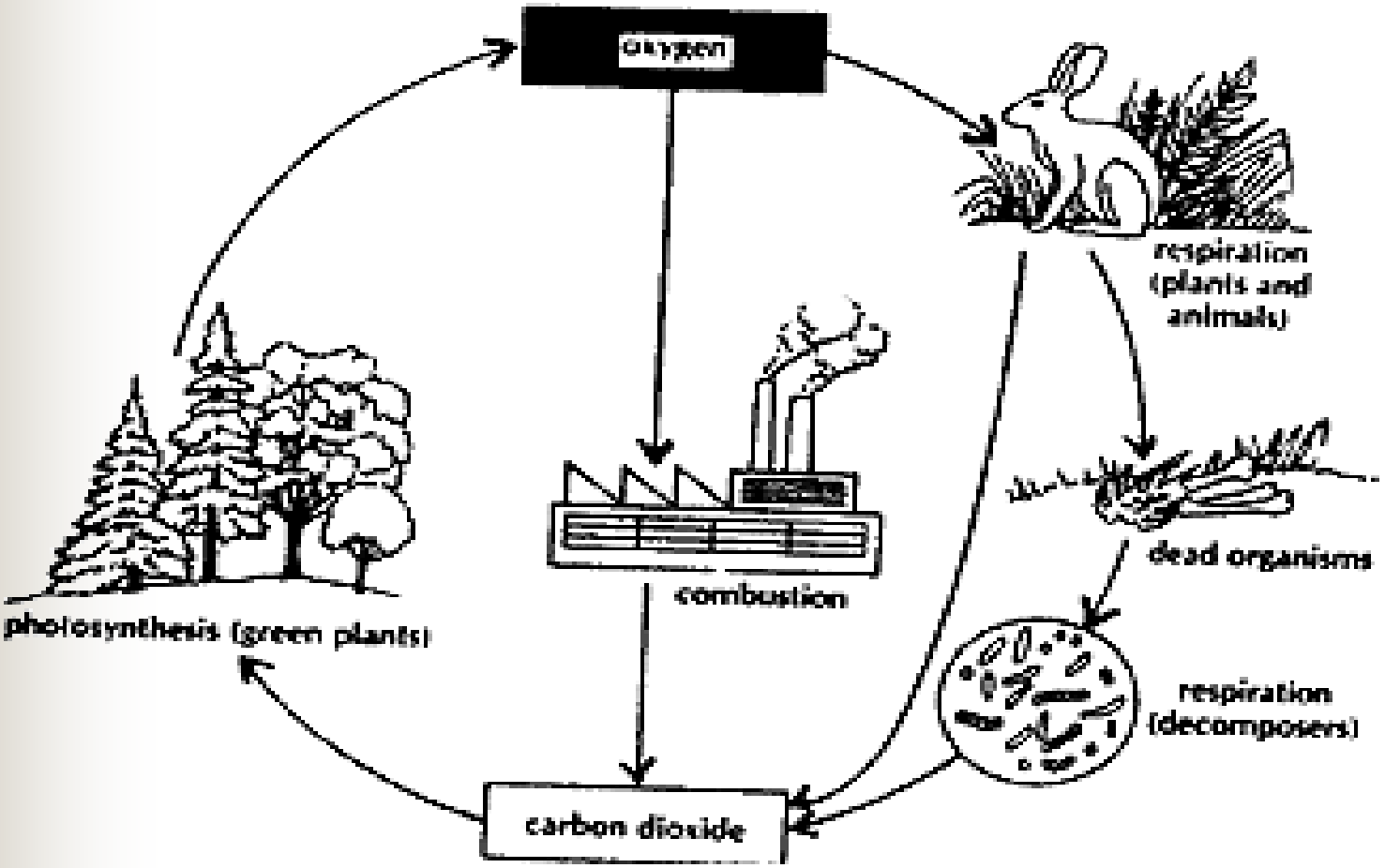


Greenhouse Effect

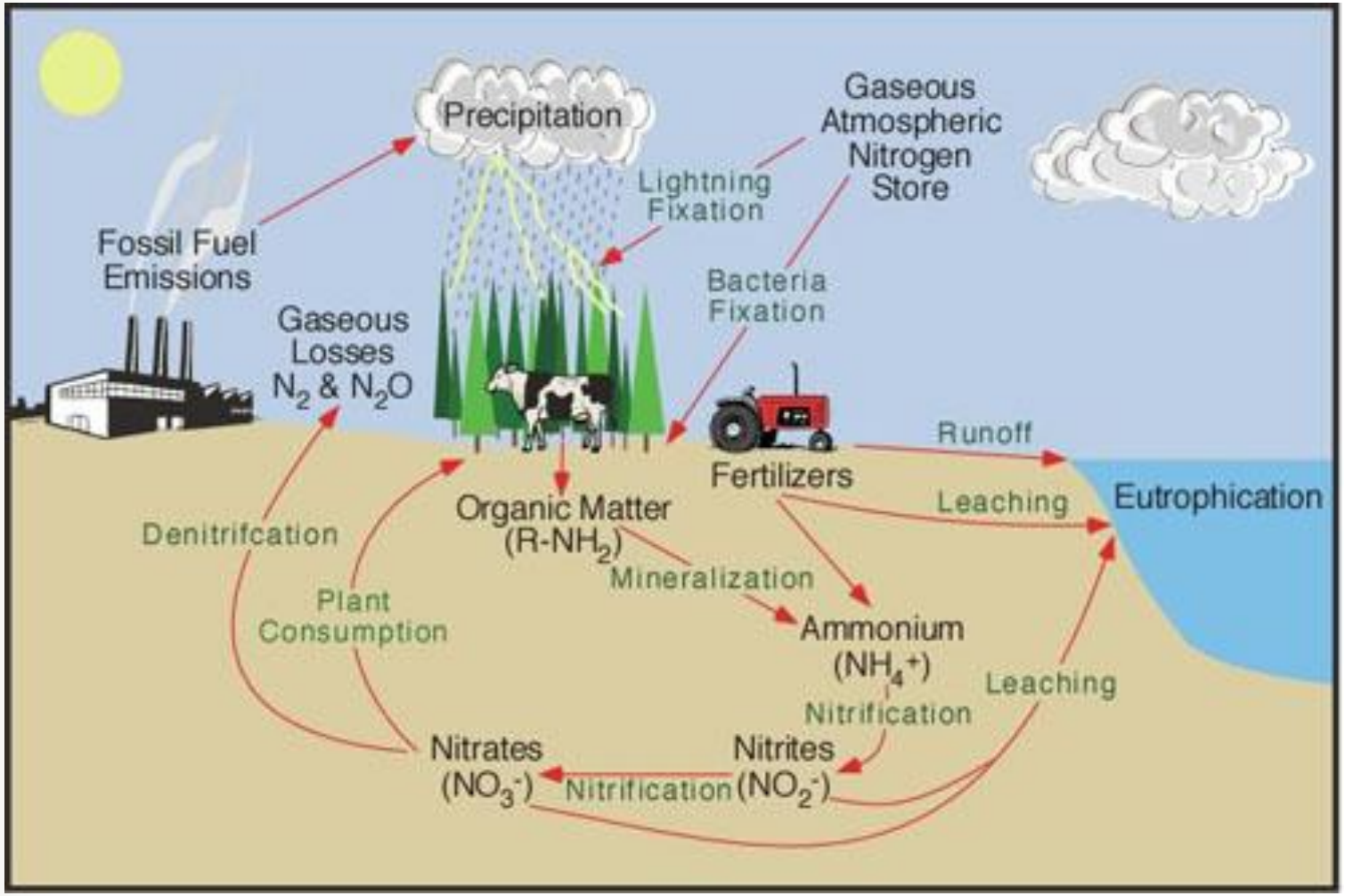
- Is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be without its atmosphere



The Oxygen Cycle



The Nitrogen Cycle - read pp. 66 - 67.

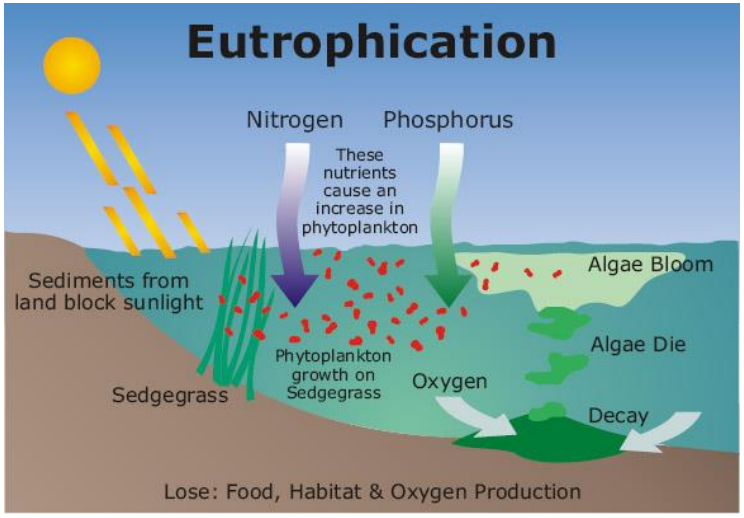


The Nitrogen Cycle

- There is a LOT of nitrogen (~80%) in our atmosphere but it must be in another form for organisms to use!
- Nitrogen is changed into nitrates by:
  1. Lightning
  2. Bacteria

Eutrophication

- When there is an abundance of nutrients (usually by human runoff – fertilizers) which cause excessive plant growth and death of animal life from lack of oxygen.

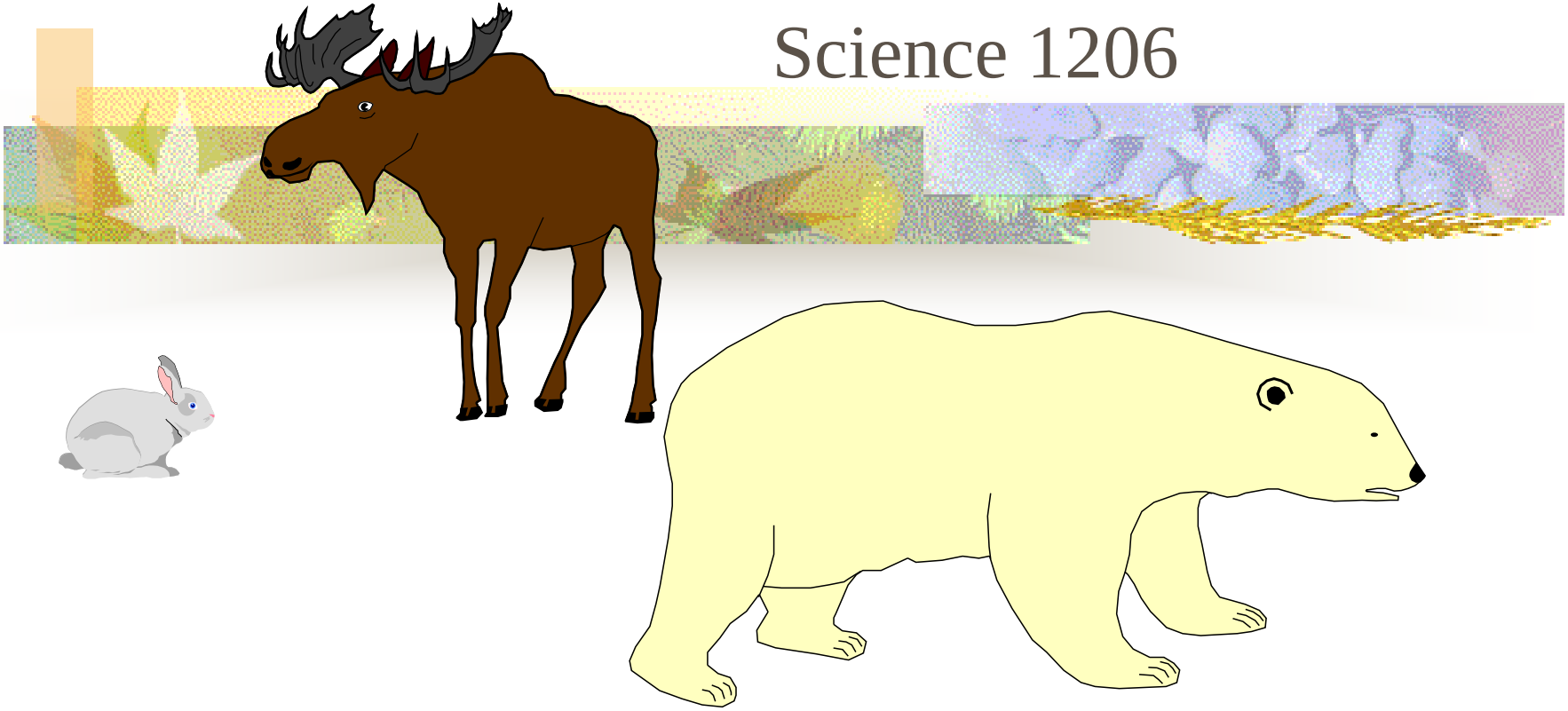


Algal Bloom

- A rapid growth of algae in the water (scum on the surface!)

Aquatic & Terrestrial Biomes

Science 1206



Biomes

There are *two major types of ecosystems*:

- **Aquatic**
- **Terrestrial**

Each can be subdivided further.

Aquatic

Can be subdivided into:

- ***Freshwater***
- ***Estuarine***
- ***Marine***

These are divided based upon their chemical composition, such as salt content, also known as ***salinity.***

Terrestrial

Are subdivided into:

- Grassland
- Forests (boreal, coniferous, etc.)
- Tundra, etc.

These are divided based upon the predominant vegetation, such as grasses or trees, etc.

These major terrestrial ecosystems are often referred to as **Biomes**.

Biomes

A **Biome** is a large geographical region that has a particular type of **climax community.**

In the case of terrestrial (land) biomes, the climax community is defined by the dominant plant species.

The major land biomes are encountered with changes in latitude as one moves from the equator towards the poles. This concept is referred to as **latitudinal succession.**

Biomes

The key to the concept is to realize that the different lines of latitude receive different amounts of solar radiation, which affects temperature and precipitation.

As one moves over lines of latitude, changes in climate occur that impact the types of organisms to be found in any given biome.

Terrestrial Biomes found in Canada

- **Tundra**
- **Boreal Forest (Taiga) or the Coniferous Forest**
- **Temperate Deciduous Forest**
- **Grasslands (The Prairies)**

The Tundra

Location:

South of the ice caps of the Arctic extending across North America

The Tundra Climate

Low average temperature.

Average yearly precipitation of 10-12 cm. Due to low evaporation, the region is wet with ponds and bogs during the short, warm summer (poor drainage).

Short growing season of about 60 days.

The Tundra Plants

- **Mosses**
- **Lichens (reindeer moss)**
- **Grasses**
- **Sedges**
- **Shrubs.**

The word tundra means “marshy plain”.

The Tundra Animals

- Musk oxen
- Caribou
- Wolves
- Arctic hares
- Arctic fox
- Lemmings
- Snowy owls

- Insects include black flies and mosquitoes.

The Tundra Soil

Permafrost (permanently frozen soil) is present.

This makes the growth of large plants impossible.

It ranges in depth from a few inches to several feet.

Boreal Coniferous Forest (Taiga)

Location:

South of the tundra extending across North America.

Newfoundland is considered part of the boreal forest biome.

Boreal Forest Climate

- **Temperature: Slightly higher than Tundra biome, cold winters and warm summers**
- **Average precipitation of 50-100 cm.**
- **Growing season is about 120 days.**

Boreal Forest Plants

- **Dominated by conifers (pine, fir, spruce)**
- **Some deciduous trees (birch, maple)**
- **Ferns**
- **Moss**

Boreal Forest Animals

- **Moose, Bears, Marten (Pine martin), Snowshoe hares, Foxes, Beavers**

- **Variety of birds such as warblers (coniferous nesters).**

Boreal Forest Soil

Special Features: Soil with no permafrost, a deep litter layer, and is highly acidic.

Acidity due to decay of coniferous leaves which prevents other plants from growing there.

Temperate Deciduous Forest

Location:

South of the boreal forest.

Temperate Deciduous Forest Climate

- **Temperature: Cold winters with hot summers, higher temperatures than tundra and boreal biomes**

- **Precipitation: 75 to 150 cm of rain a year**

Temperate Deciduous Forest Plants/ Flora

- **Dominated by deciduous trees (maple, birch, chestnut, beech, oak)**
- **Well developed and diversified shrubs, ferns, moss, etc.**

Temperate Deciduous Forest Animals

- Animals are abundant and diverse due to greater diversity of plants (black bears, gray fox, squirrels, skunks, racoons, etc.)

- Wider variety of birds
- Amphibians, reptiles and insects are also abundant and diverse.

Temperate Deciduous Forest Soils

- **Special Features: Organic material from fallen leaves provides for richer soils than in boreal forests**
- **Brown soil forests and thin surface litter layer due to rapid decomposition**

Grasslands

Location:

Canada: Extends from Eastern Manitoba to the Rocky mountains.

Interior of North America.

Usually referred to in Canada as “the Prairies”.

Grassland Climate

- Temperatures: Very cold winters with hot summers that cause rapid decay of organic material.
- Precipitation: 25 to 75 cm a year, not enough to support trees
- Growing season is about 180 days.

Grassland Plants

- **Grasses, wild flowers, trees grow next to rivers, ponds, and lakes**

Grassland Animals

- **Less animal diversity (Snakes, badgers, prairie dogs, ground squirrel, bison were once numerous, etc.**

- **Grassland birds are limited due to the vegetation (sparrows, etc.)**
- **Most abundant insect is the grasshopper.**

Special Features:

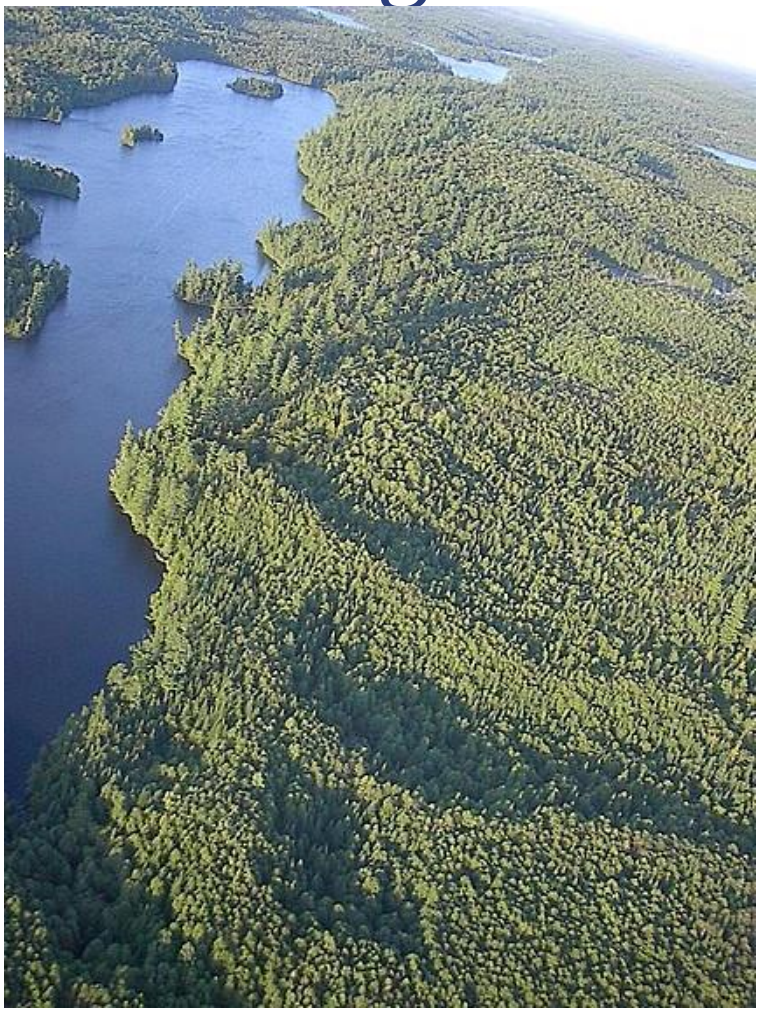
- **Soil is deep and rich (fertile) causing this biome to become the most productive farmland on Earth.**
- **Called black earth soil, organic matter accumulates in the upper portion of the soil, making it dark.**
- **Neutral or slightly alkaline soil.**

What Biome Does This Region Belong To?

What Biome Does This Region Belong To?

What Biome Does This Region Belong To?

What Biome Does This Region Belong To?



Which Biome has the greatest diversity of plants and animals?