



Aim: What are ecosystems?

Ecosystems

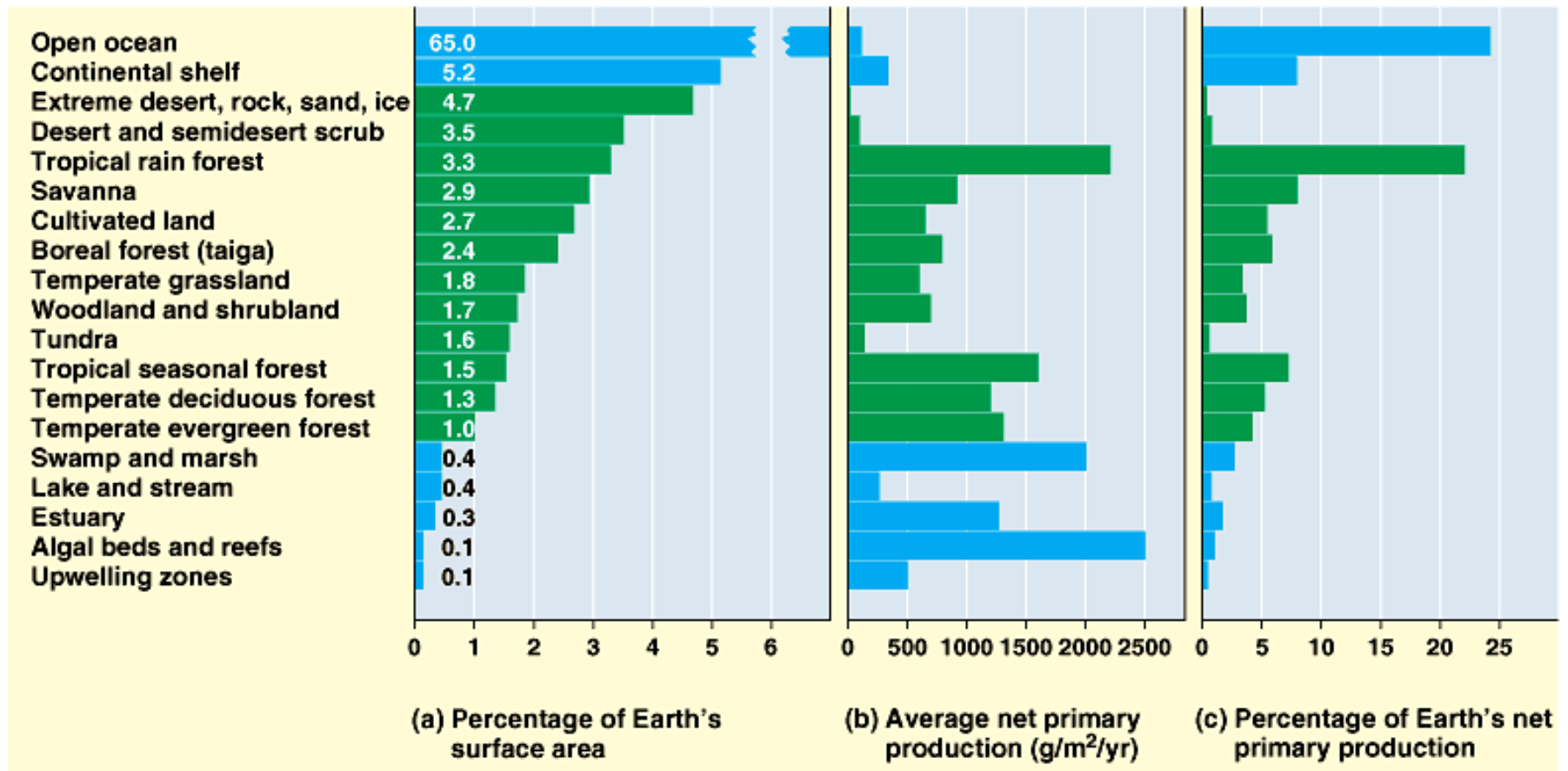
- ◆ Ecosystem = Abiotic + biotic
- ◆ **Primary production** = amount of light energy converted to chemical energy by an ecosystem's autotrophs in a given time period

Primary Productivity

- ◆ Only 1% of visible light is converted to chemical energy.
- ◆ Total primary production is known as **gross primary production (GPP)**.
- ◆ **Net primary production (NPP)** is equal to gross primary production minus the energy used by the primary producers for respiration (R):
 - ◆ $NPP = GPP - R$

Biomass

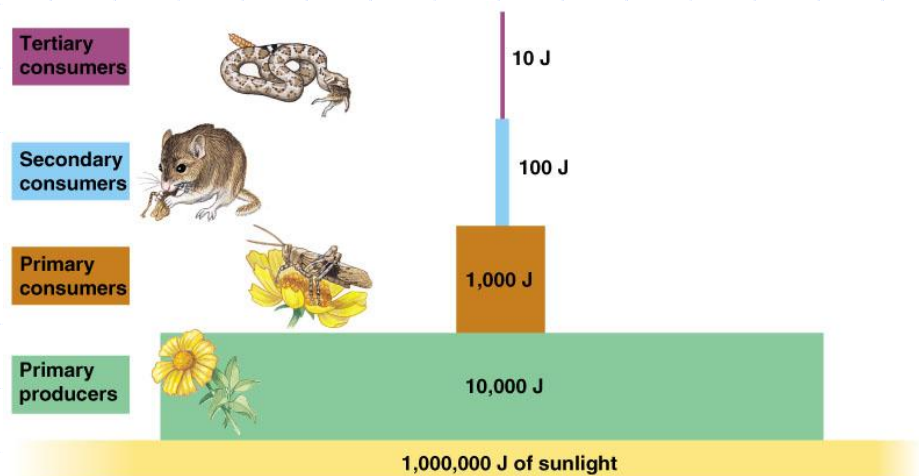
- Primary production can be expressed in terms of energy per unit area per unit time, or as **biomass** of vegetation added to the ecosystem per unit area per unit time.
 - ◆ This should not be confused with the total biomass of photosynthetic autotrophs present in a given time, called the **standing crop**.



- Nitrogen is the one nutrient that limits phytoplankton growth in many parts of the ocean.

Pyramid of production

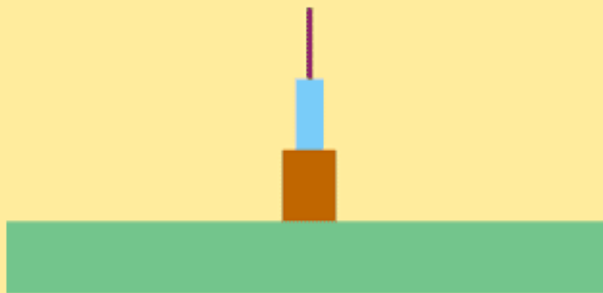
◆ **Pyramids of production** represent the multiplicative loss of energy from a food chain.



Pyramid of biomass

**Dry weight
(g/m²)**

1.5
11
37
809



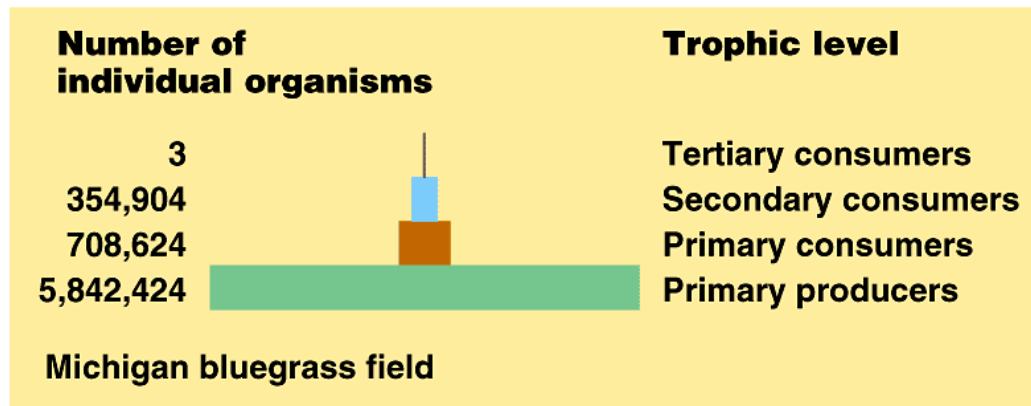
Trophic level

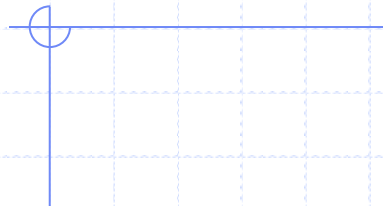
Tertiary consumers
Secondary consumers
Primary consumers
Primary producers

(a) Florida bog

Pyramid of numbers

- ◆ **Pyramids of numbers** show how the levels in the pyramids of biomass are proportional to the number of individuals present in each trophic level.



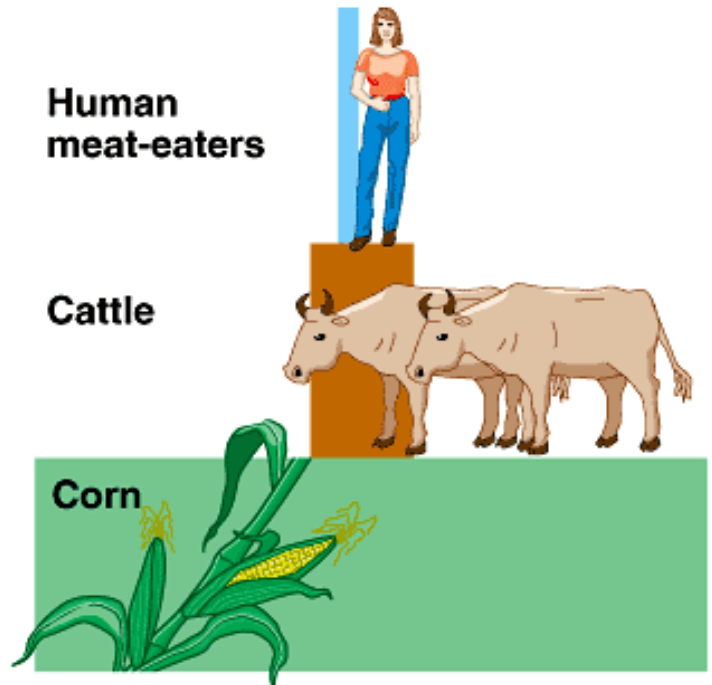
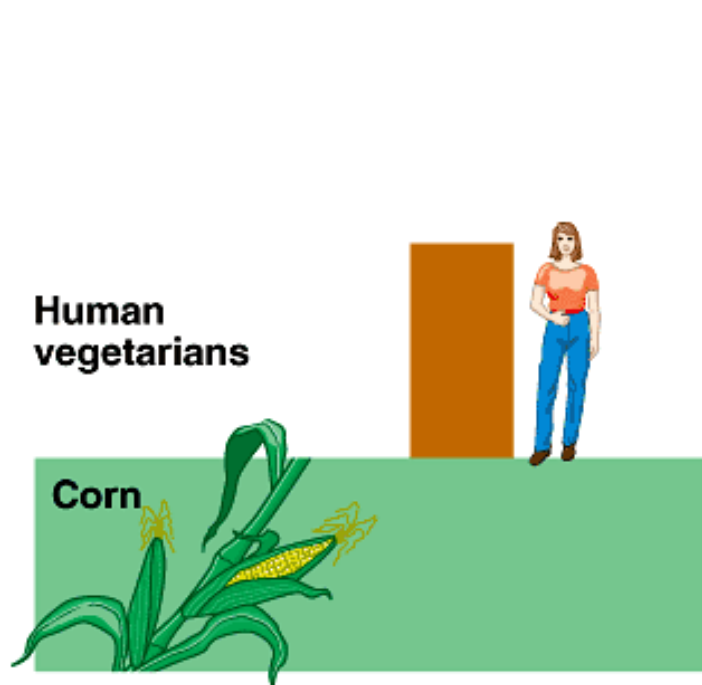


Trophic level

Secondary consumers

Primary consumers

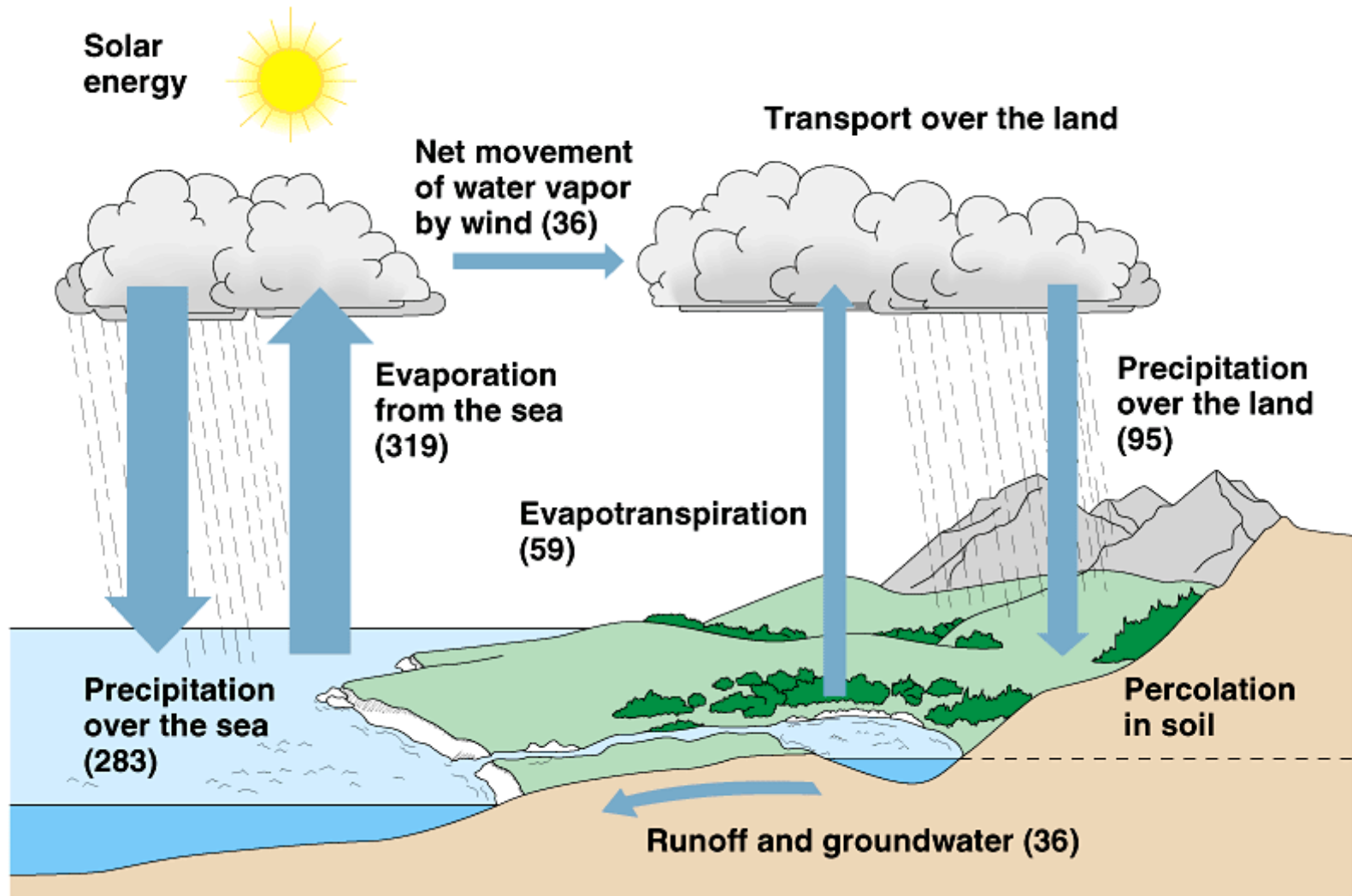
Primary producers



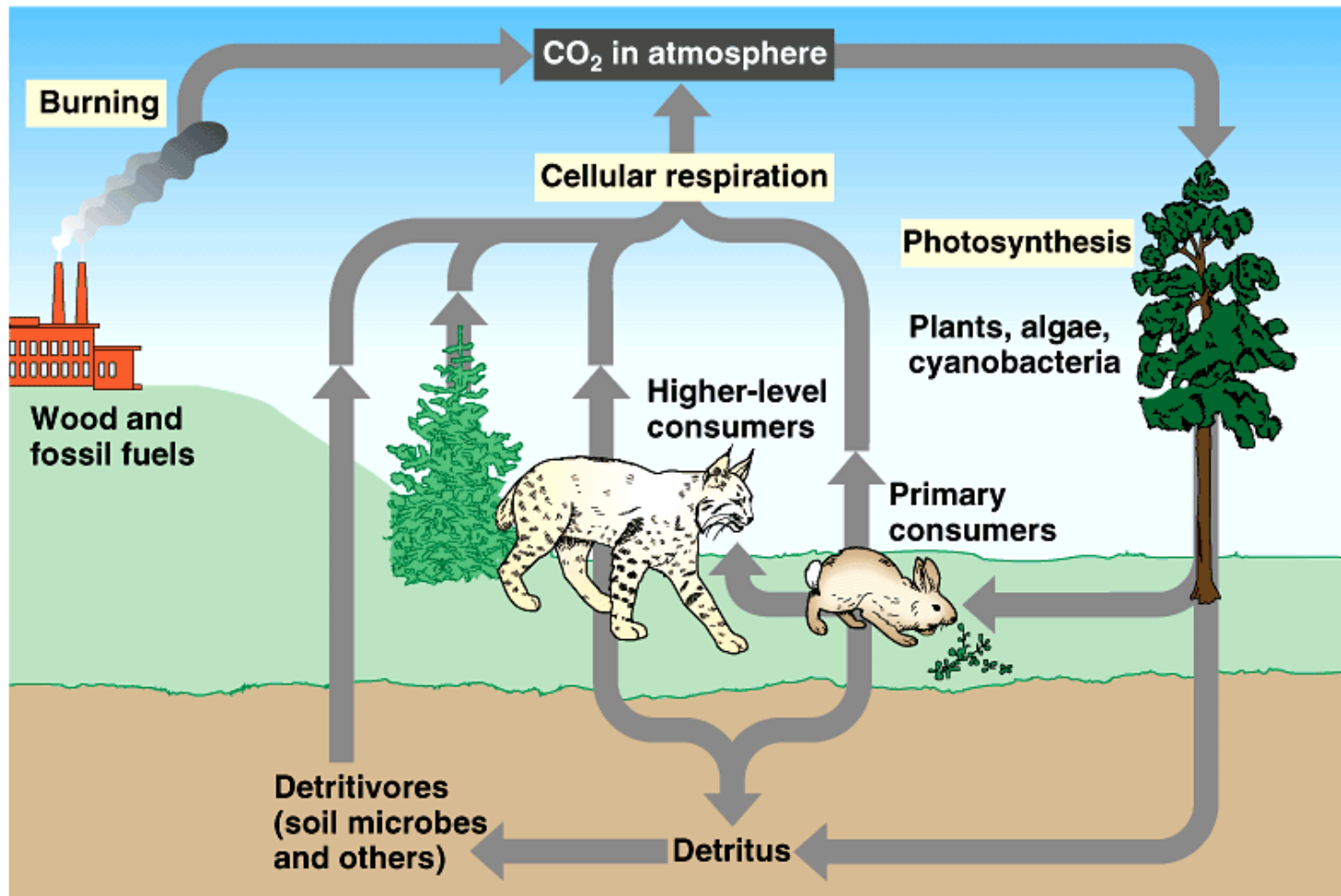
Biogeochemical Cycles

- ◆ Nutrient circuits involve both biotic and abiotic components of ecosystems and are called **biogeochemical** cycles.

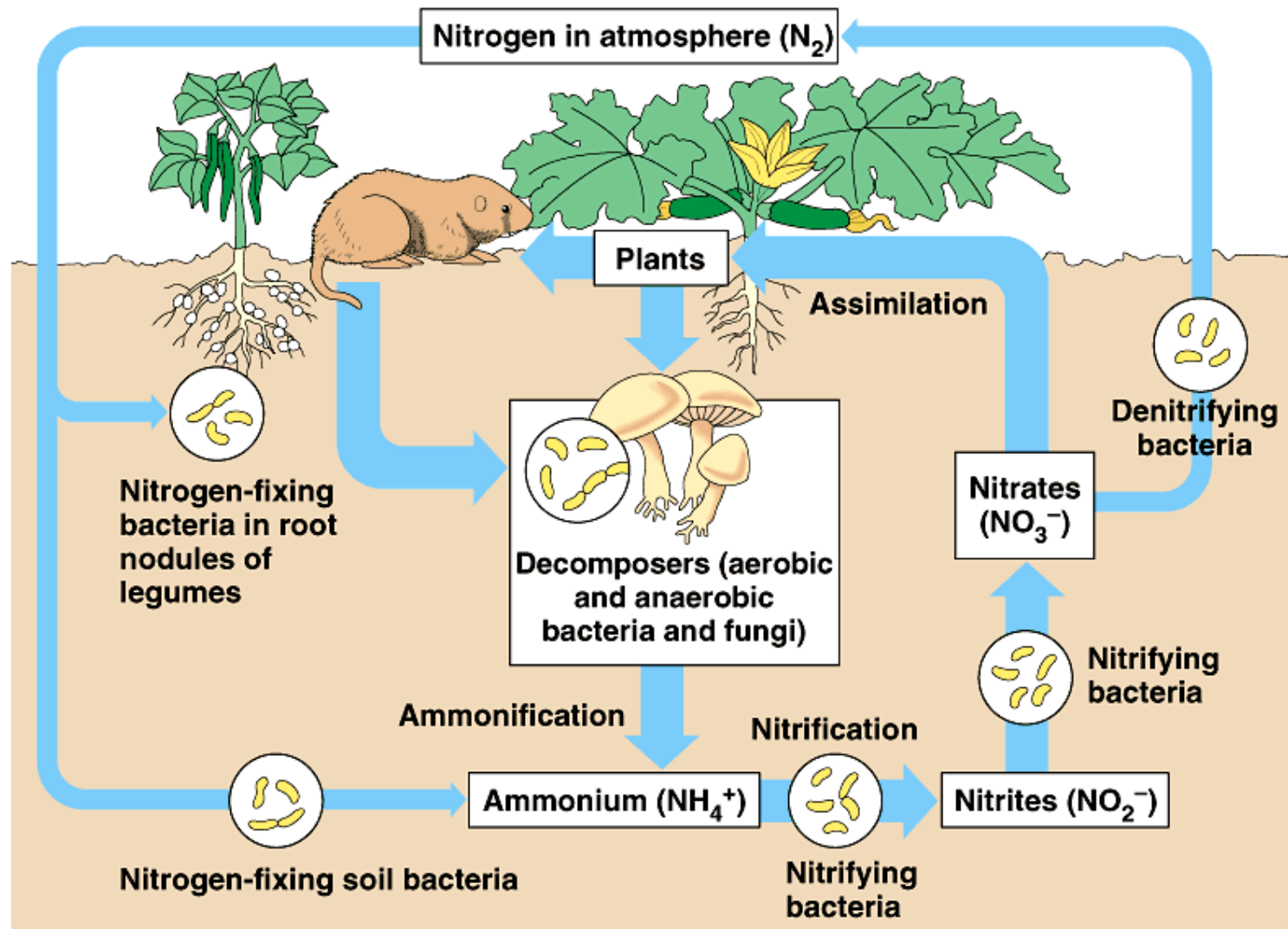
Water cycle



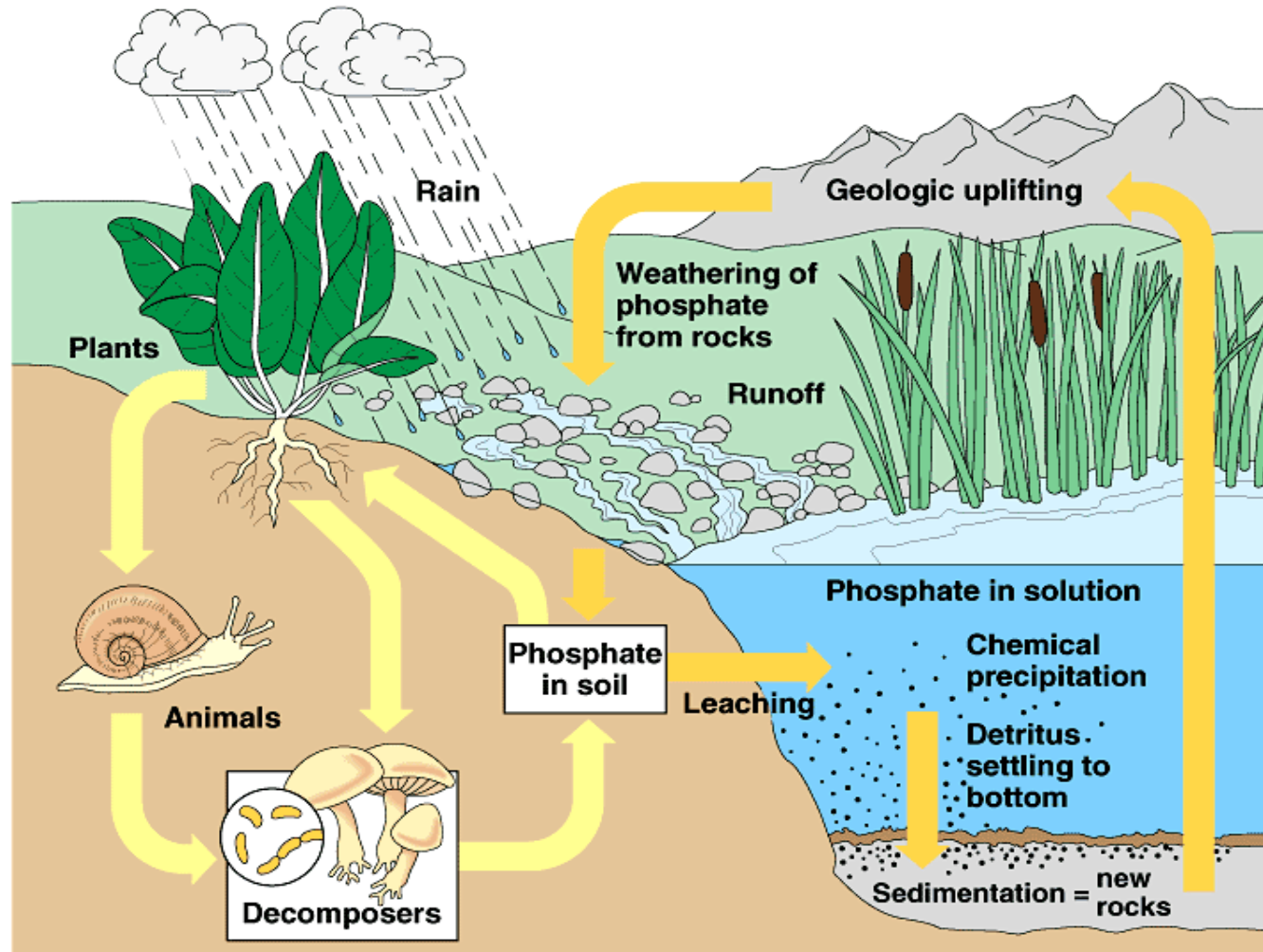
Carbon cycle



Nitrogen Cycle



Phosphorus Cycle



Humans vs Ecosystem

- ◆ Human activity intrudes in nutrient cycles by removing nutrients from one part of the biosphere and then adding them to another.
- ◆ Agriculture depletes nutrients.
- ◆ Nitrate use (fertilizer) has doubled the nitrogen content in global ecosystems.

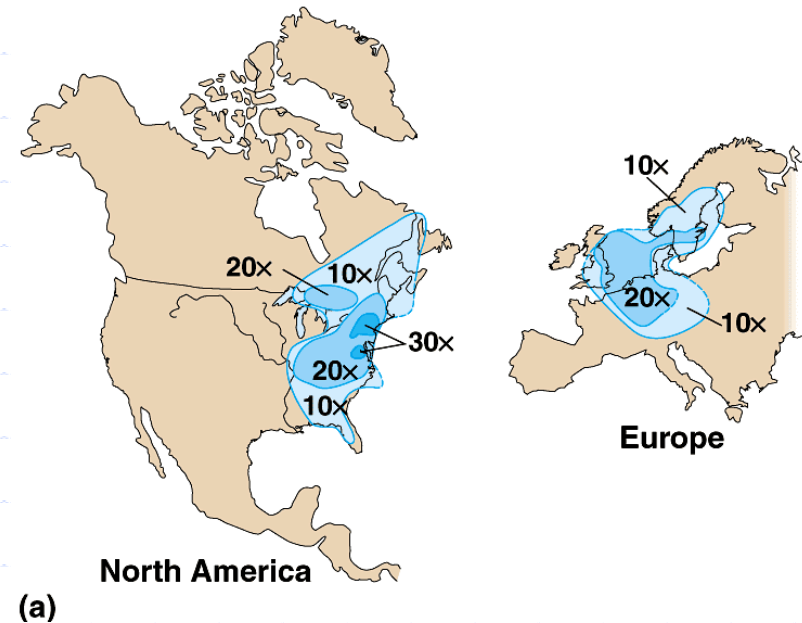
Cultural Eutrophication

- ◆ Sewage and factory waste as well as runoff from farms have overloaded ponds with nitrates.
- ◆ Overproduction of algae leads to intraspecific competition.
- ◆ Many algae die and aerobic bacteria decompose them, producing too much CO_2 and depleting O_2 .
- ◆ Animals suffocate.

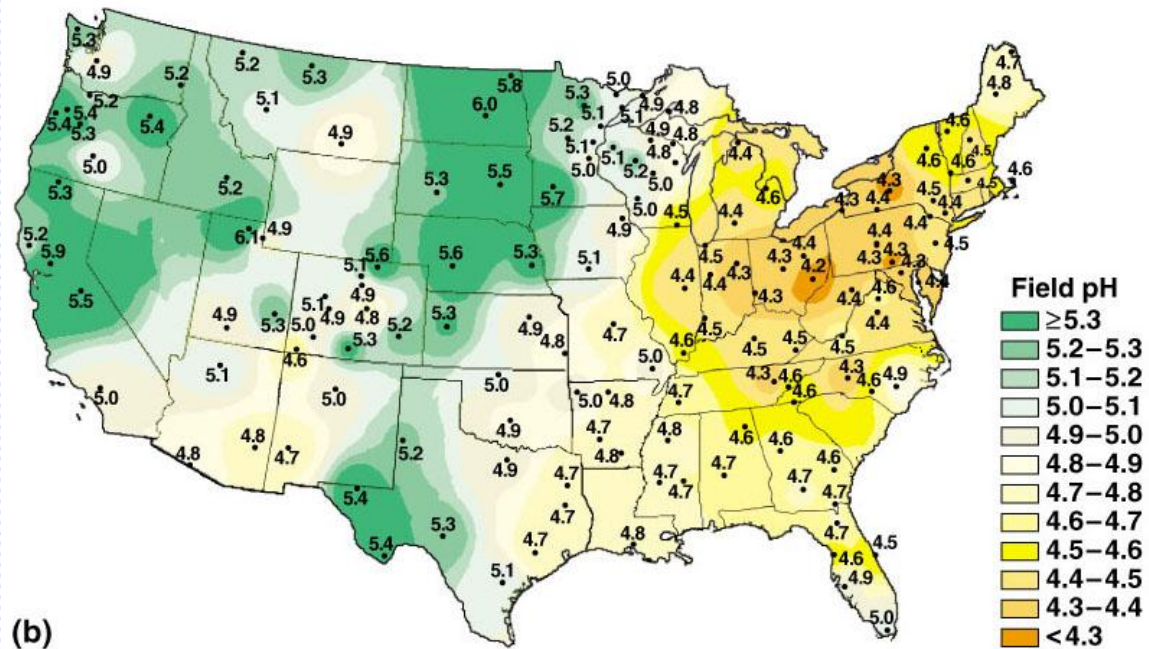


Air Pollution

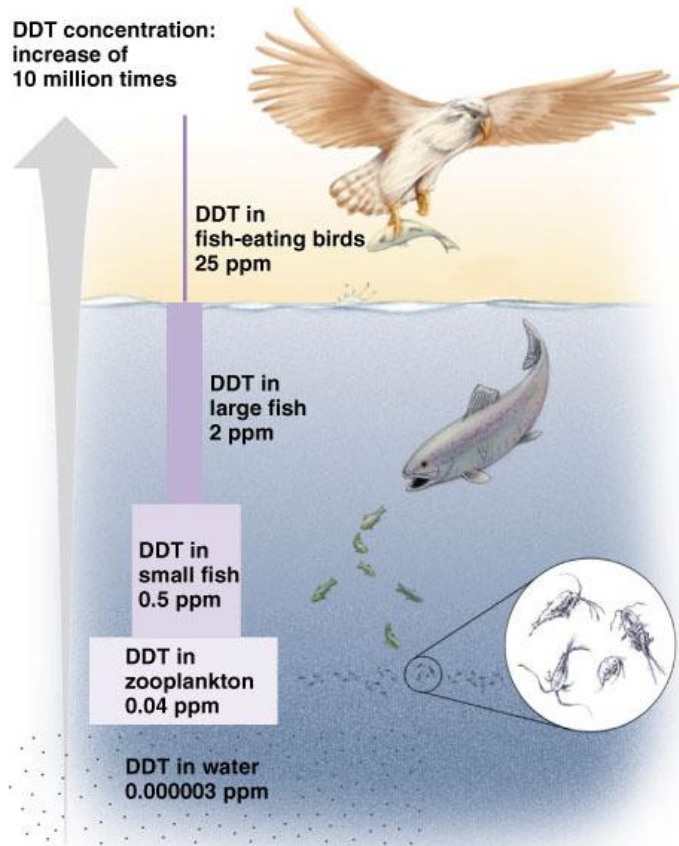
- ◆ The burning of fossil fuels releases sulfur oxides and nitrogen that react with water in the atmosphere to produce sulfuric and nitric acids.



- These acids fall back to earth as **acid precipitation**, and can damage ecosystems greatly.
- The acids can kill plants, and can kill aquatic organisms by changing the pH of the soil and water.

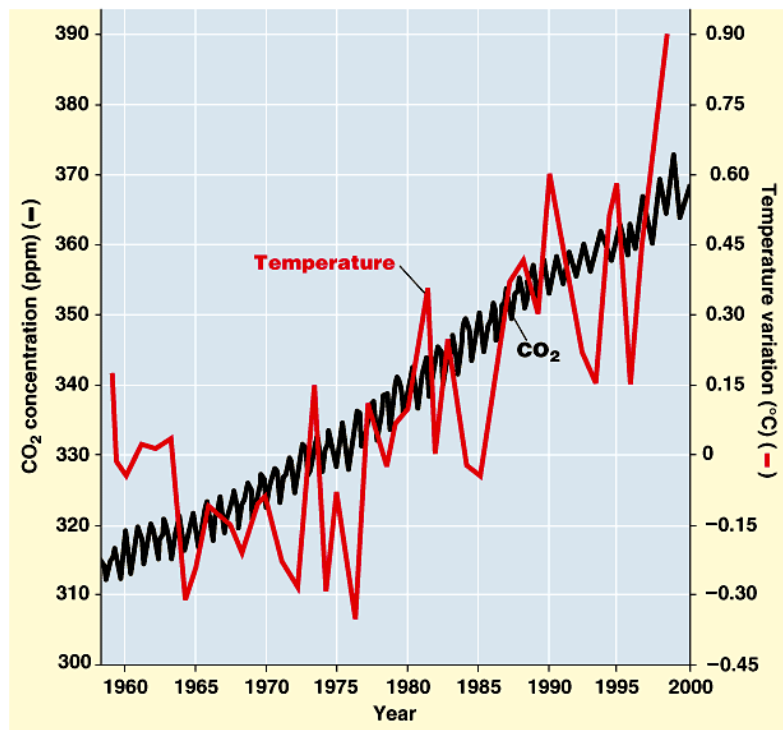


Biomagnification



- These toxins become more concentrated in successive trophic levels of a food web, a process called **biological magnification**.

Global Warming



- ◆ Rising atmospheric CO₂.
 - Since the Industrial Revolution, the concentration of CO₂ in the atmosphere has increased greatly as a result of burning fossil fuels.
- ◆ Measurements in 1958 read 316 ppm and increased to 370 ppm today

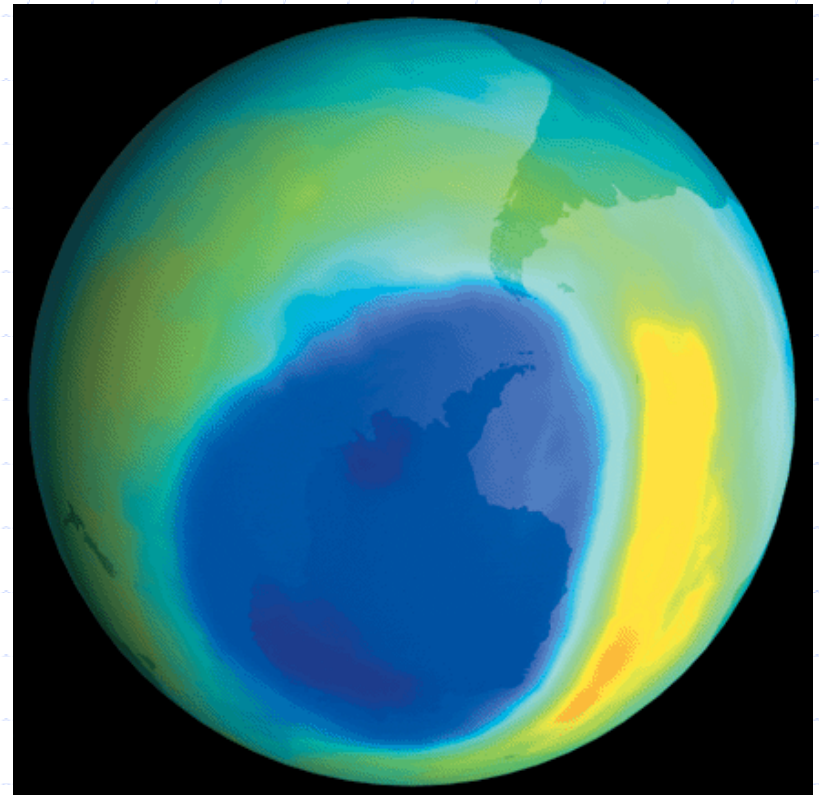
Greenhouse Effect

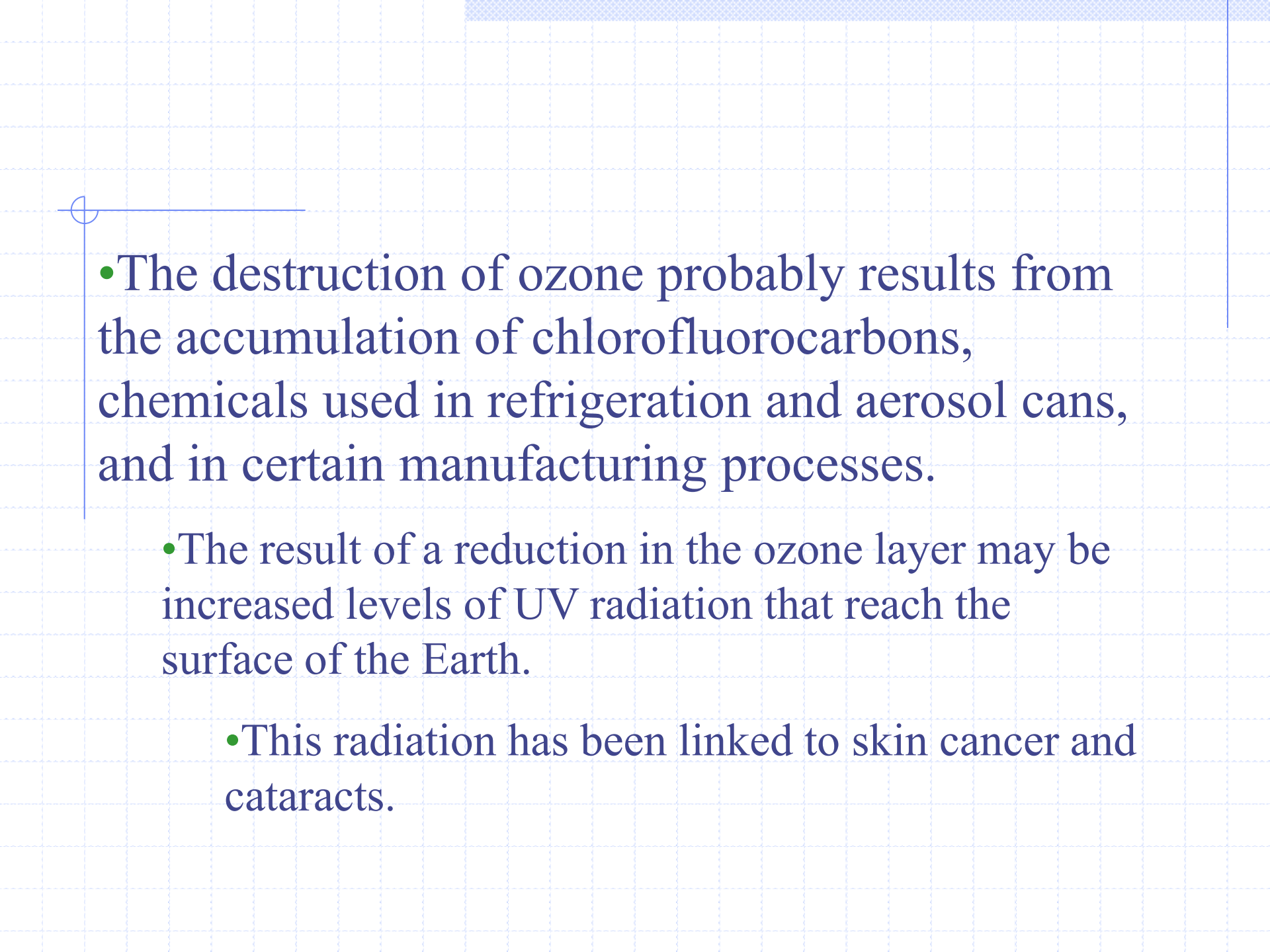
CO₂ causes the Earth to retain some of the energy that would ordinarily escape the atmosphere.

- This phenomenon is called the **greenhouse effect**.
- The Earth needs this heat, but too much could be disastrous.
- Several studies predict a doubling of CO₂ in the atmosphere will cause a 2° C increase in the average temperature of Earth.
- Rising temperatures could cause polar ice cap melting, which could flood coastal areas.

Ozone Depletion

- ◆ Life on earth is protected from the damaging affects of ultraviolet radiation (UV) by a layer of O_3 , or ozone.
- ◆ Studies suggest that the ozone layer has been gradually "thinning" since 1975.





- The destruction of ozone probably results from the accumulation of chlorofluorocarbons, chemicals used in refrigeration and aerosol cans, and in certain manufacturing processes.

- The result of a reduction in the ozone layer may be increased levels of UV radiation that reach the surface of the Earth.

- This radiation has been linked to skin cancer and cataracts.