

Ecosystem ecology II

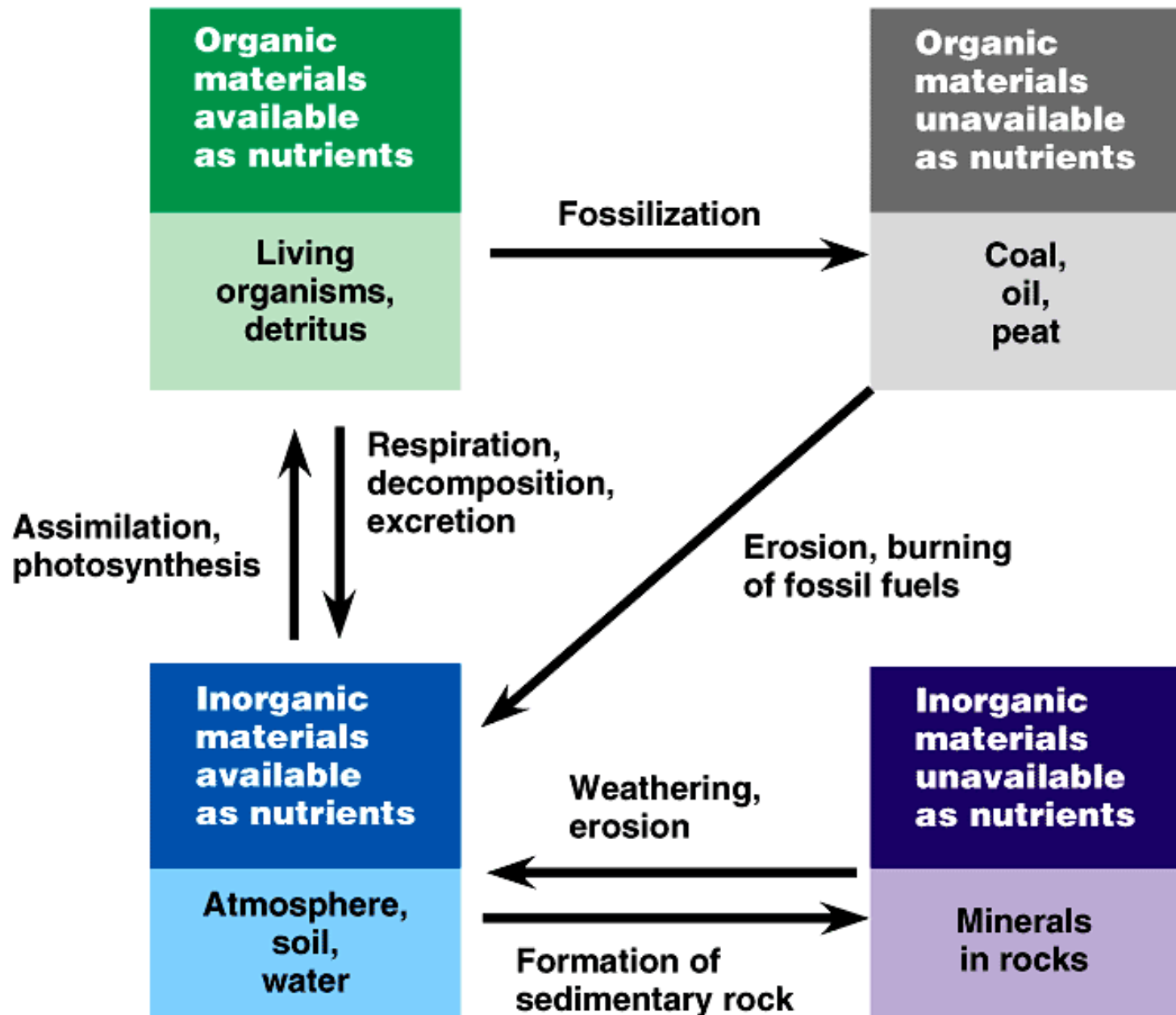
Generalities of chemical cycling

- There are two general categories of biogeochemical cycles:
 - Global cycles: involve elements that occur in gaseous forms in the atmosphere (carbon, oxygen, sulfur, nitrogen)
 - Local cycles: involve elements that are less mobile in the environment and for which soil is the main abiotic reservoir (phosphorus, potassium, calcium, trace elements)

General model of nutrient cycling

- Defines major reservoirs of elements and processes that transfer elements
- Most nutrients accumulate in four reservoirs that are defined by two characteristics:
 - If they contain organic or inorganic materials
 - Whether or not materials in them are directly or indirectly available to organisms

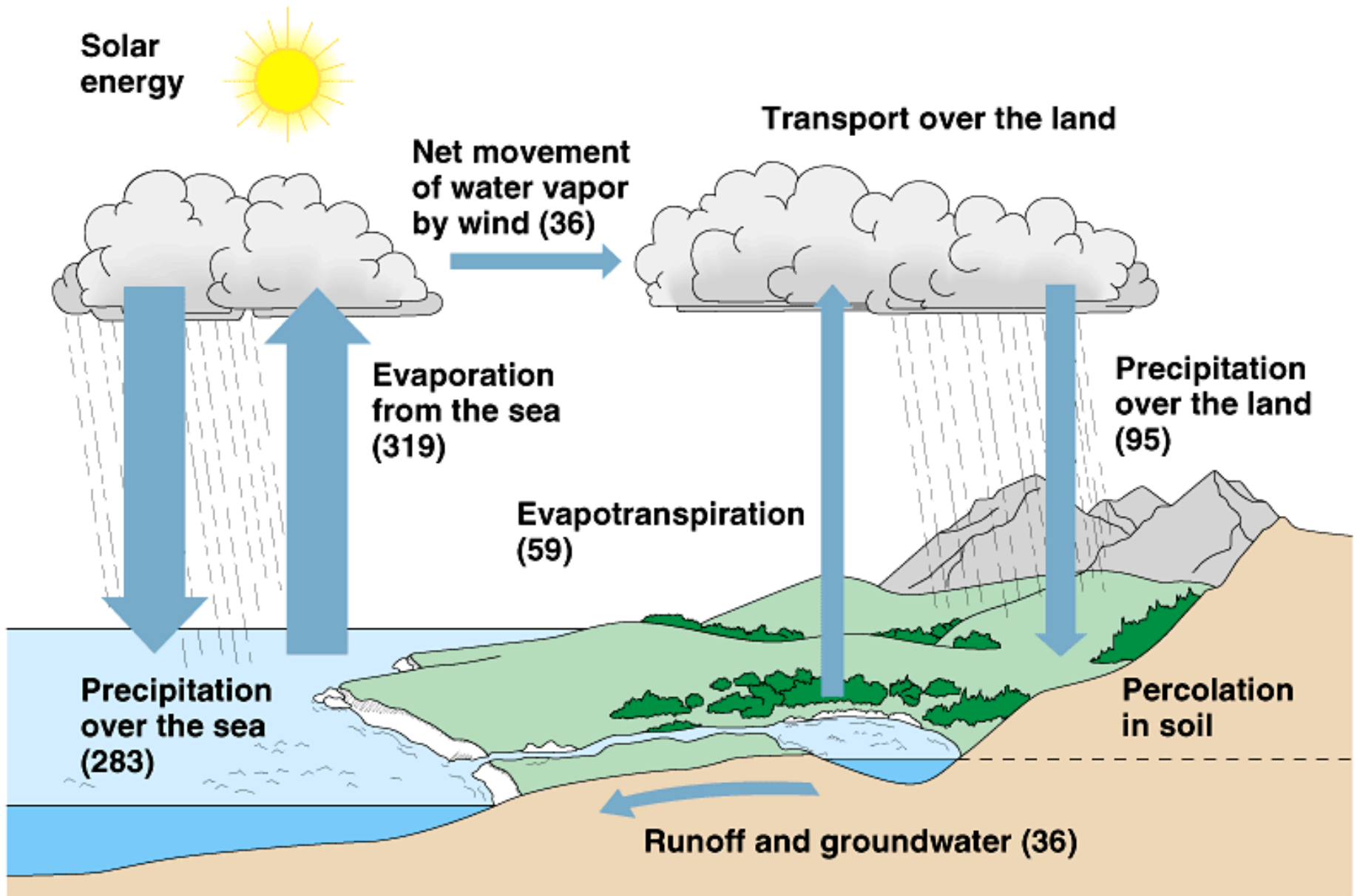
A general model of nutrient cycling



Water cycle

- It is essentially a physical cycle not a biogeochemical one
 - Very little of the water that cycles through ecosystems is chemically altered by either abiotic or biotic components
 - The water cycle mainly involves changes between the liquid and gaseous states and the transport of the liquid water and water vapor

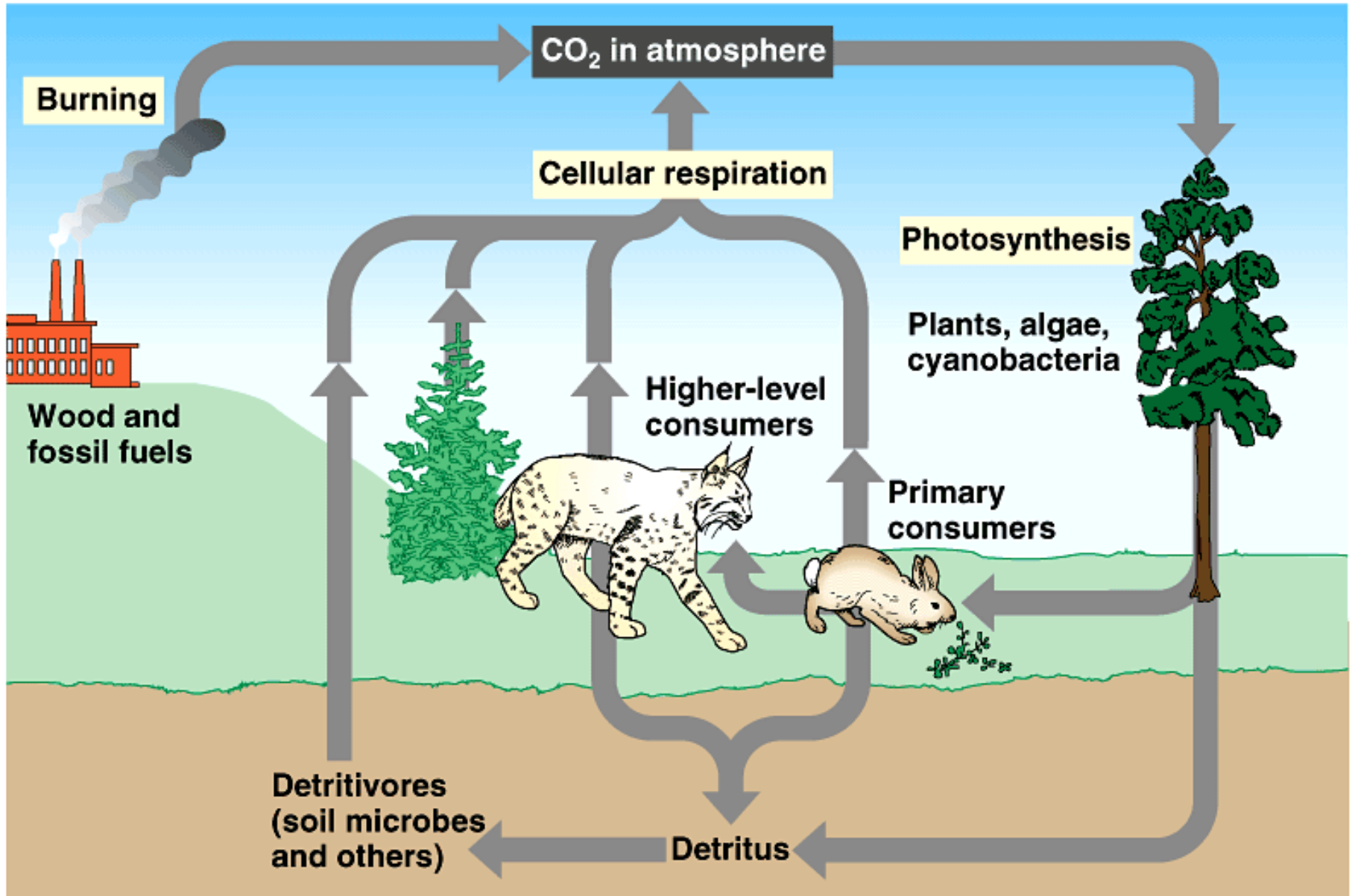
The water cycle



Carbon cycle

- The reciprocal processes of photosynthesis and cellular respiration are responsible for the major transformations and movements of carbon.
- On a global scale the return of CO₂ to atmosphere by respiration closely balances its removal by photosynthesis
- The burning of wood and fossil fuels adds more CO₂ to the atmosphere

The carbon cycle



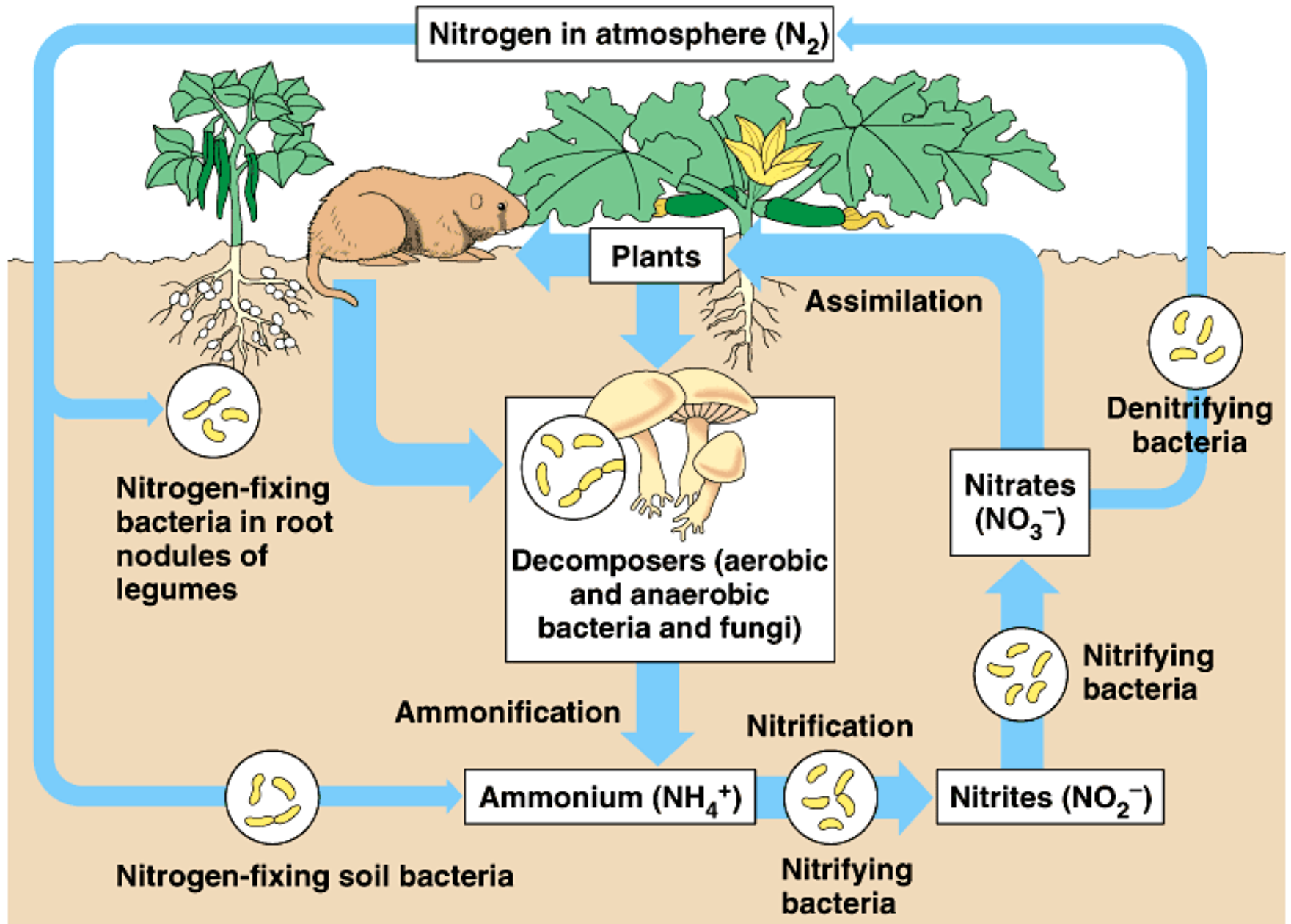
Nitrogen cycle

- Needed to elaborate proteins and amino acids or as source of energy
- Although the N cycle can occur globally, the majority of N in most ecosystems is recycled locally by decomposition and reassimilation
- Global aspects:
 - N can enter an ecosystem through atmospheric deposition and nitrogen fixation
 - N can go back to atmosphere through evaporation or denitrification

Nitrogen cycle

- Local aspects:
 - Nitrification (oxidization of ammonium to nitrite and nitrate by aerobic bacteria), assimilation (assimilation of nitrates by plants and organic nitrogen by animals) and ammonification (decomposition of organic nitrogen to ammonium)

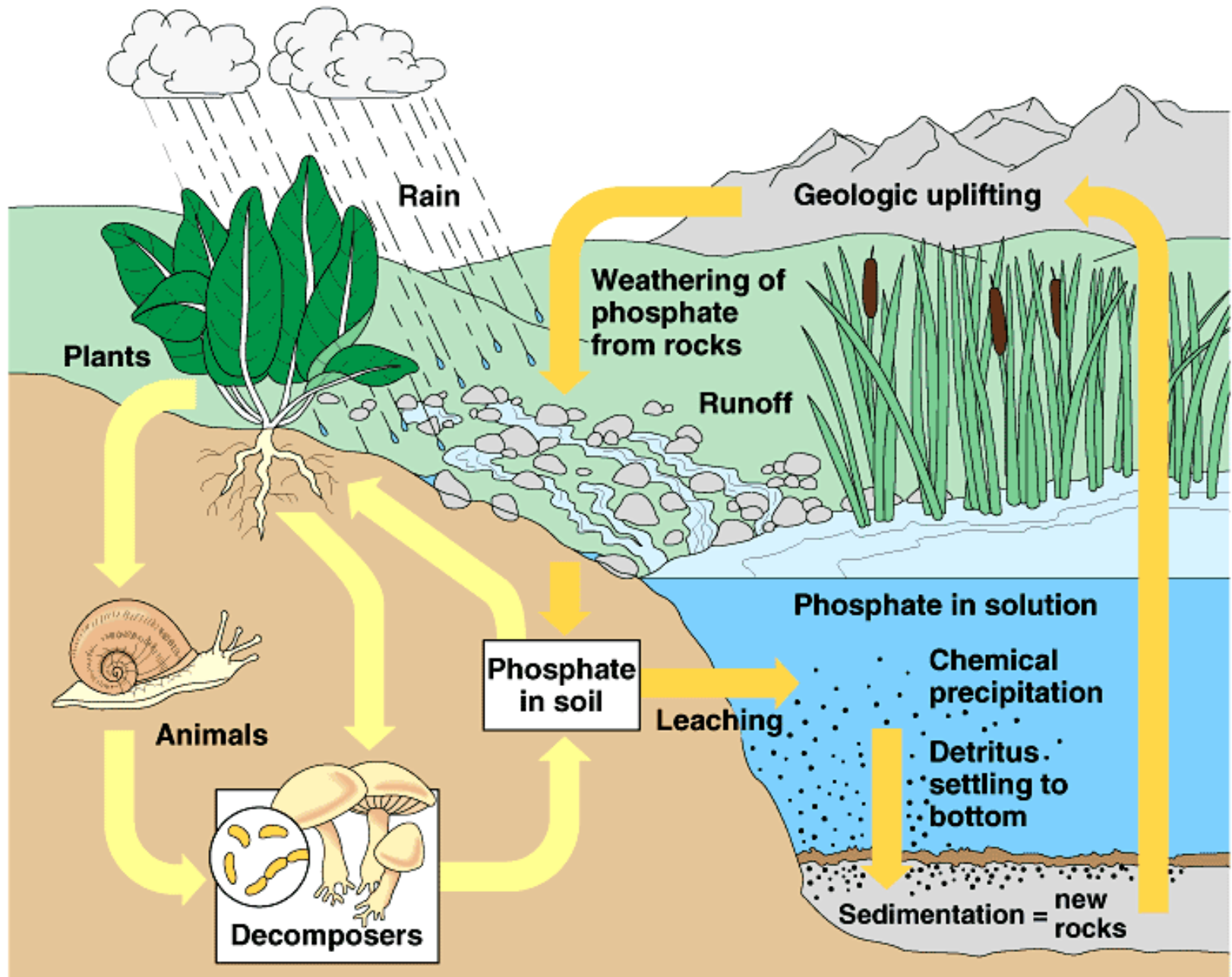
The nitrogen cycle



Phosphorus cycle

- Needed to elaborate nucleic acids, phospholipids, ATP
- Local cycle (no phosphorus-containing gases)
- Phosphate is the only inorganic form of importance
- Phosphorus may become unavailable for organisms during long periods of time

The phosphorous cycle



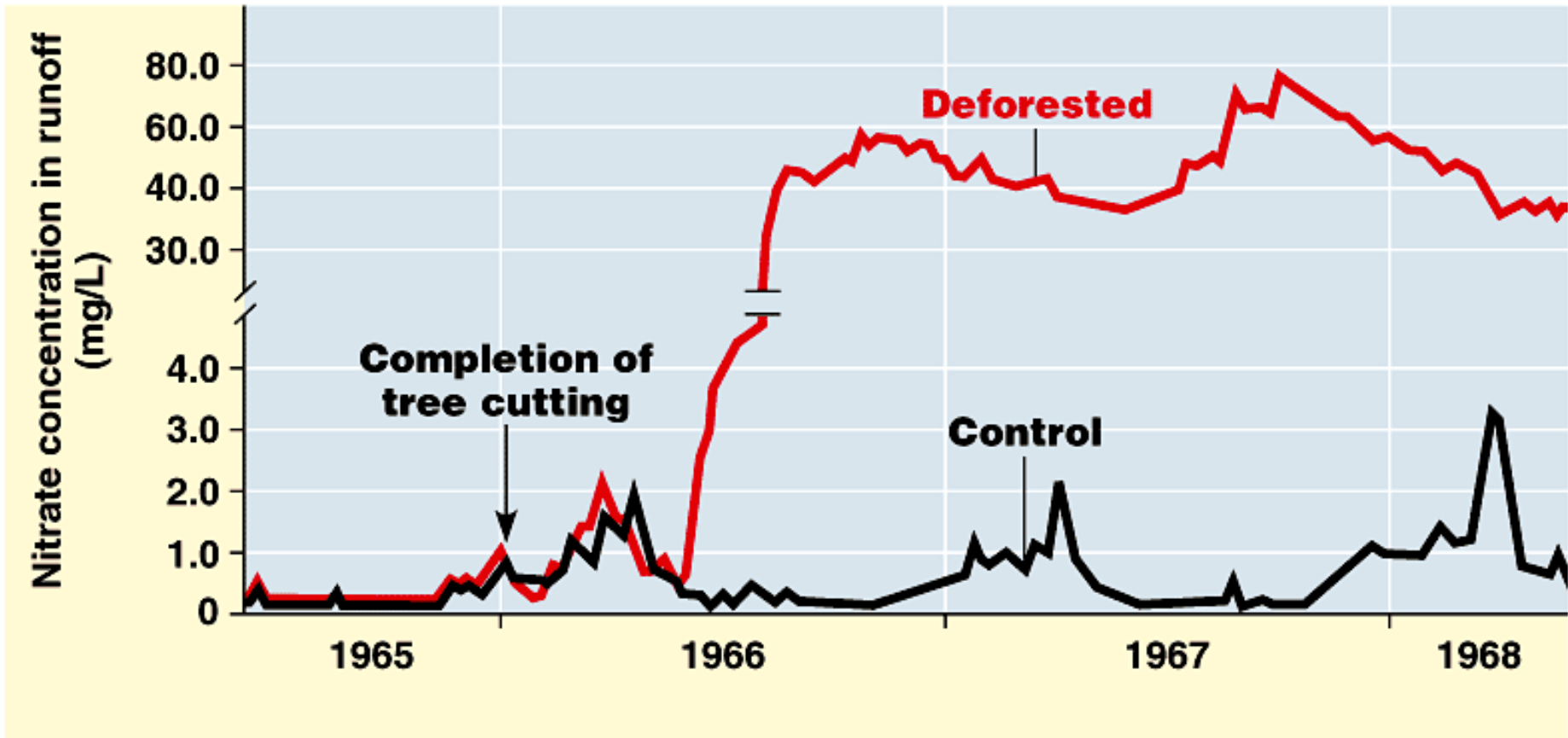
Nutrient cycling regulation

- Rates of nutrient cycling can vary across ecosystems as a result of differences in rates of decomposition
 - In tropical forests cycling times of nutrients are as fast as decomposition of most organic material can happen in a few months to a few years
 - In temperate forests decomposition can take 4-5 yrs in tundra up to 50 years and in aquatic ecosystems even more

Nutrient cycling regulation

- Amount of nutrients leaving an ecosystem is controlled by the plants found on it; when plants are not present to retain them, nutrients are lost from the system
 - This was observed in deciduous forests in New Hampshire

Nutrient cycling in the Hubbard Brook Experimental Forest: an example of long-term ecological research



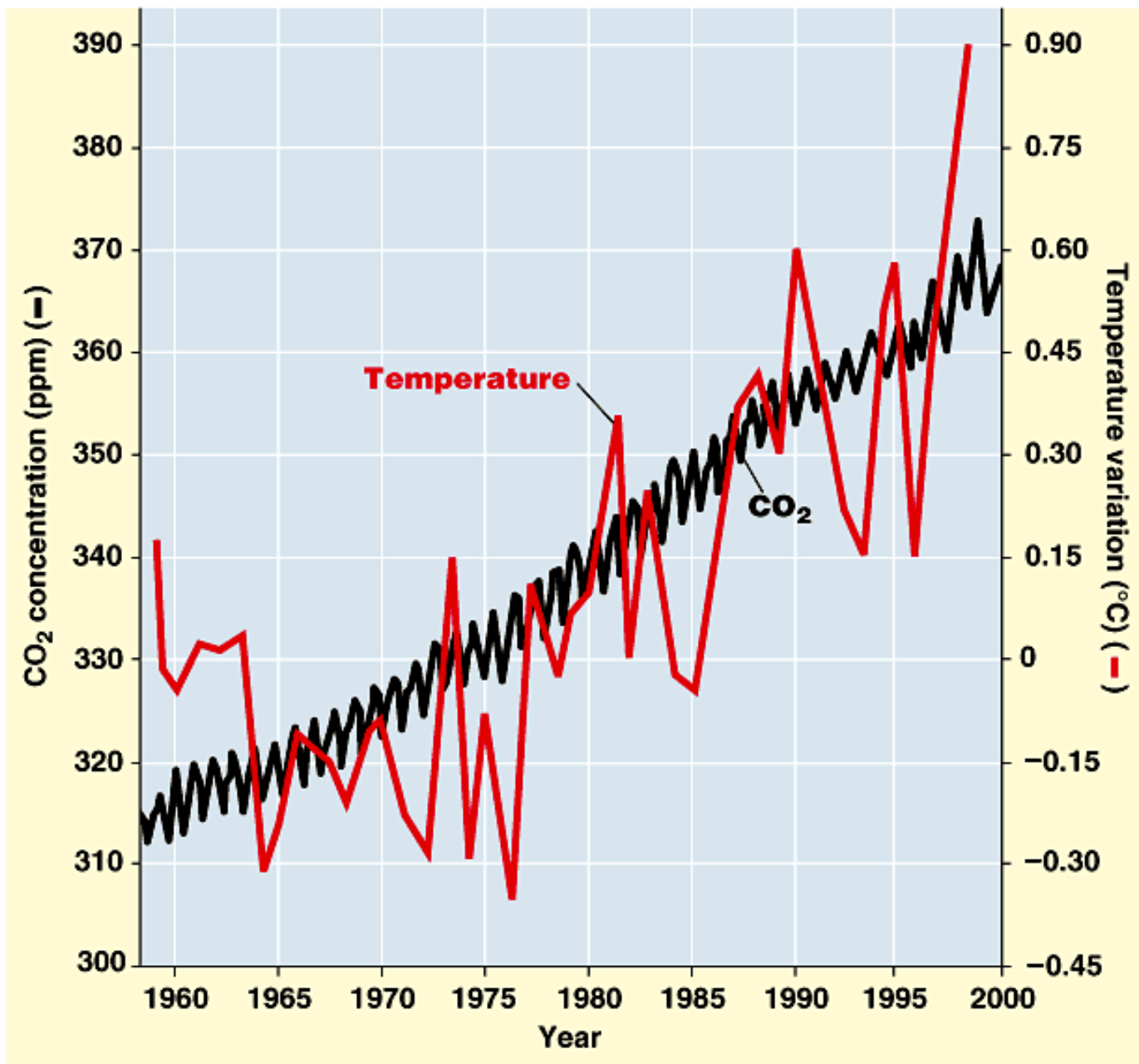
Human impacts on ecosystems

- Agriculture has great impact on nitrogen cycle
 - Cultivation increases decomposition which removes N, harvesting removes plants which further remove N from system. Fertilizer is then used to make up for loss in N
 - Excess of N due to fertilization can lead to dangerous concentrations of N in water systems. In some cases it can be beneficial (human point of view) as N can increase primary production in forest ecosystems

Human impacts on ecosystems

- Increase of carbon dioxide in atmosphere.
 - Can lead to changes in composition of plants communities as high levels of CO₂ favor C₃ plants
 - Will increase the Greenhouse effect in the atmosphere leading to warmer global temperatures

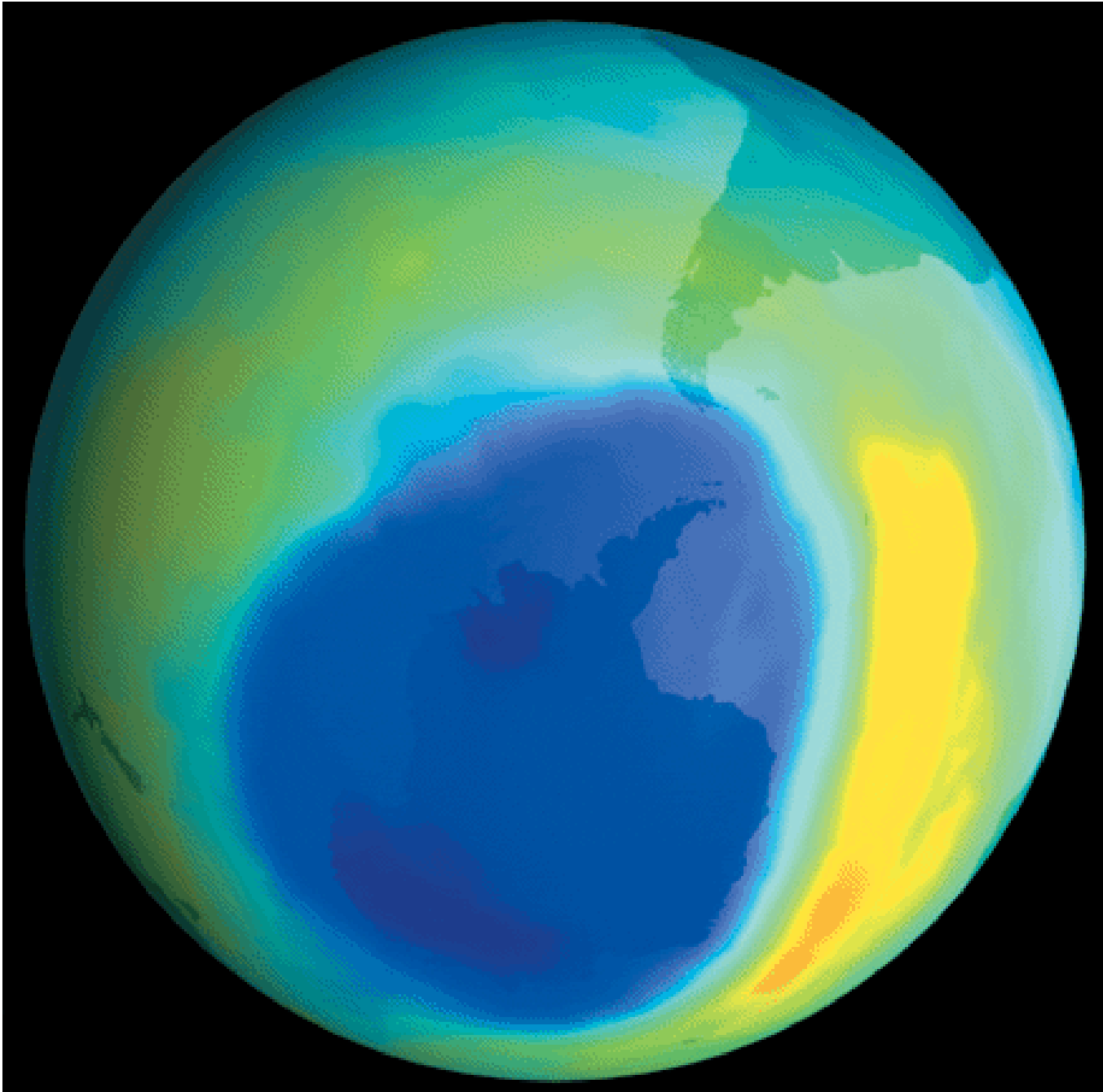
The increase in atmospheric carbon dioxide and average temperatures from 1958 to



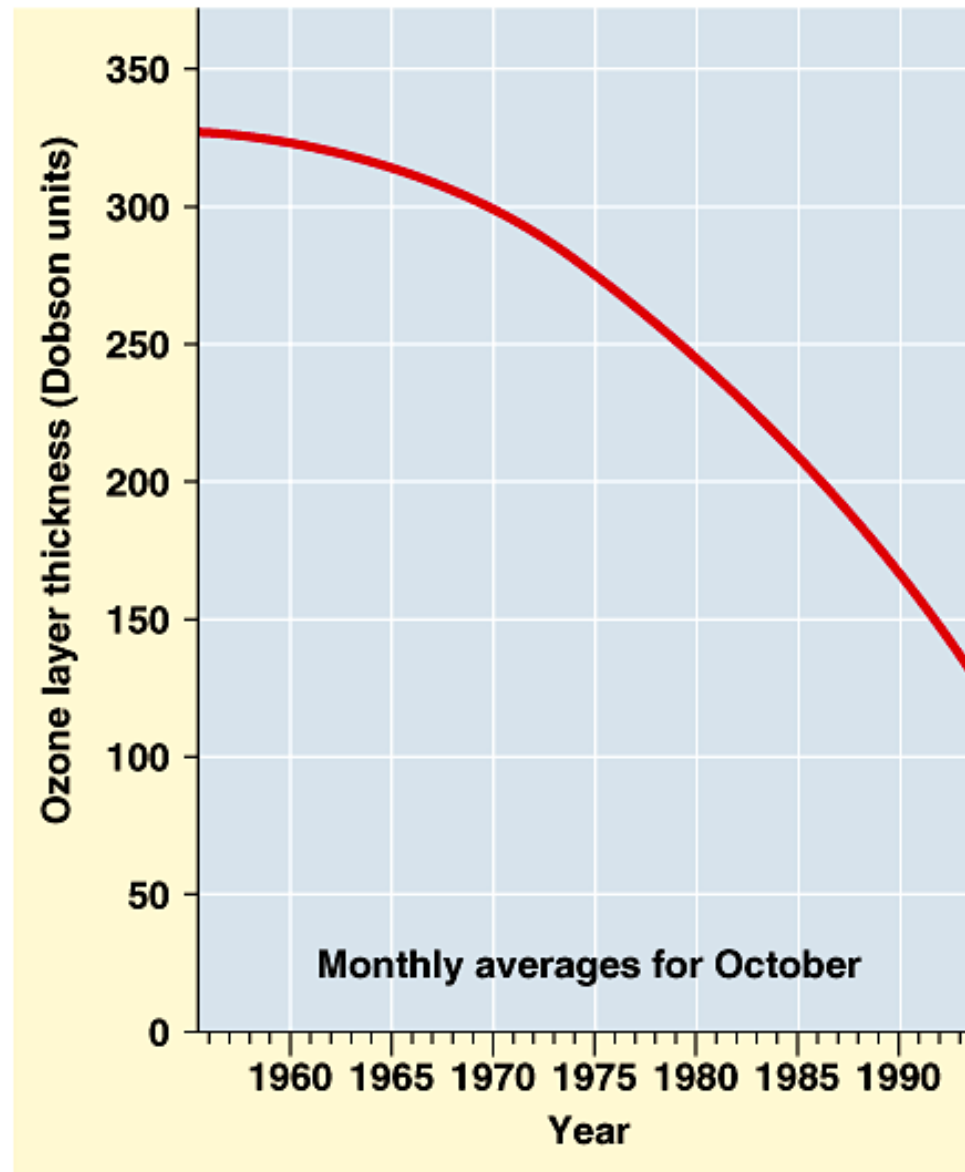
Human impacts on ecosystems

- Depletion of ozone layer
 - Destruction of atmospheric ozone due to accumulation of chlorofluorocarbons in stratosphere, chemicals used in refrigeration or as propellants in aerosol cans
 - Can lead to increase of skin cancers and cataracts in humans, unpredictable changes on crops and natural communities

Erosion of Earth's ozone shield: The ozone hole over the Antarctic



Erosion of Earth's ozone shield: Thickness of the ozone layer



(b) Thickness of the ozone layer