Nutrient Cycling and Retention

Chapter 19

Energy is a one-way flow (as we saw last chapter).

Nutrients, however, are recycled!!!

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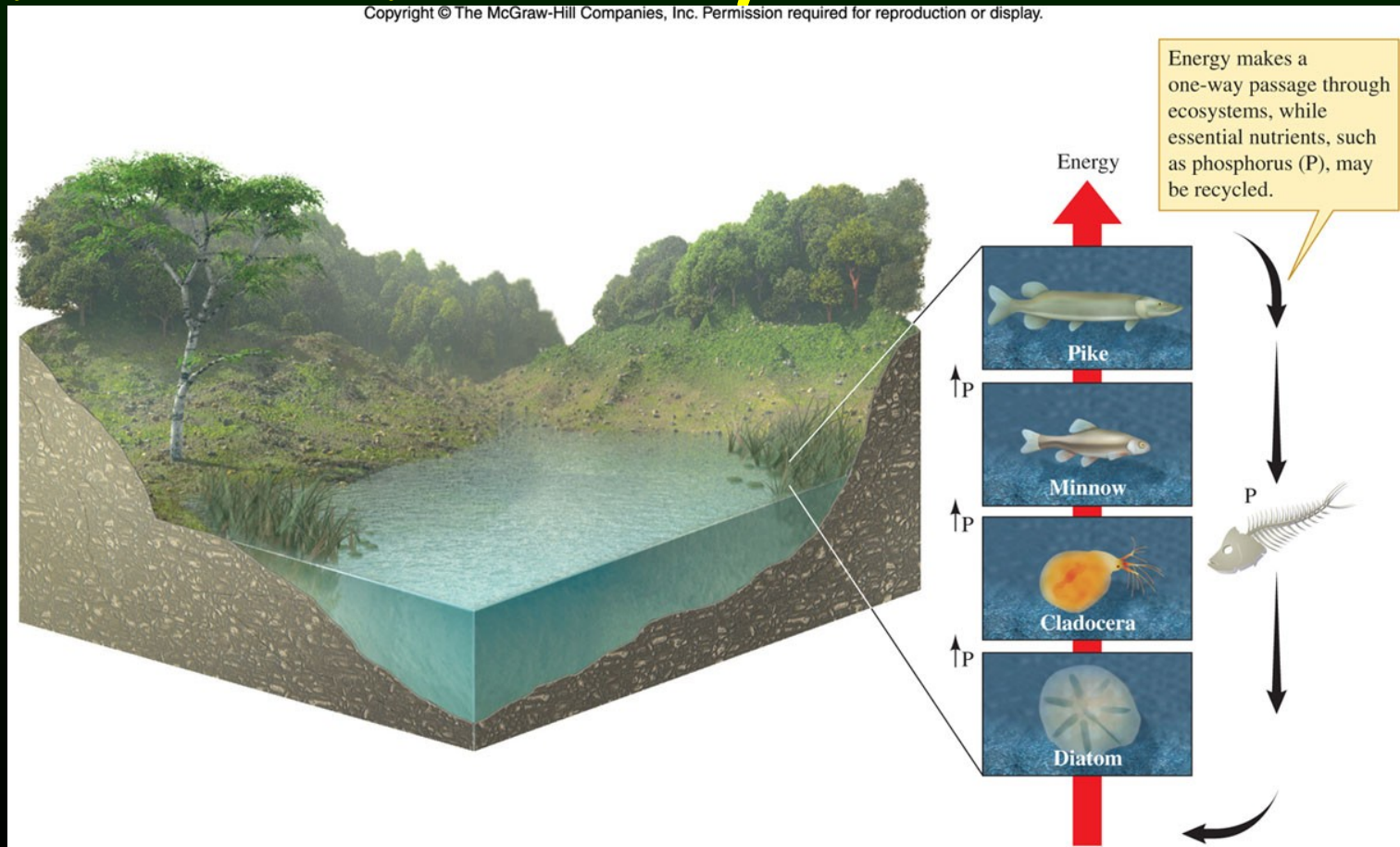


Nutrient Cycles

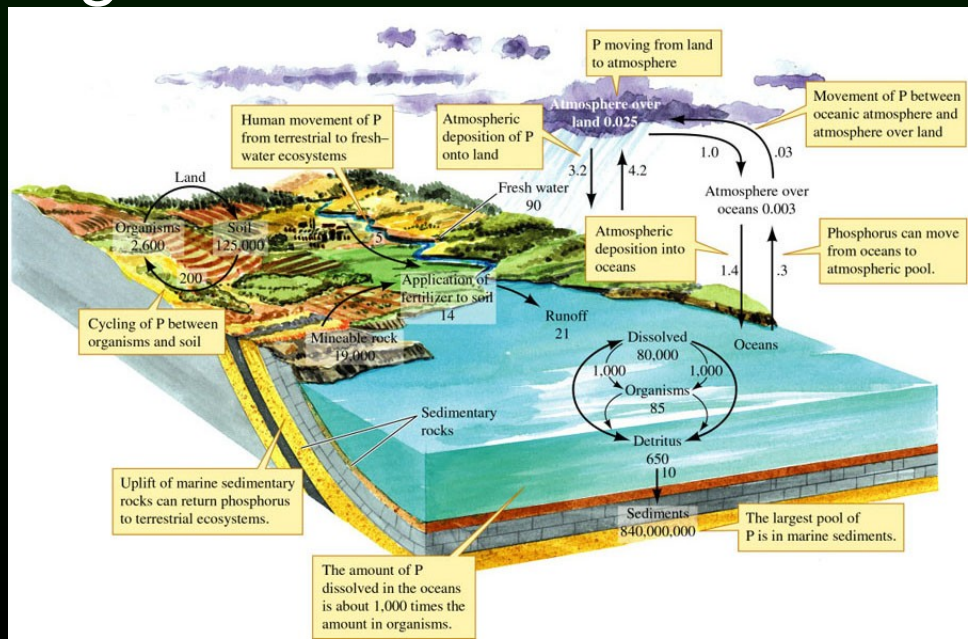
- Nutrient cycles involve the storage (nutrient pools) and movement (nutrient flux) of nutrients in an ecosystem
- 3 nutrient cycles play prominent roles!
  - Phosphorus
  - Nitrogen
  - Carbon

Nutrient sink vs. nutrient source
(bottom sediment) (CO_2 in atmosphere)

Phosphorus Cycle

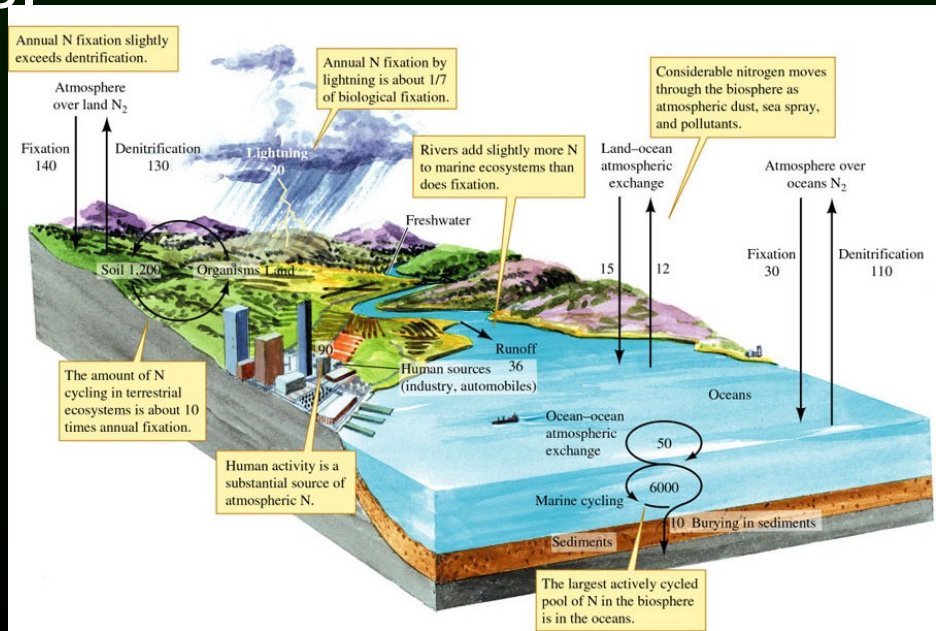
- ATP, ADP, RNA, DNA, phospholipids
  - Largest quantities found in mineral deposits and marine sediments.
    - Much not directly available to plants.
    - Not a big atmospheric pool of P!
  - Slowly released in terrestrial and aquatic ecosystems via weathering of rocks.

Mycorrhizae help plants absorb P!



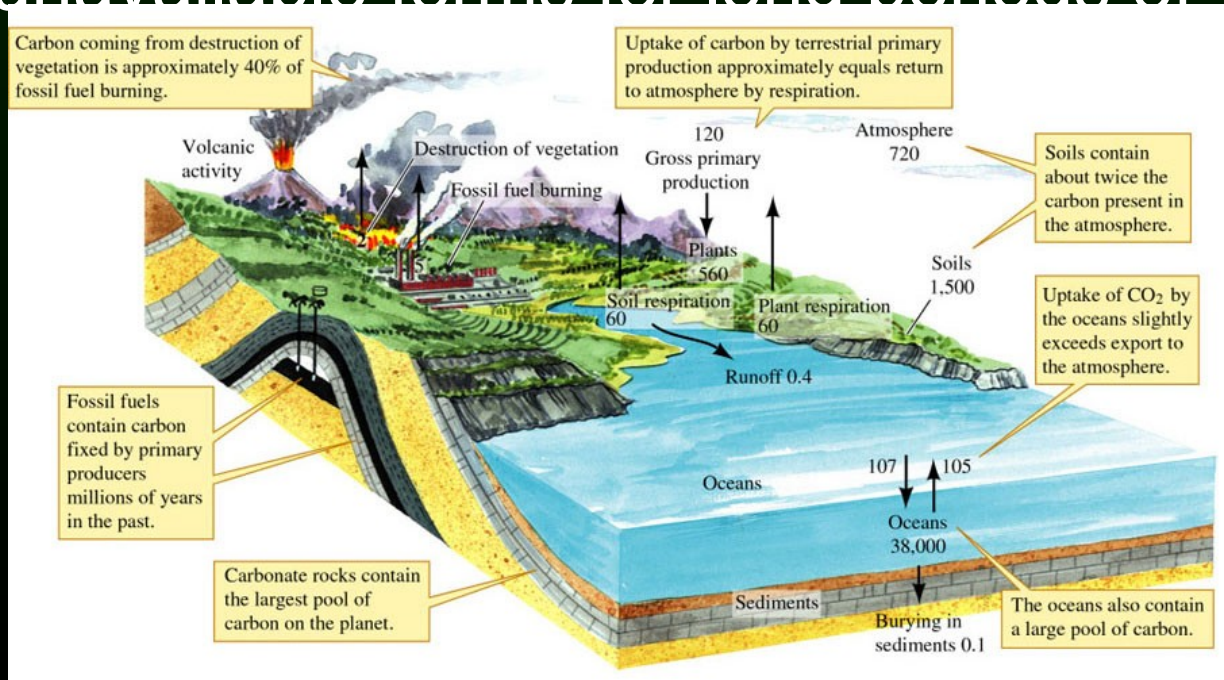
Nitrogen Cycle

- Amino acids, nucleic acids, chlorophyll, hemoglobin
- Includes major atmospheric pool - N_2.
  - Only nitrogen fixers can use atmospheric supply directly.
    - N_2 reduced to ammonia (NH_3).
    - Once N is fixed it is available to organisms.
      - Upon death of an organism, N can be released by fungi and bacteria during decomposition.



Carbon Cycle

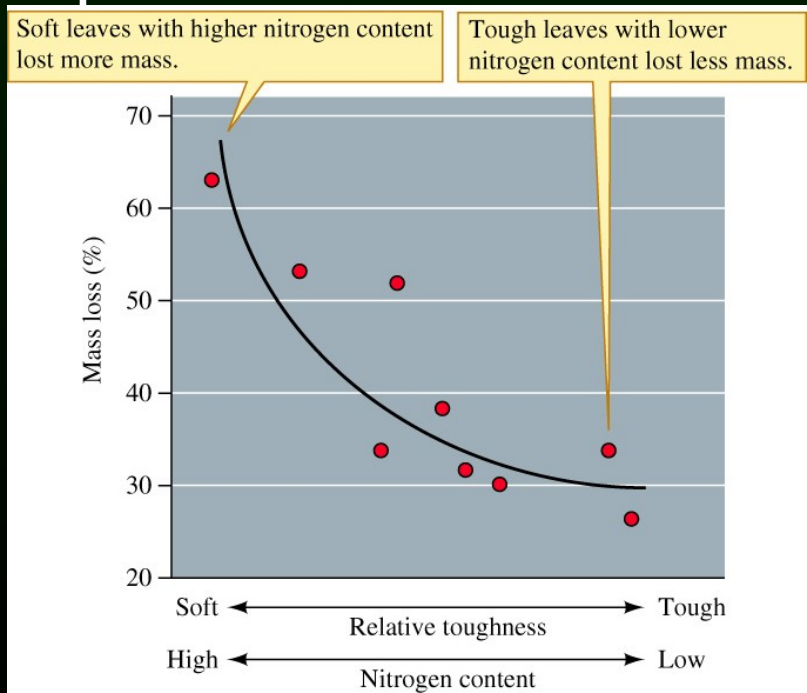
- The carbon backbone!
- Moves between organisms and atmosphere: photosynthesis and respiration.
  - In aquatic ecosystems, CO_2 must first dissolve into water before being used by primary producers.
  - Although some C cycles rapidly, some remains sequestered in unavailable forms for long periods of time. (i.e. soils)



Rates of Decomposition

- Decomposition rate is influenced by temperature, moisture, and chemical composition of litter and the environment
- Rate at which nutrients are made available to primary producers is determined largely by rate of mineralization (conversion of organic to inorganic).
  - Occurs primarily during decomposition.

Quick summary:
warm, moist = greater decomposition rate
Increases with nitrogen
Decreases with lignin



More examples!

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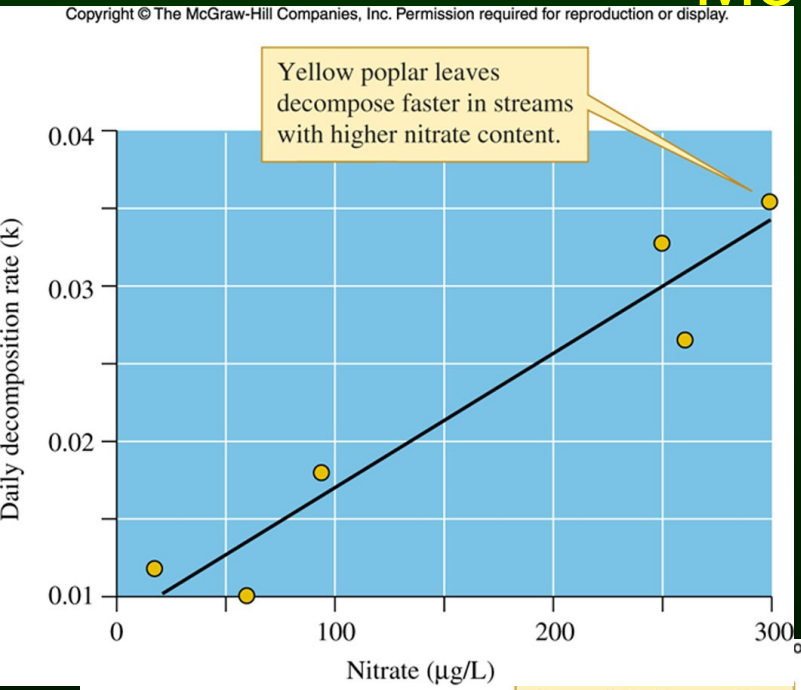

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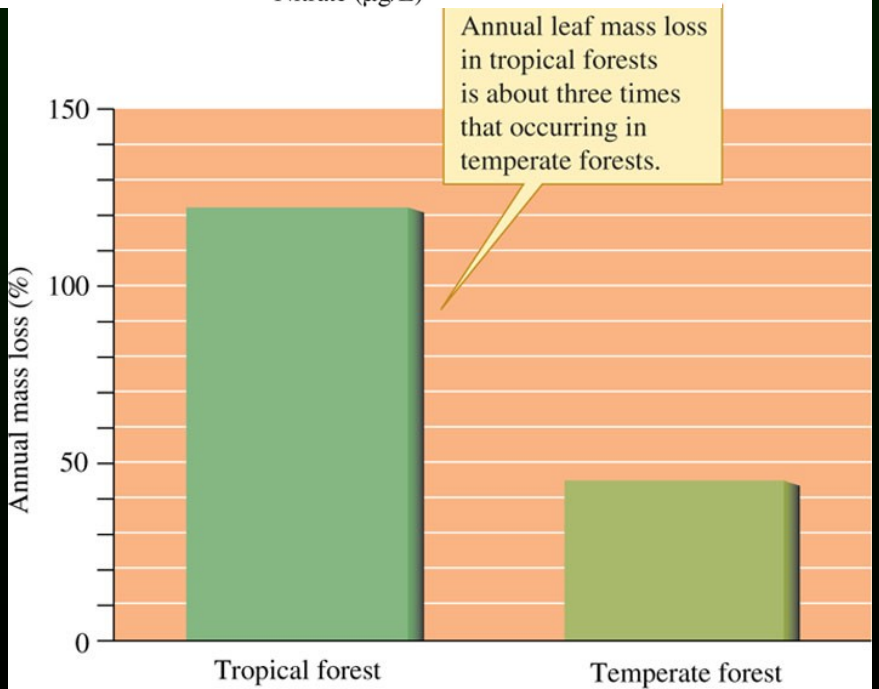

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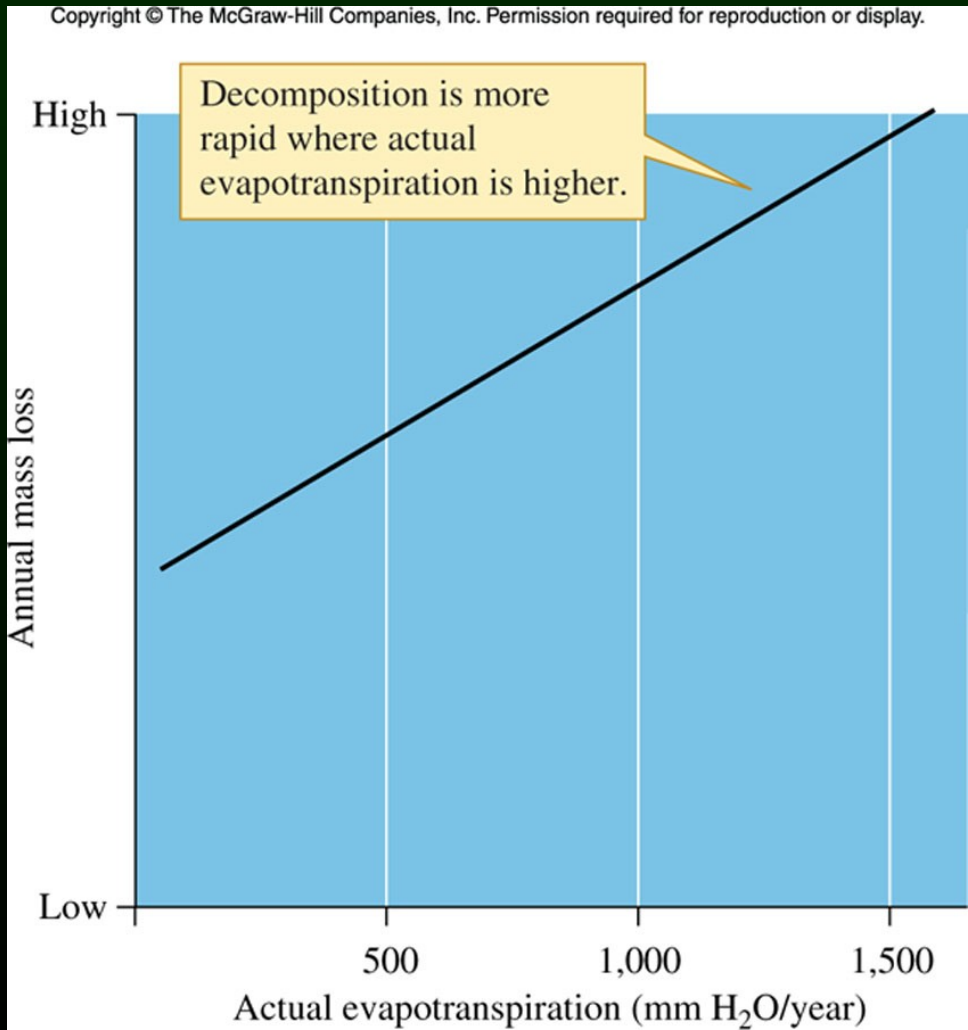
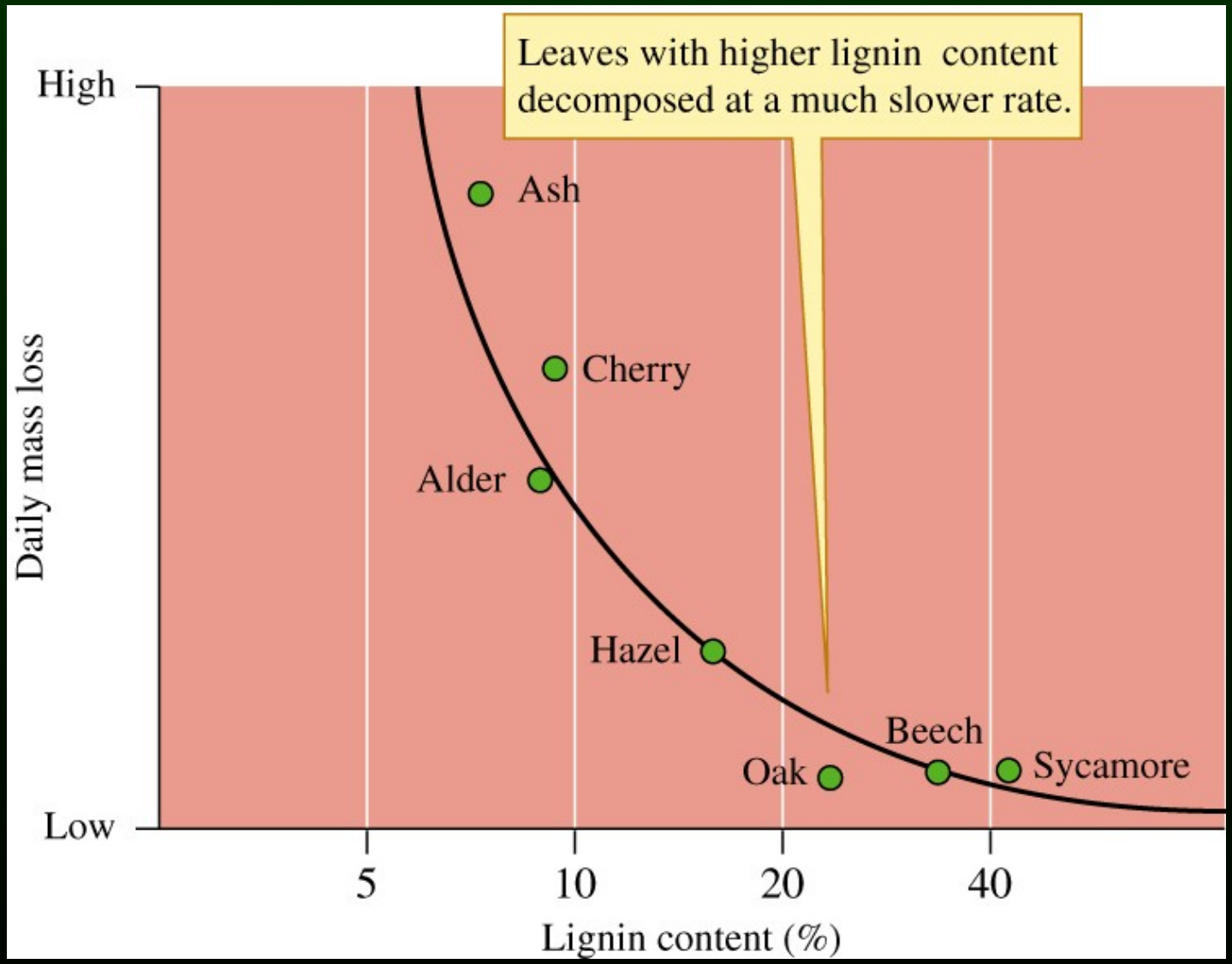


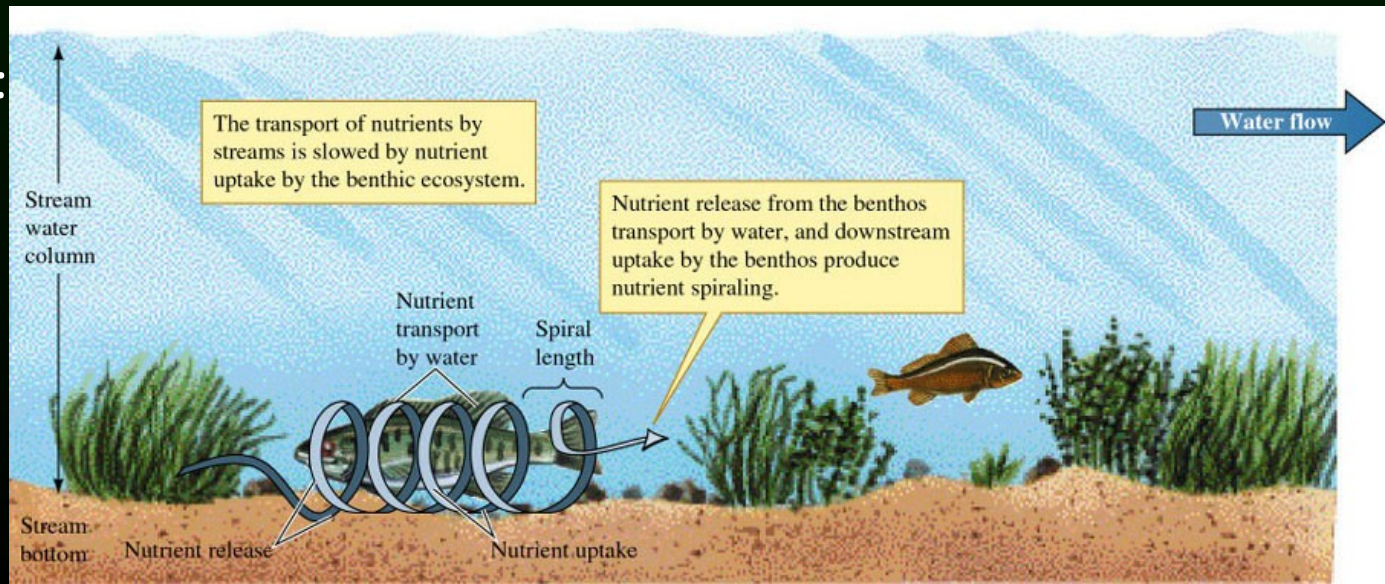
Decomposition in Aquatic Ecosystems



Organisms and Nutrients

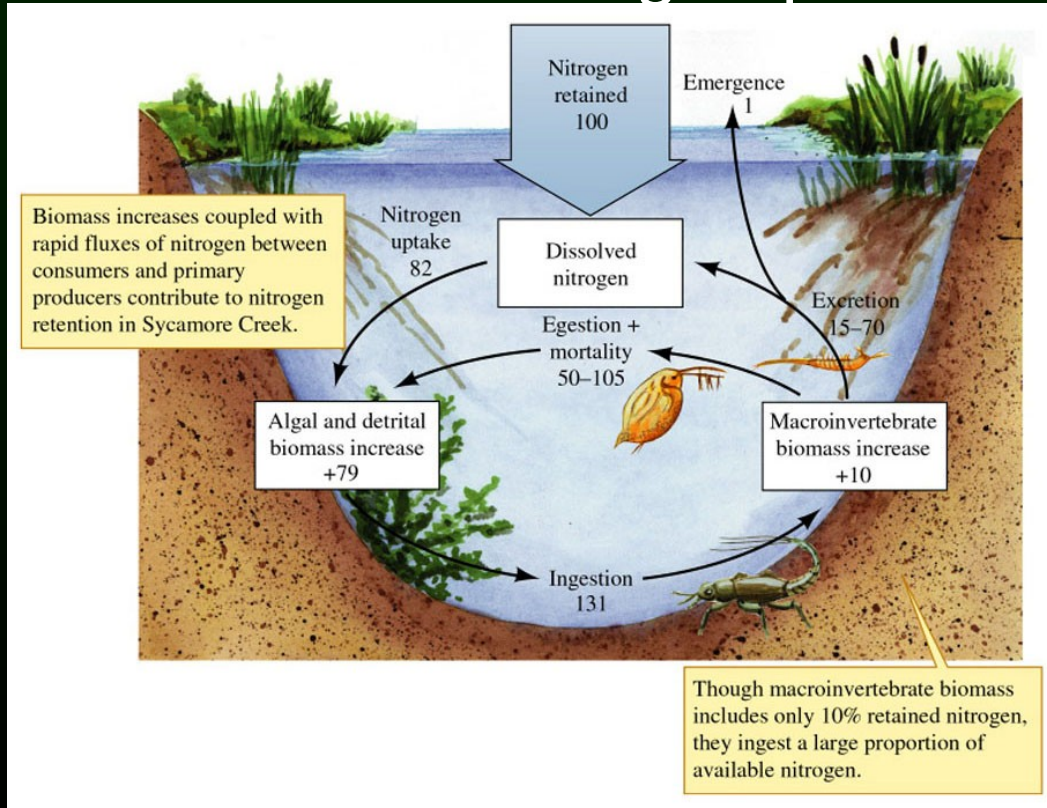
- Plants and animals can modify the distribution and cycling of nutrients
  - Little nutrient cycling in one place in streams (current flow!).
    - Nutrient Spiraling instead!
  - Spiraling Length is the length of a stream required for a nutrient atom to complete a cycle.
    - Related to rate of nutrient cycling and water velocity

Short lengths = high nutrient retention
Long lengths = low



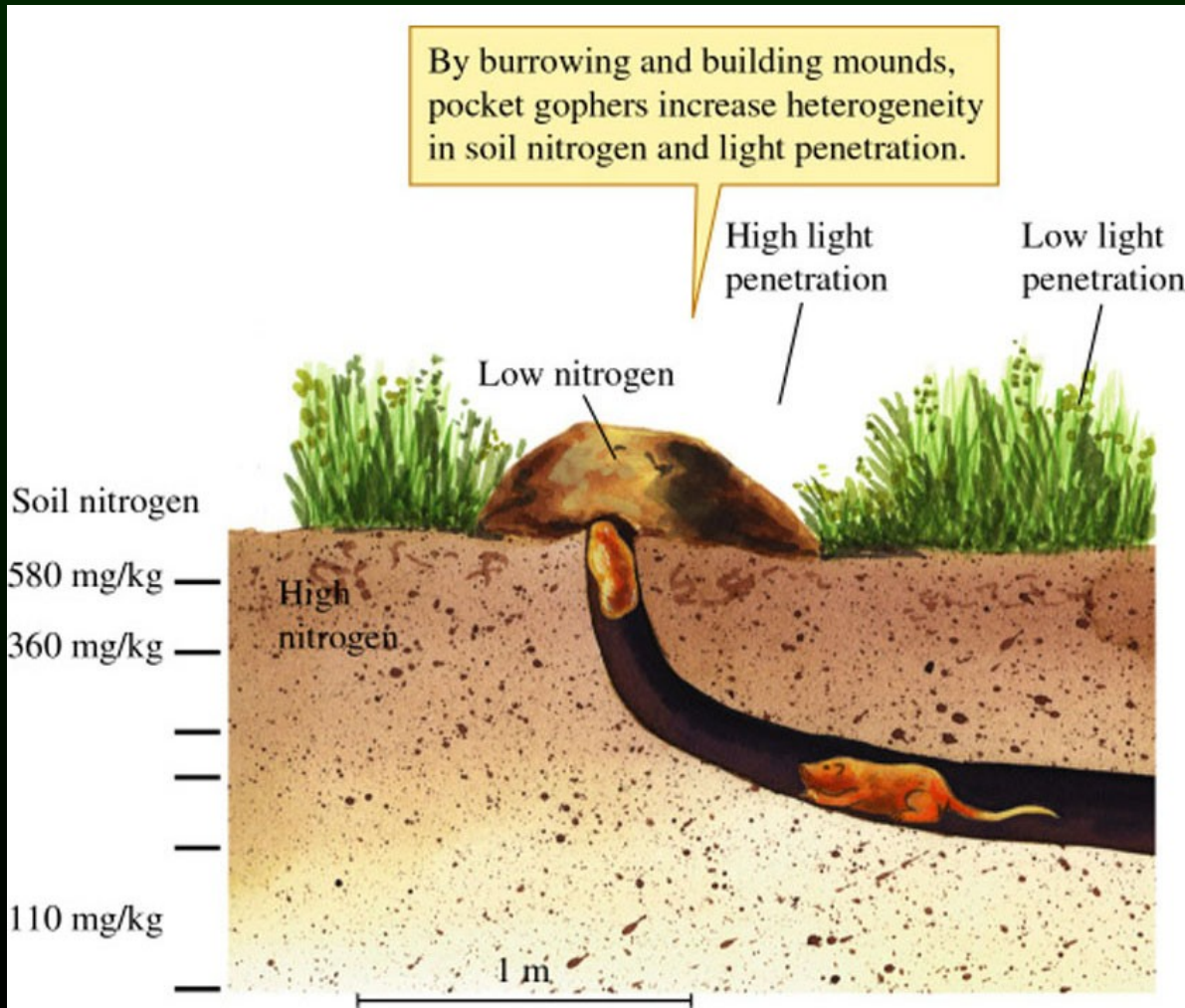
Stream Invertebrates and Spiraling Length

- *Grimm* showed aquatic invertebrates significantly increase rate of N cycling.
  - Suggested rapid recycling of N by macroinvertebrates may increase primary production.
    - Excreted and recycled 15-70% of nitrogen pool as ammonia.



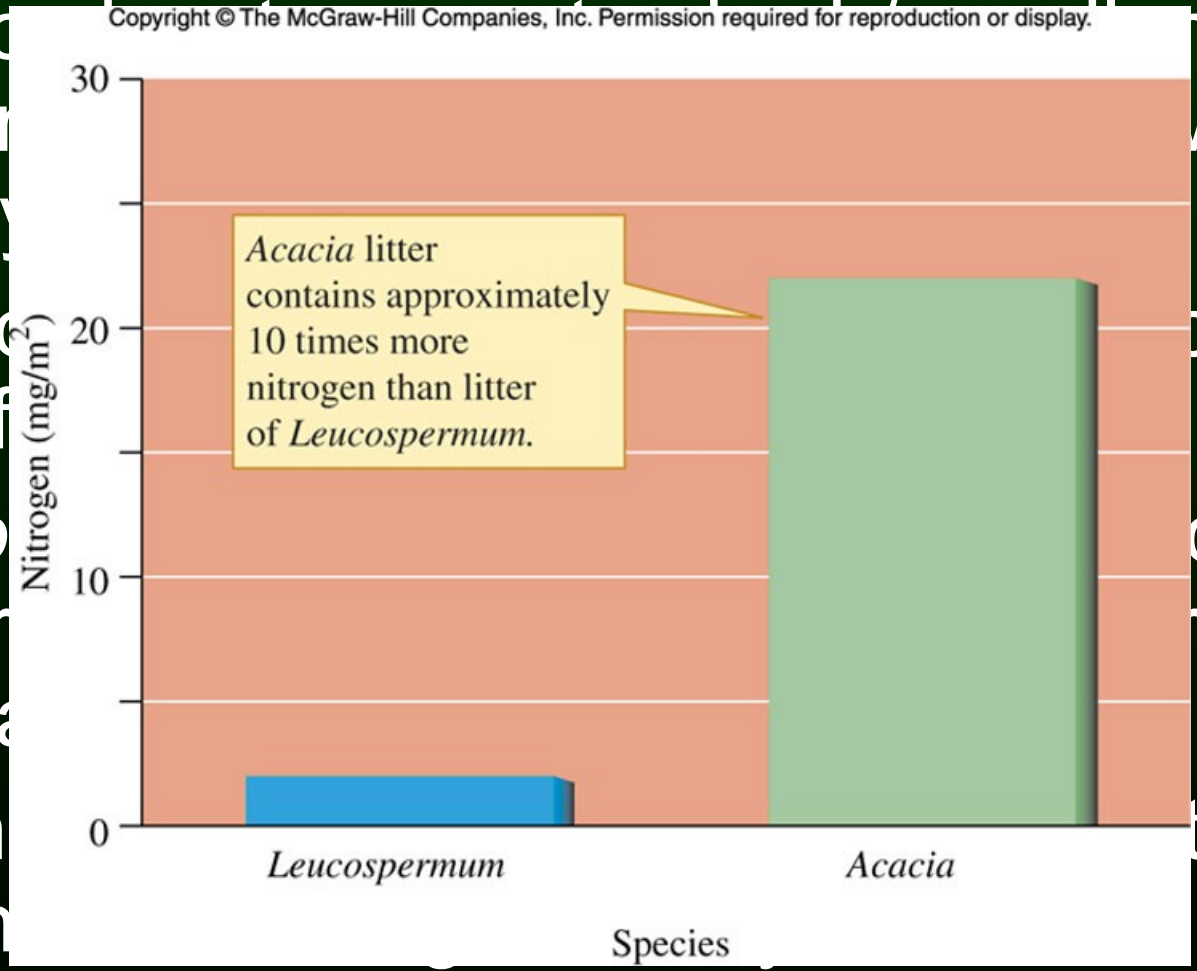
Animals and Nutrient Cycling in Terrestrial Ecosystems

- *Huntley* and *Inouye* found pocket gophers altered N cycle by bringing N-poor subsoil to the surface.



Plants and Ecosystem Nutrient Dynamics

- Fynbo… …nd known… …v soil fertilit…
  - Two… …bilize shif…
- *Witko*… …cs under… …roduced acacia…
  - Am… …trient con…
  - Acacia - N fixer



Disturbance and Nutrients

- Disturbance increases nutrient loss from ecosystems.

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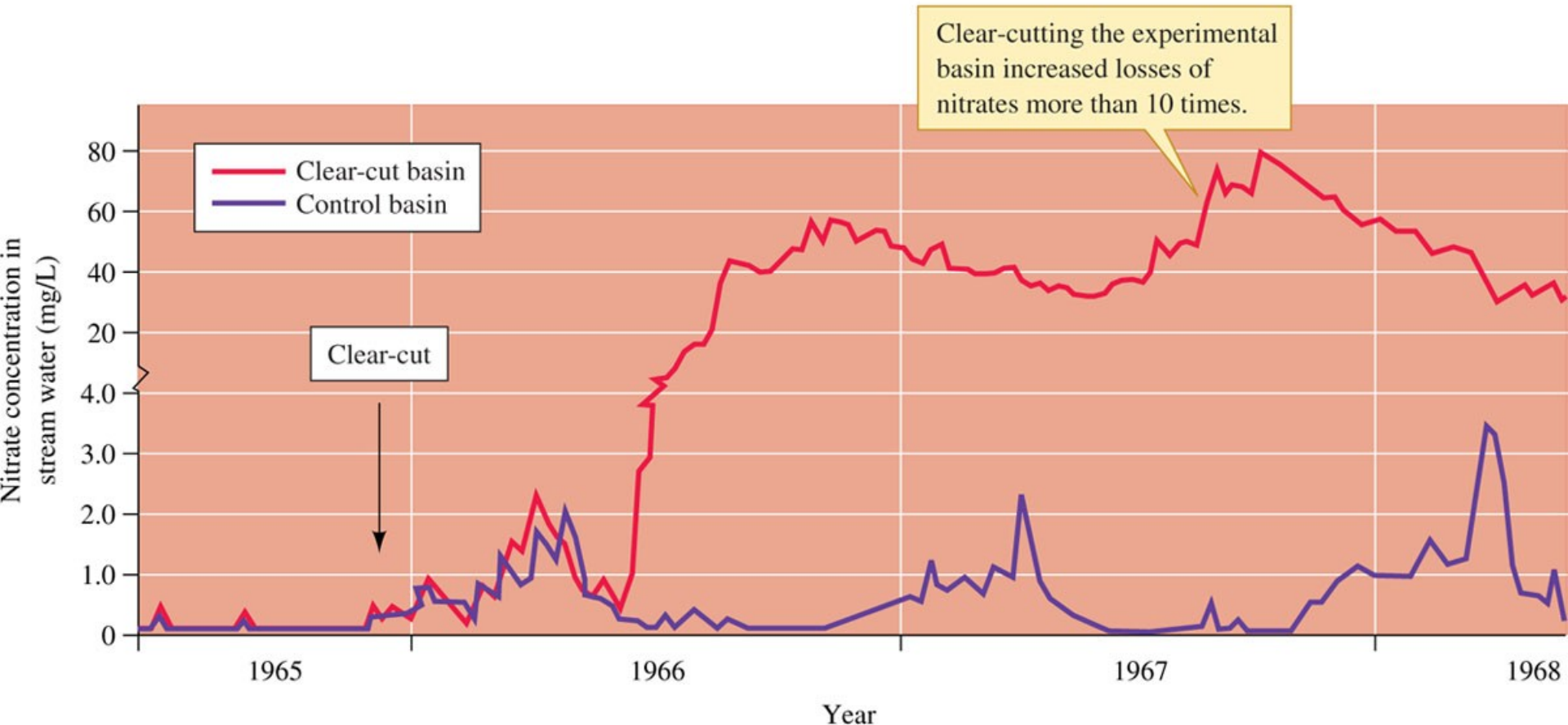

Altering Aquatic and Terrestrial Ecosystems

- Human activity increasingly affects the nutrient cycles of ecosystems
  - We enrich ecosystems especially with nitrogen and phosphorus
  - Leads to eutrophication: increased primary productivity & reduced diversity…why???

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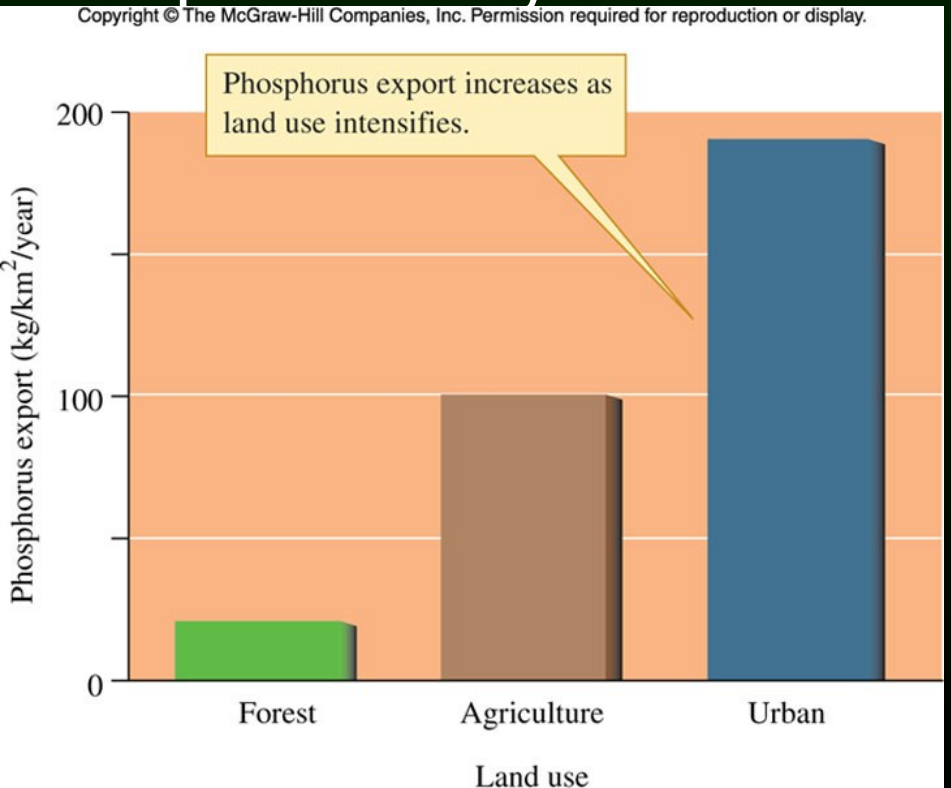

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