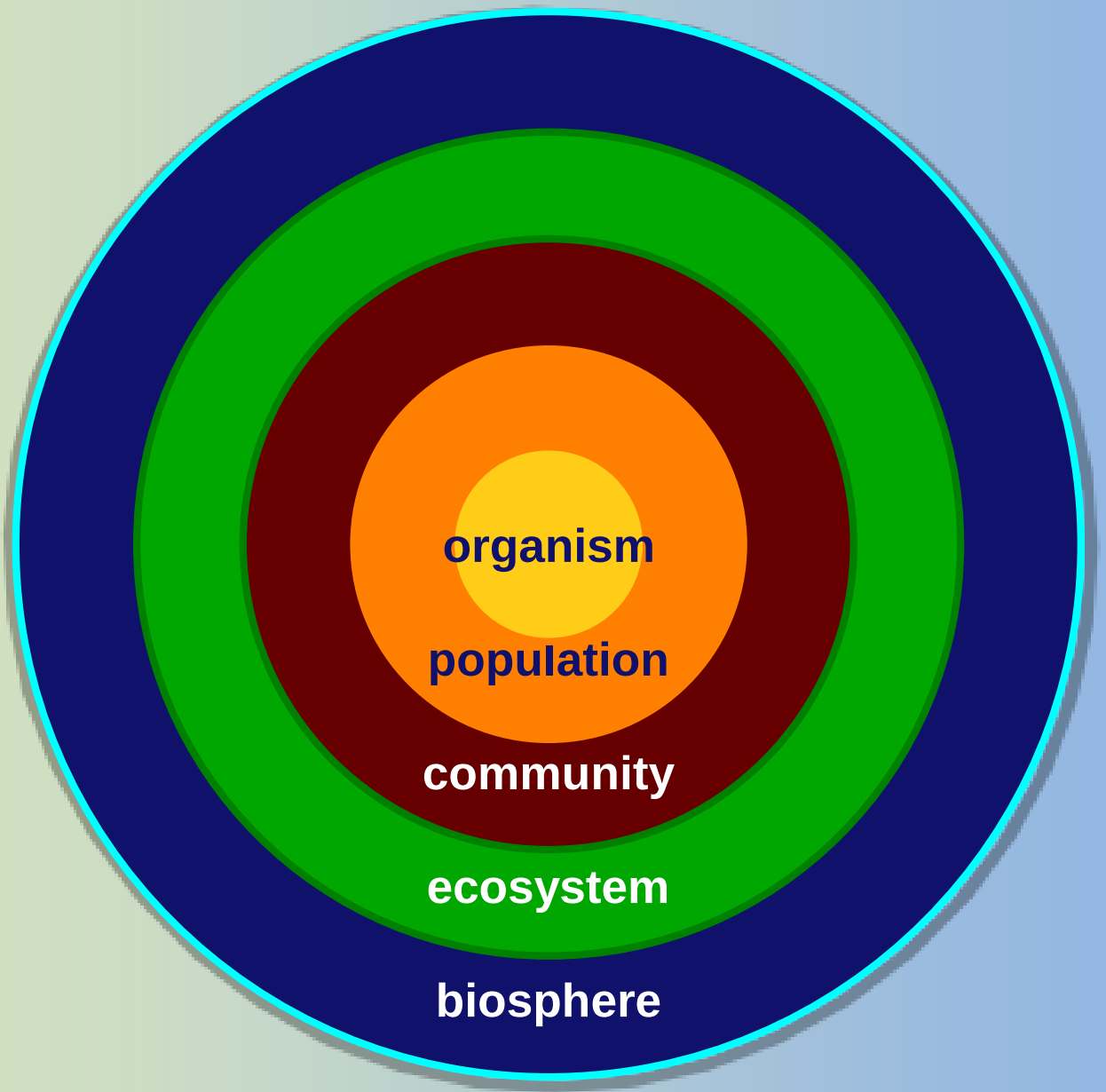
Ecosystems (Ch. 3)

Studying organisms in their environment



Essential questions

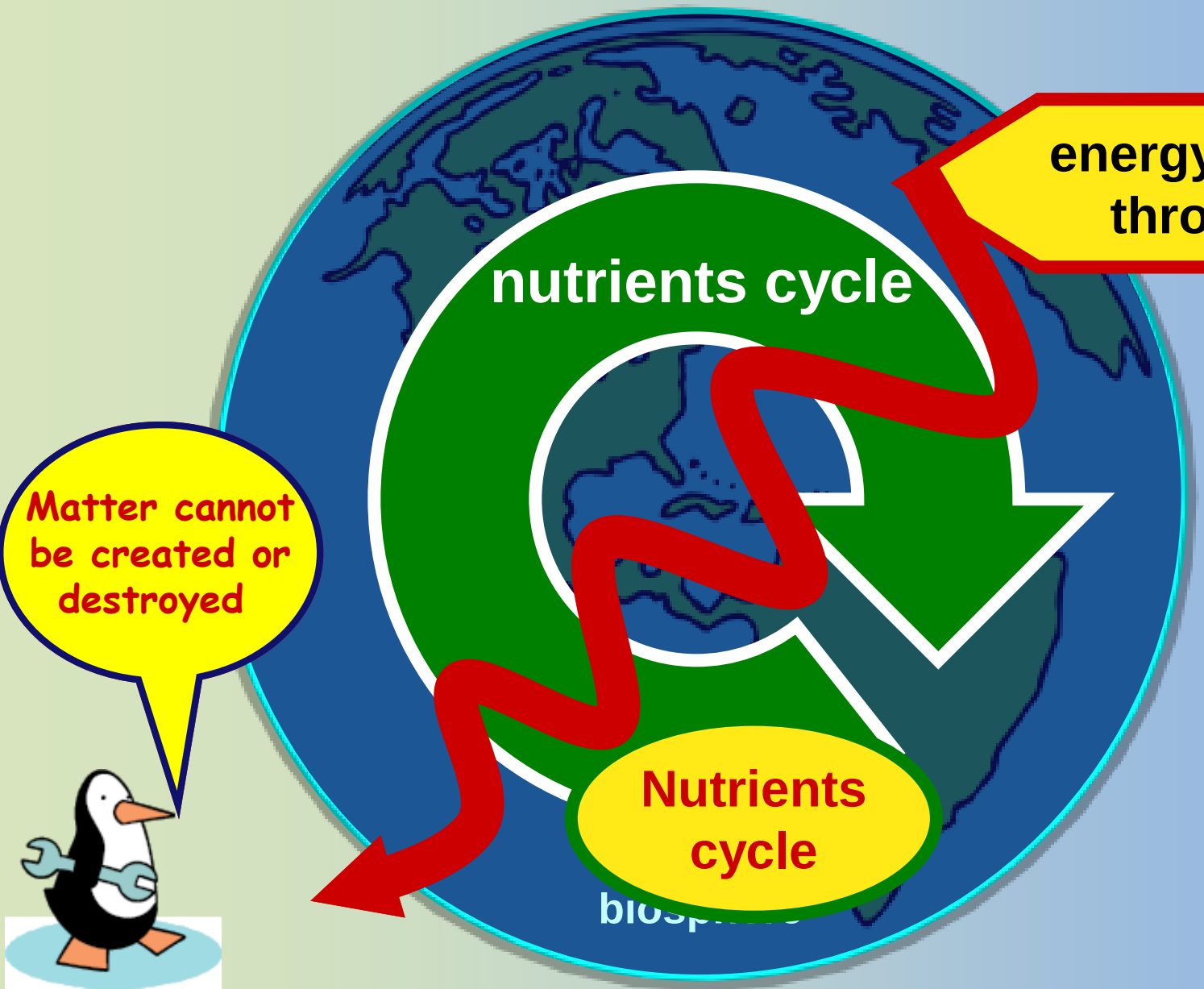
- What limits the production in ecosystems?
- How does energy move through the ecosystem?
- How do nutrients move in the ecosystem?

Ecosystem

- All the organisms in a community plus abiotic factors
  - Transform energy & process matter
- Ecosystems are self-sustaining
  - what is needed?

- **capture energy**
- **transfer energy**
- **cycle nutrients**

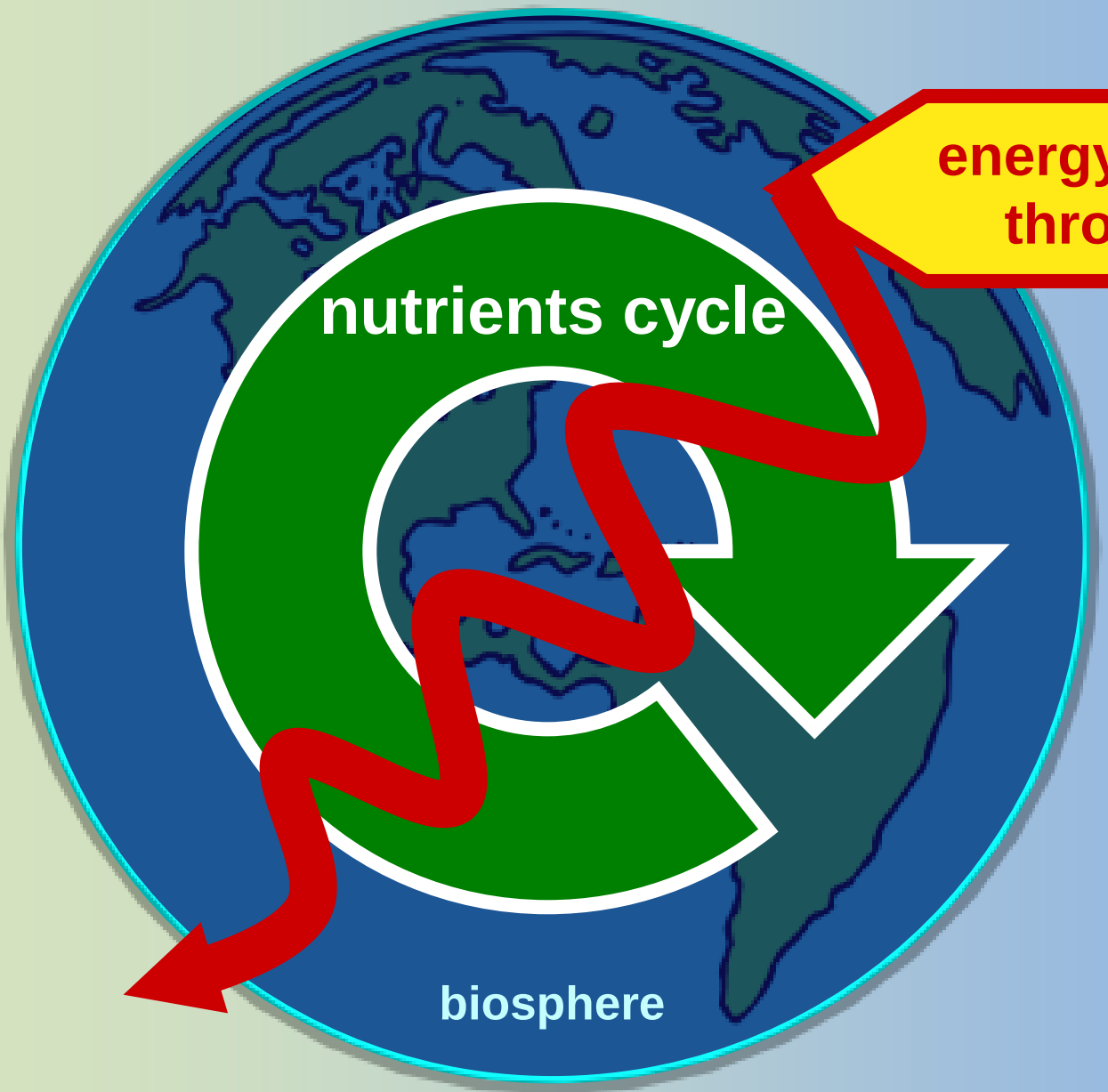
Ecosystem inputs



inputs

- **energy**
- **nutrients**

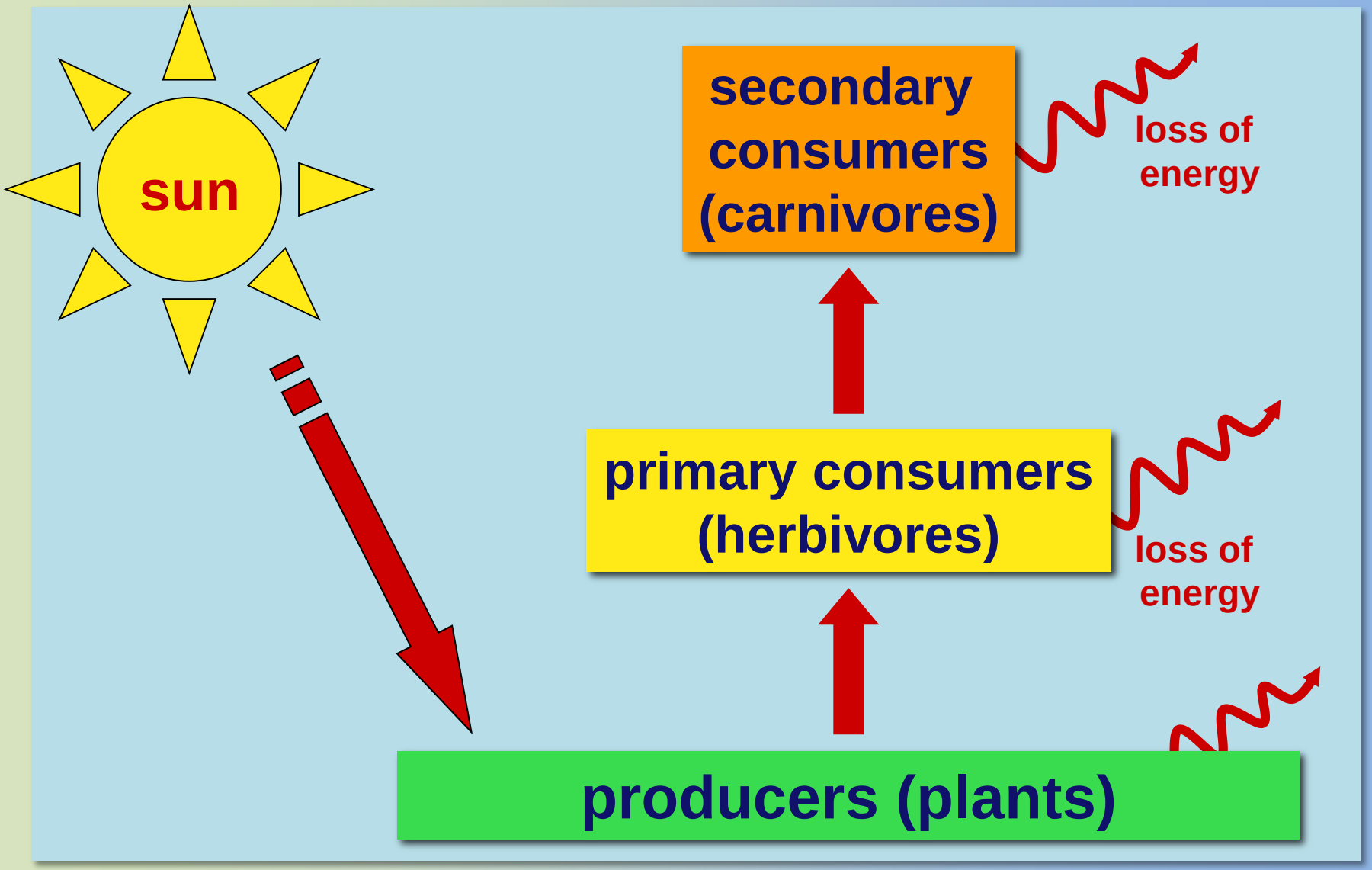
Ecosystem inputs



inputs

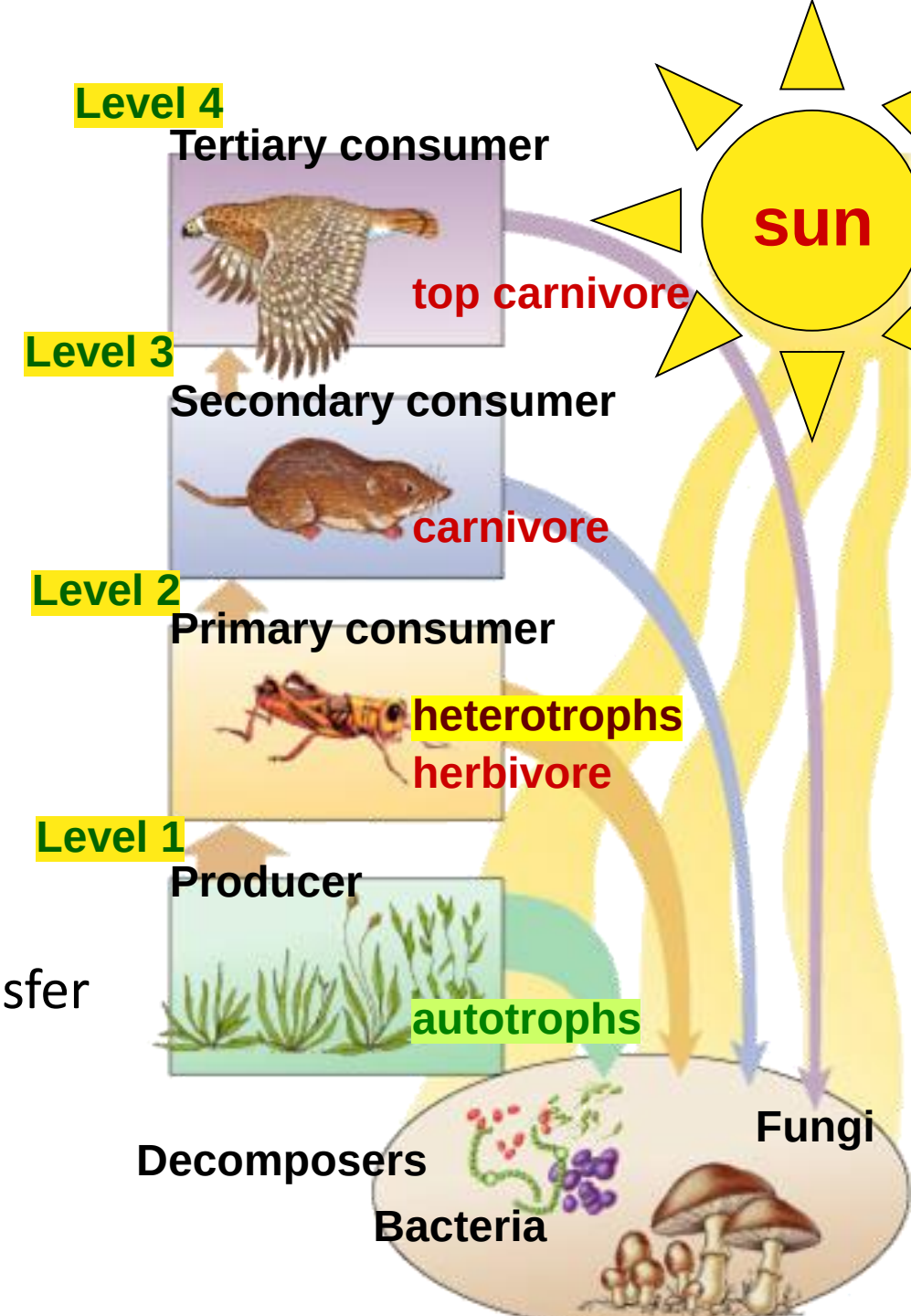
- **energy**
- **nutrients**

Energy flows through ecosystems



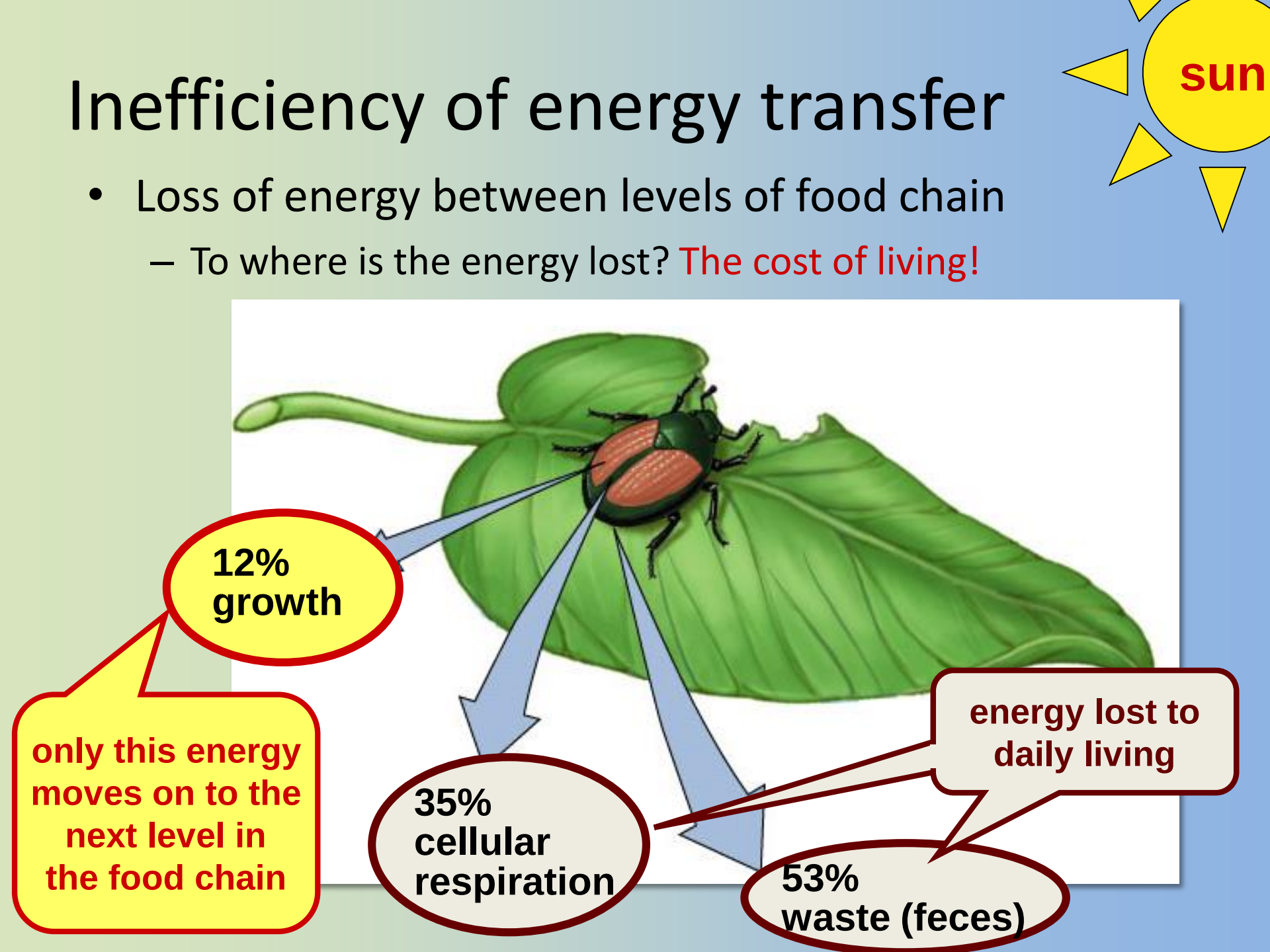
Food chains

- Trophic levels
  - feeding relationships
  - start with energy from the sun
  - captured by plants
    - 1st level of all food chains
  - food chains usually go up only 4 or 5 levels
    - inefficiency of energy transfer
  - all levels connect to decomposers



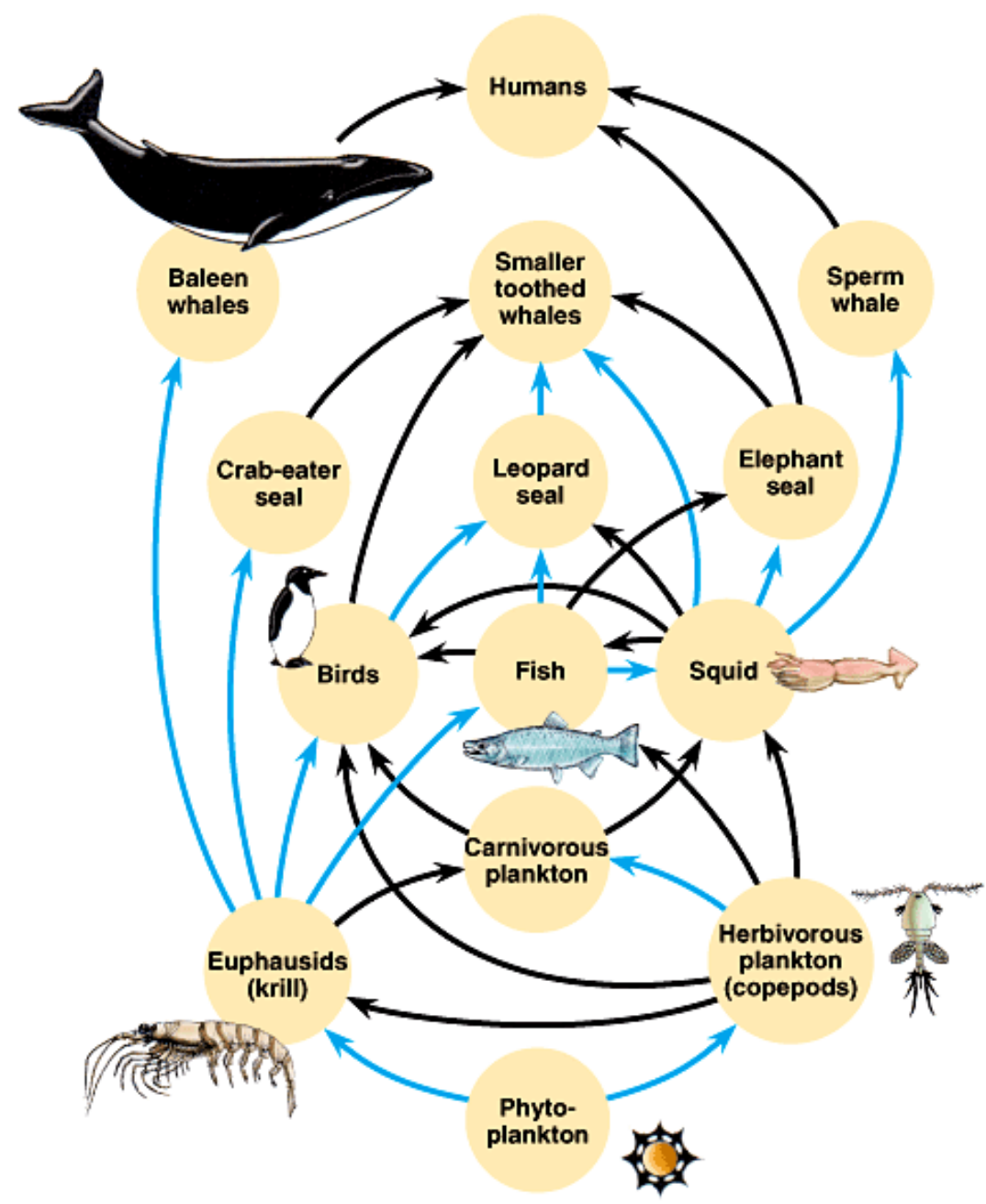
Inefficiency of energy transfer

- Loss of energy between levels of food chain
  - To where is the energy lost? The cost of living!



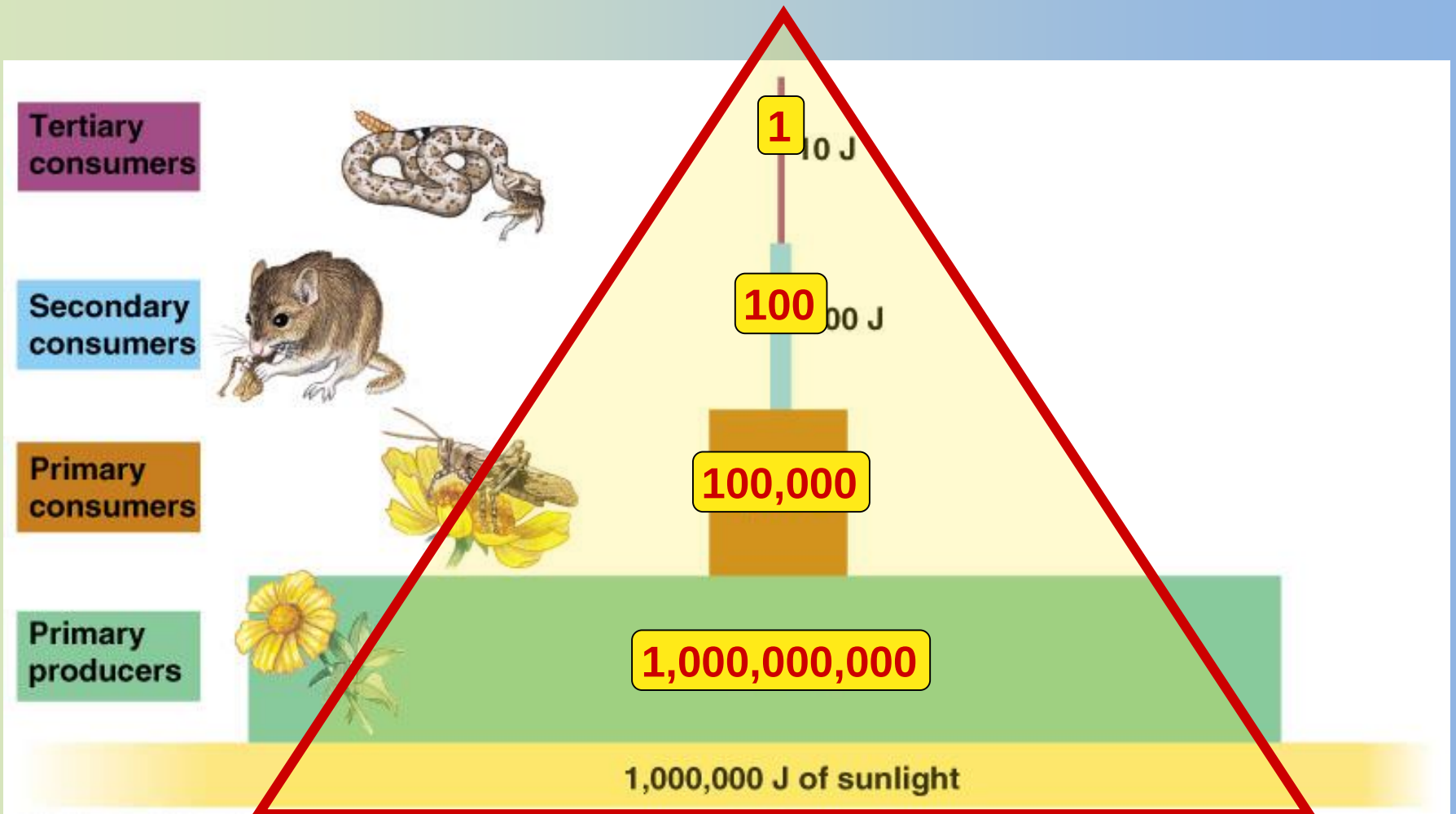
Food webs

- Food chains are linked together into food webs
- Who eats whom?
  - a species may weave into web at more than one level
    - bears
    - humans
      - eating meat?
      - eating plants?



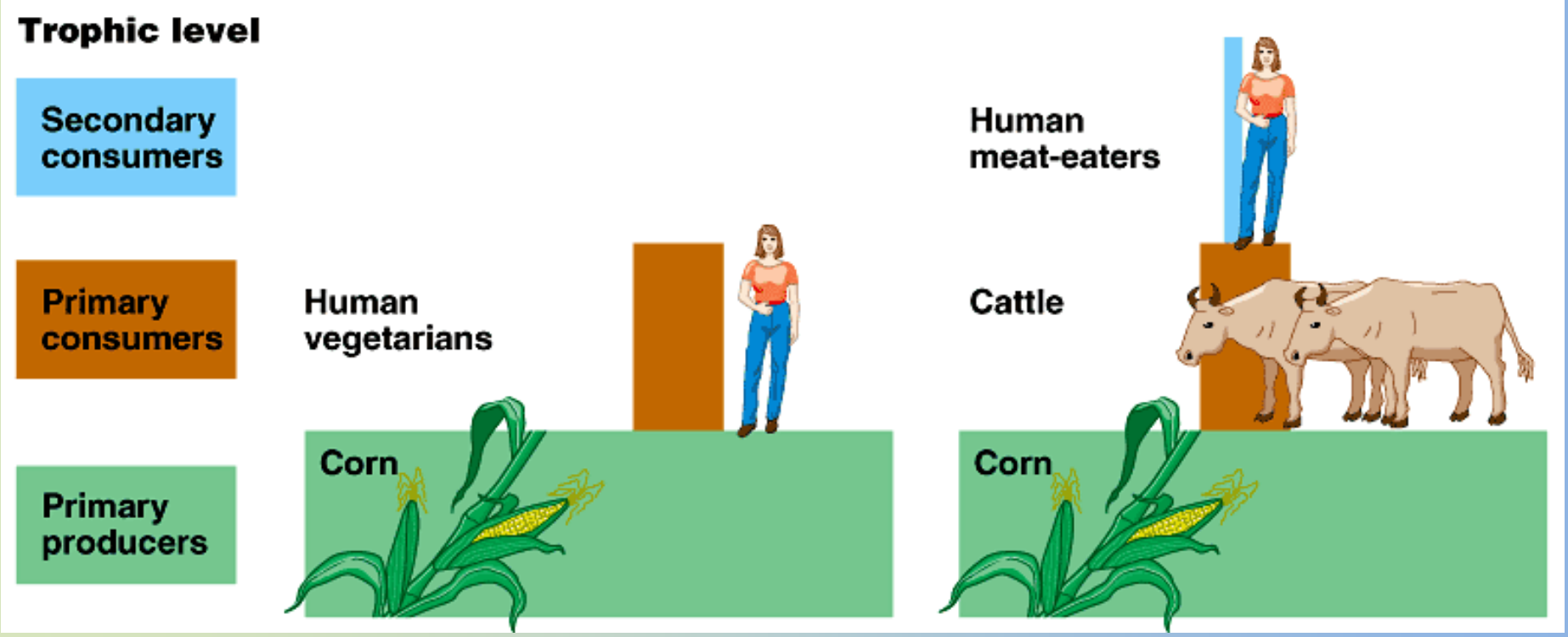
Ecological pyramid

- Loss of energy between levels of food chain
  - can feed fewer animals in each level



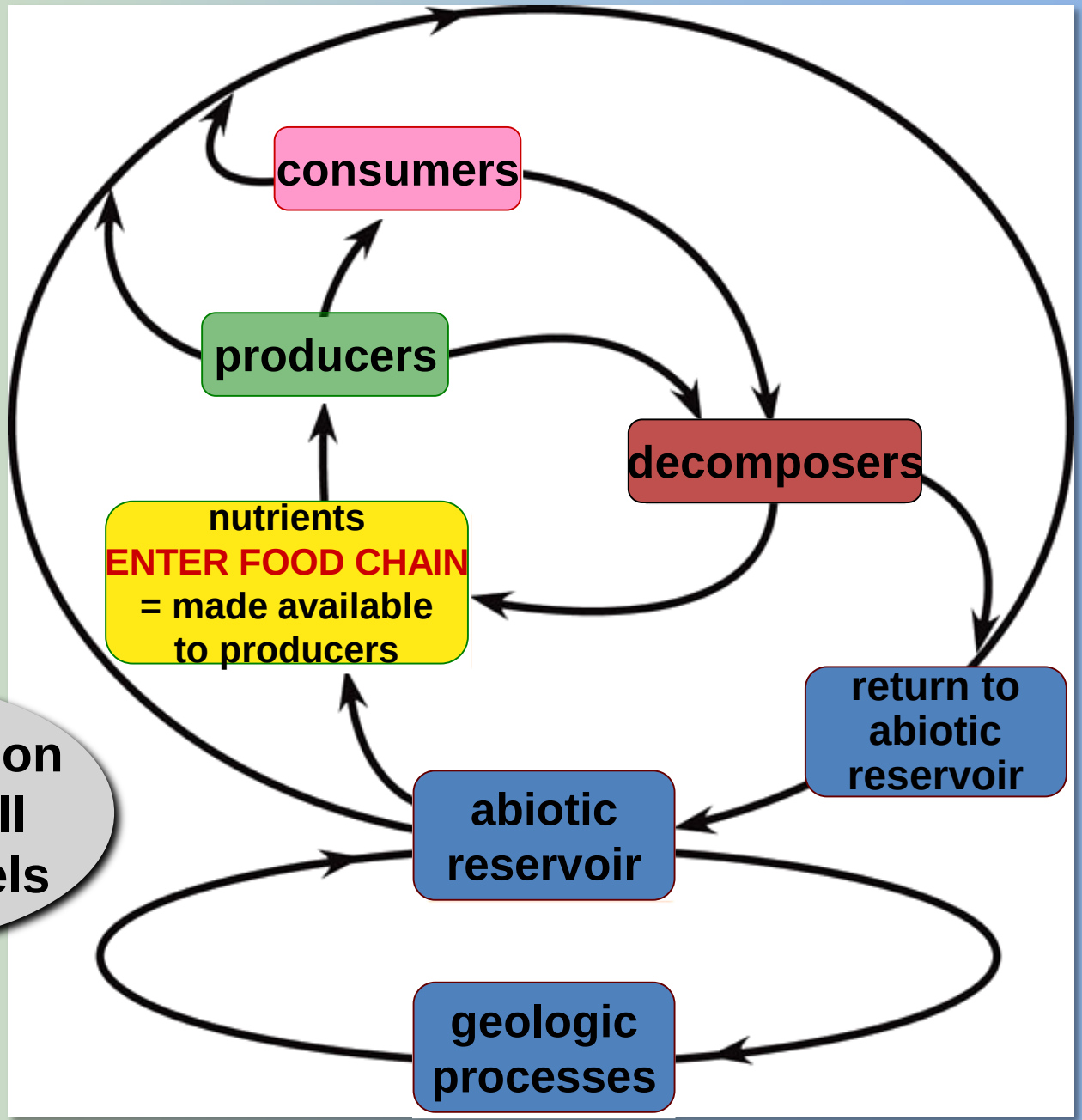
Humans in food chains

- Dynamics of energy through ecosystems have important implications for human populations
  - how much energy does it take to feed a human?
    - if we are meat eaters?
    - if we are vegetarian?

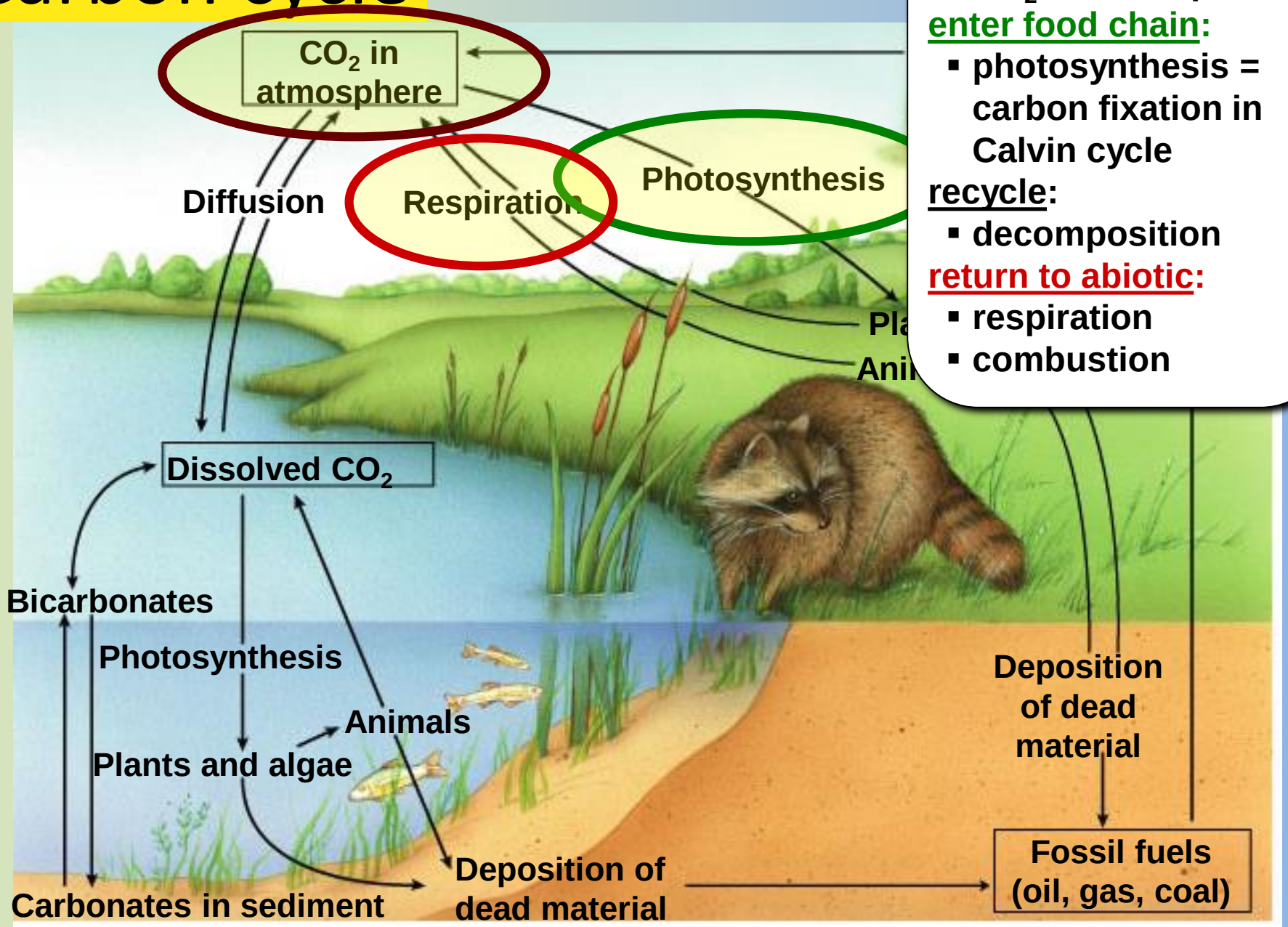


Generalized Nutrient cycling

Decomposition connects all trophic levels



Carbon cycle



abiotic reservoir:
- CO_2 in atmosphere

enter food chain:
- photosynthesis = carbon fixation in Calvin cycle

recycle:
- decomposition

return to abiotic:
- respiration
- combustion

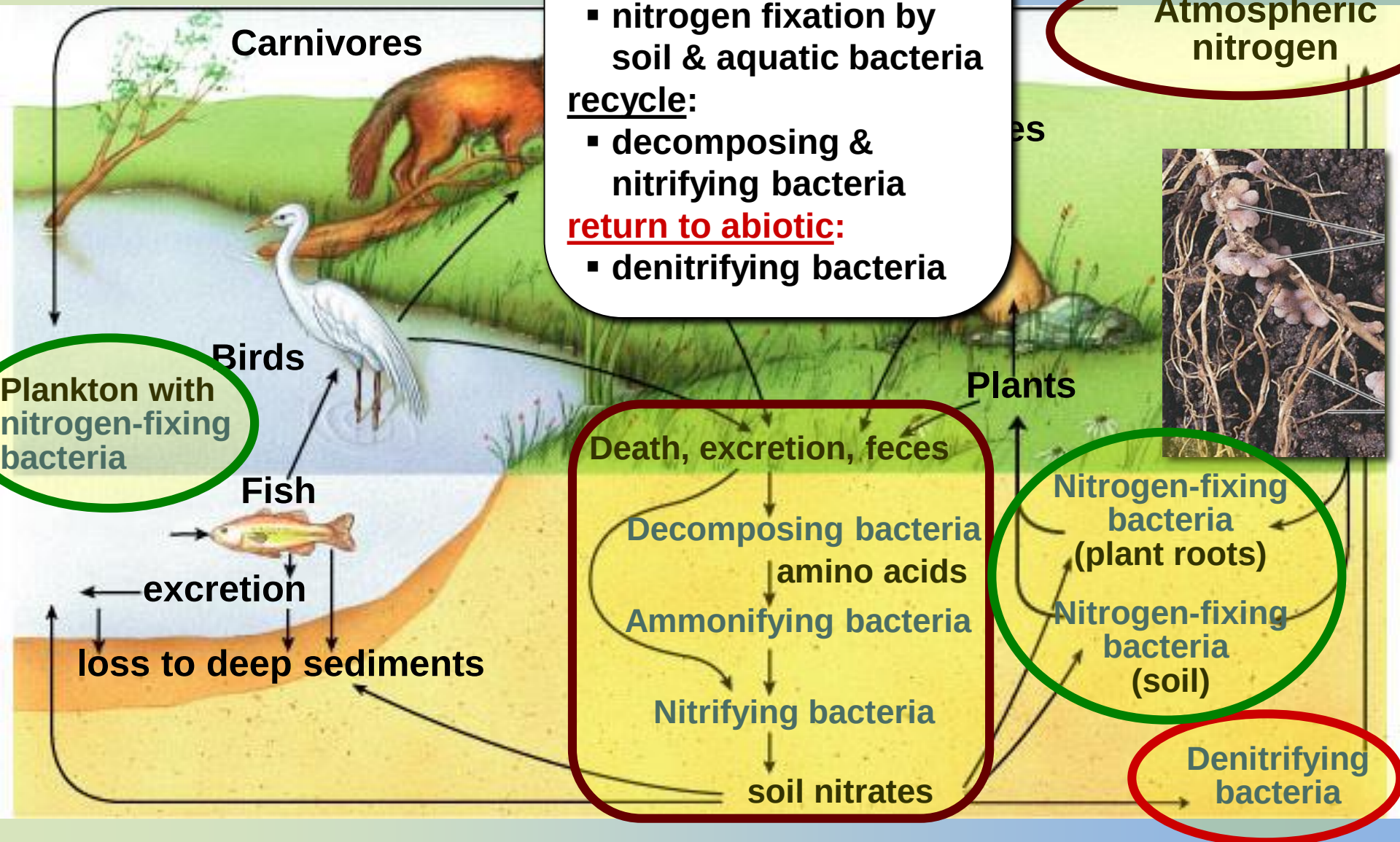
Nitrogen cycle

abiotic reservoir:
- N in atmosphere

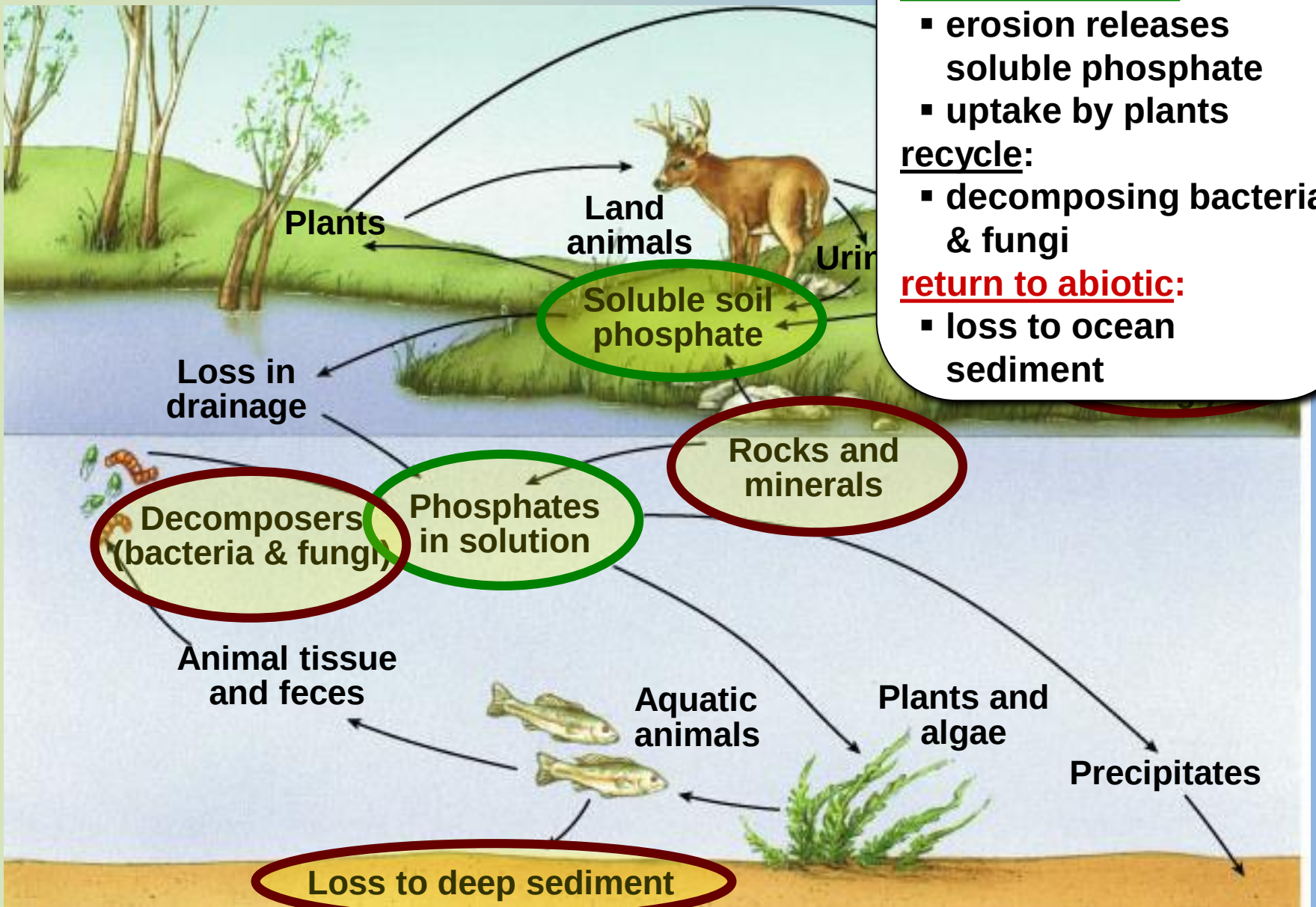
enter food chain:
- nitrogen fixation by soil & aquatic bacteria

recycle:
- decomposing & nitrifying bacteria

return to abiotic:
- denitrifying bacteria



Phosphorus cycle



abiotic reservoir:
- rocks, minerals, soil

enter food chain:
- erosion releases soluble phosphate
- uptake by plants

recycle:
- decomposing bacteria & fungi

return to abiotic:
- loss to ocean sediment

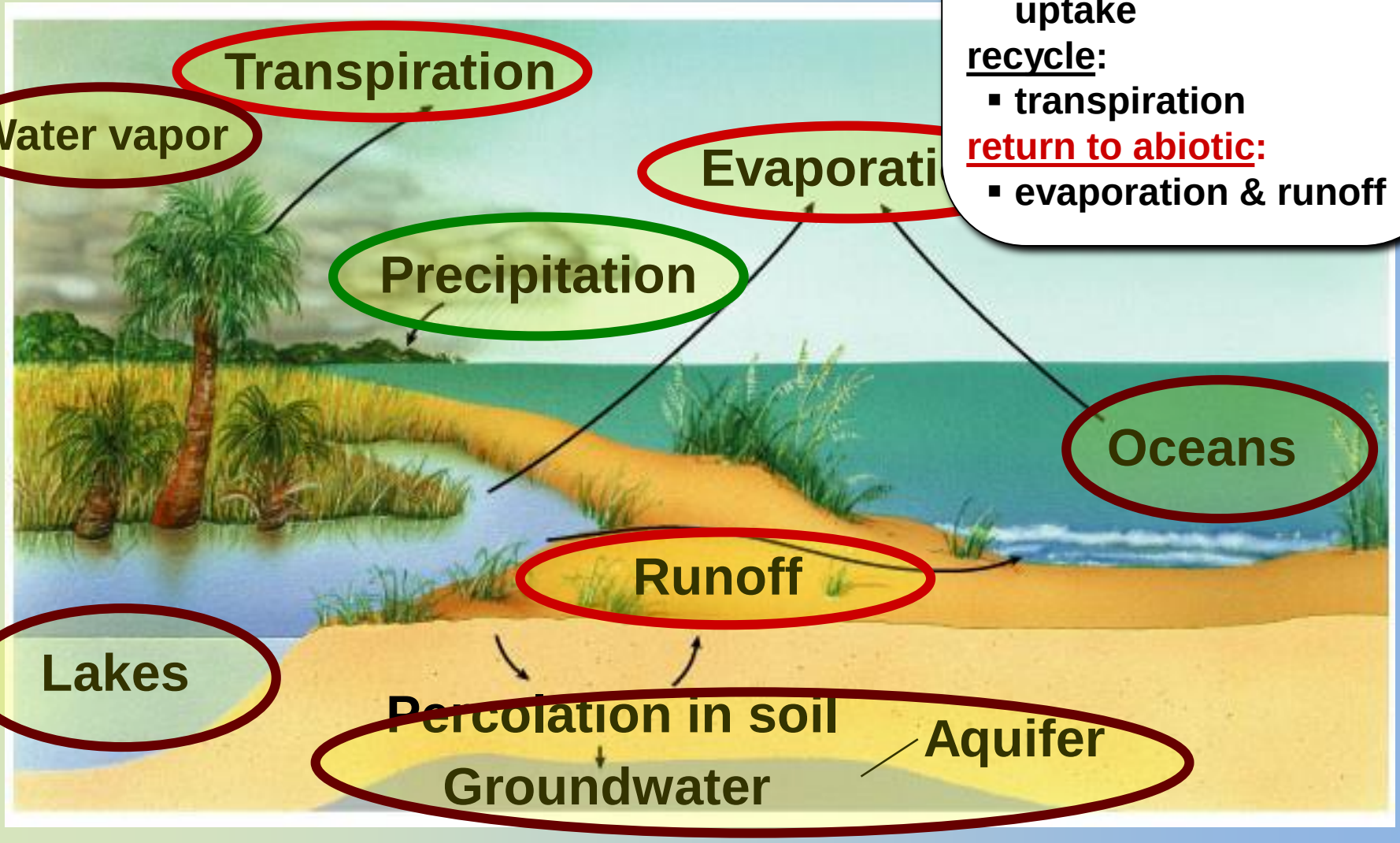
Water cycle

abiotic reservoir:
- surface & atmospheric water

enter food chain:
- precipitation & plant uptake

recycle:
- transpiration

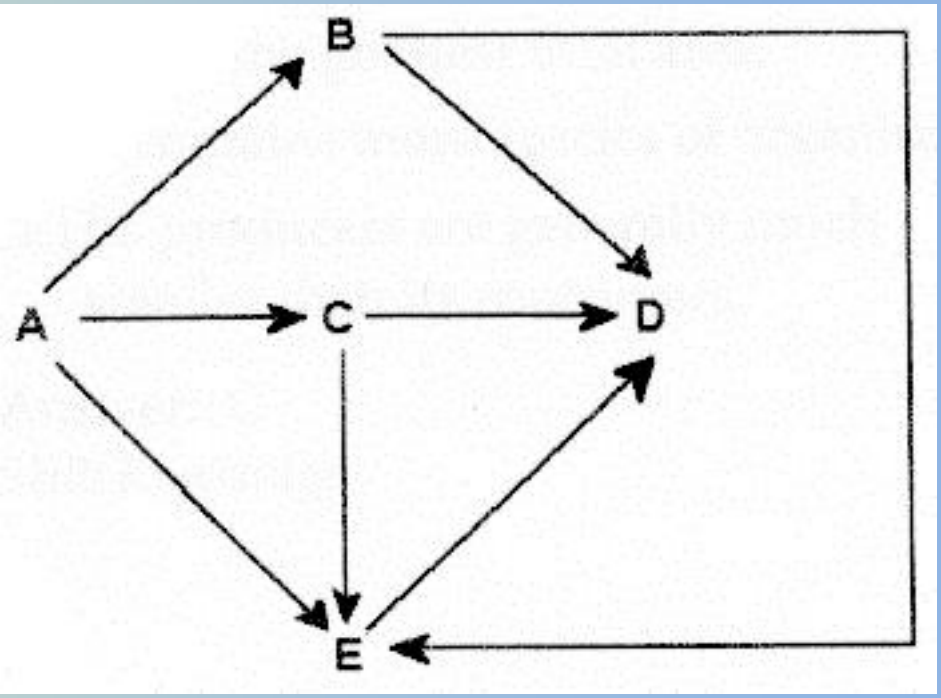
return to abiotic:
- evaporation & runoff



Review Questions

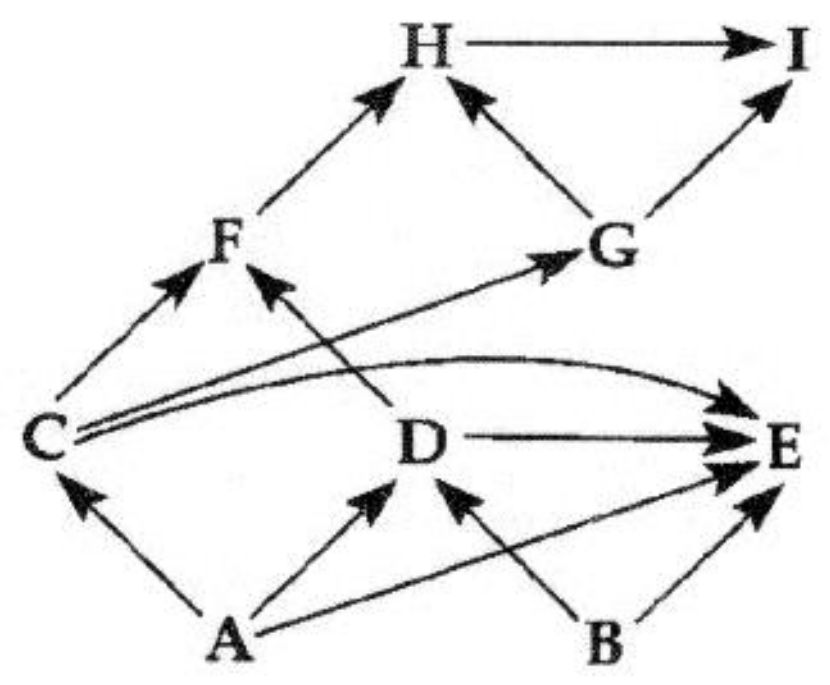
Use the figure below to answer the following question. Examine this food web for a particular terrestrial ecosystem. Each letter is a species. The arrows represent energy flow.

1. Which species is autotrophic?
   A. A
   B. B
   C. C
   D. D
   E. E



2. If this were a terrestrial food web, the combined biomass of C + D would probably be

   A. greater than the biomass of A.
   B. less than the biomass of H.
   C. greater than the biomass of B.
   D. less than the biomass of A + B.
   E. less than the biomass of E.



3. If the flow of energy in an Arctic ecosystem goes through a simple food chain from seaweeds to fish to seals to polar bears, then which of the following is *true*?
   A. Polar bears can provide more food for Eskimos than seals can.
   B. The total energy content of the seaweeds is lower than that of the seals.
   C. Polar bear meat probably contains the highest concentrations of fat-soluble toxins.
   D. Seals are more numerous than fish.
   E. The carnivores can provide more food for the Eskimos than the herbivores can.

4. Why do most food chains consist of only three to five links? *

A. There are only five trophic levels: producers; primary, secondary, and tertiary consumers; and decomposers.

B. Most communities are controlled bottom-up by mineral nutrient supply, and few communities have enough nutrients to support more links.

C. The dominant species in most communities consumes the majority of prey; thus, not enough food is left to support higher predators.

D. According to the energetic hypothesis, the inefficiency of energy transfer from one trophic level to the next limits the number of links that can exist.

E. According to the trophic cascade model, increasing the biomass of top trophic levels causes a decrease in the biomass of lower levels, so that the top levels can no longer be supported.