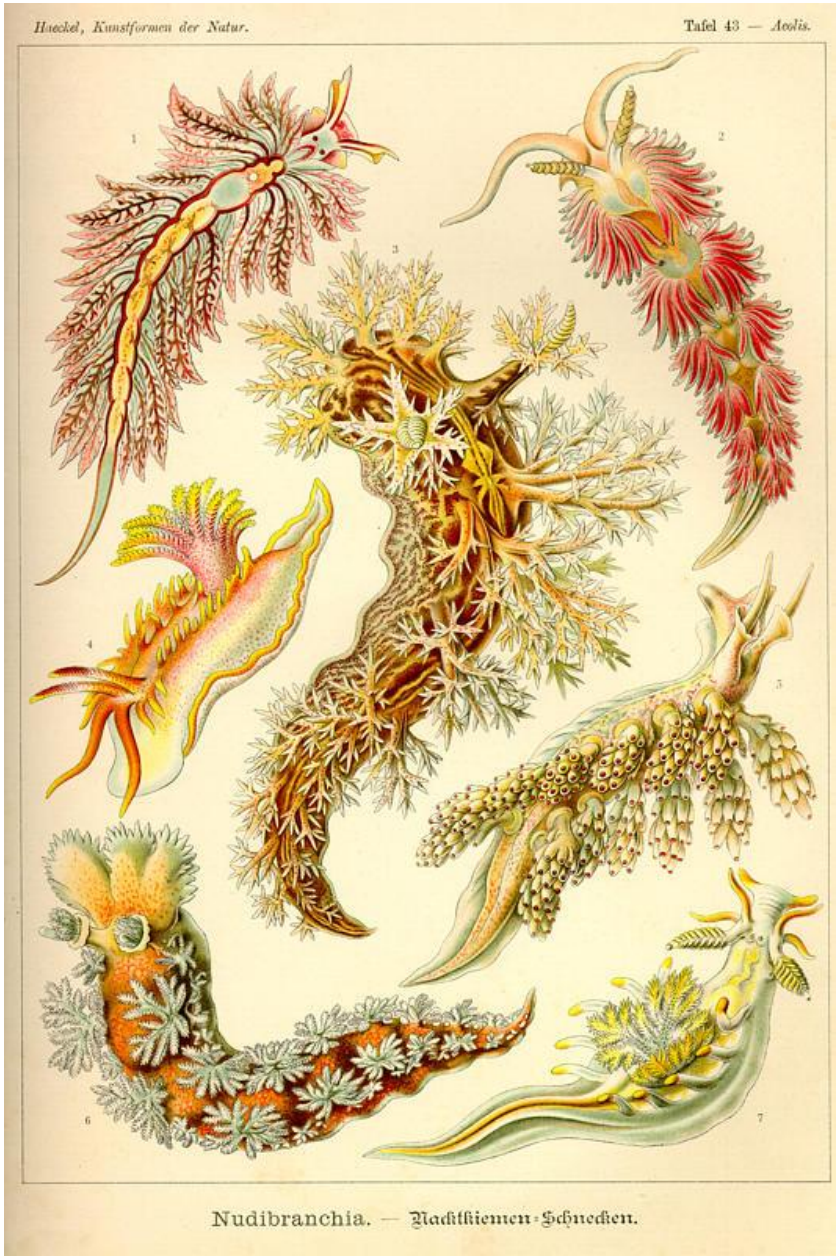
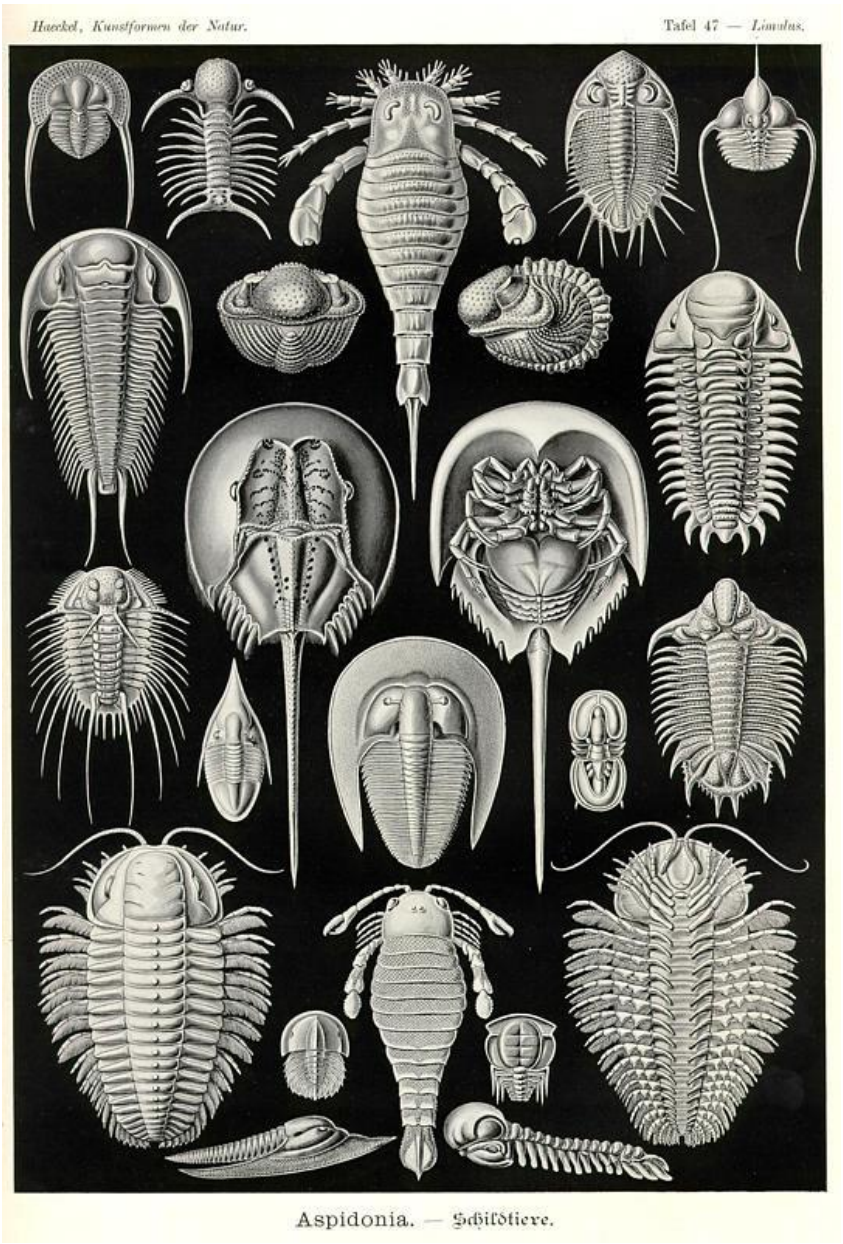
# Ecology


Haeckel, Kunstformen der Natur.
Tafel 43 — Aeolis.
Nudibranchia. — Nacktkiemen-Schnecken.


Haeckel, Kunstformen der Natur.
Tafel 47 — Limulus.
Aspidonia. — Schildtiere.

# About me (why am I giving this talk)

Dr. Bruce A. Snyder basnyder@ksu.edu

PhD: Ecology (University of Georgia)

MS: Environmental Science & Policy

BS: Biology; Environmental Science
(University of Wisconsin-Green Bay)

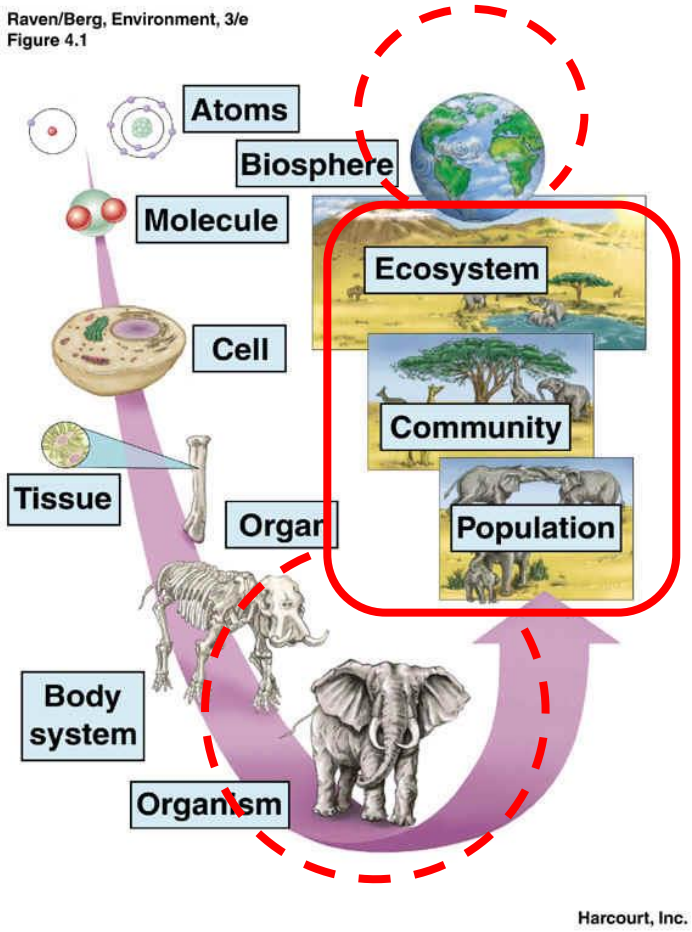
- REU Coordinator
- Research:
  - Ecology, biology, and taxonomy of soil fauna (especially earthworms and millipedes)
  - Invasion biology

# Outline and goals for today

- What is ecology?
  - Define ecology
  - Describe the levels that ecologists study
  - Describe basic principles of ecology
- What is biodiversity?
  - Define biodiversity
  - Explain how biodiversity is measured
  - Explain why biodiversity is important
- Soils and soil fauna
  - Describe the ecosystem services that soils and soil fauna perform
  - Describe one sampling technique for soil macrofauna

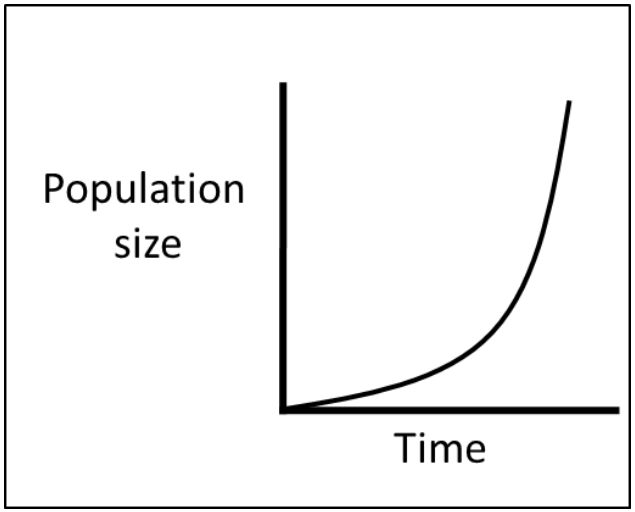
# What is ecology?

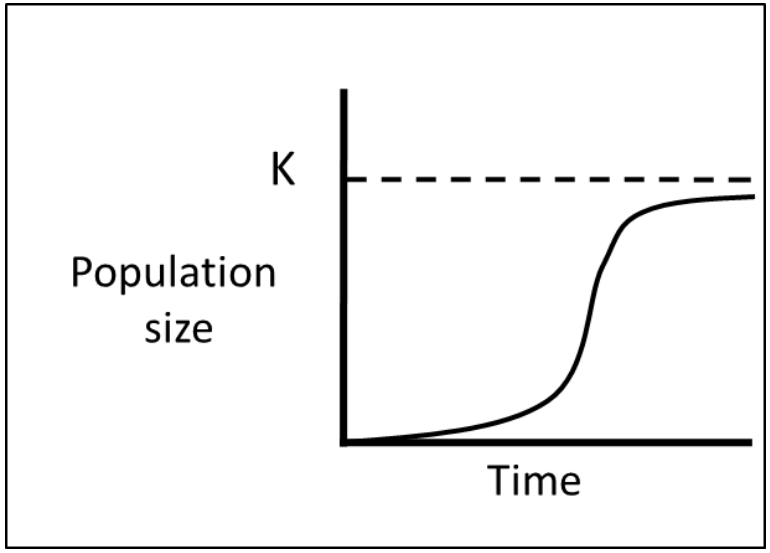
- Study of interactions between organisms and their environment
  - What is an organism?
  - What does “environment” mean?
- Levels of biological organization
  - Mostly work at population, community, and ecosystem



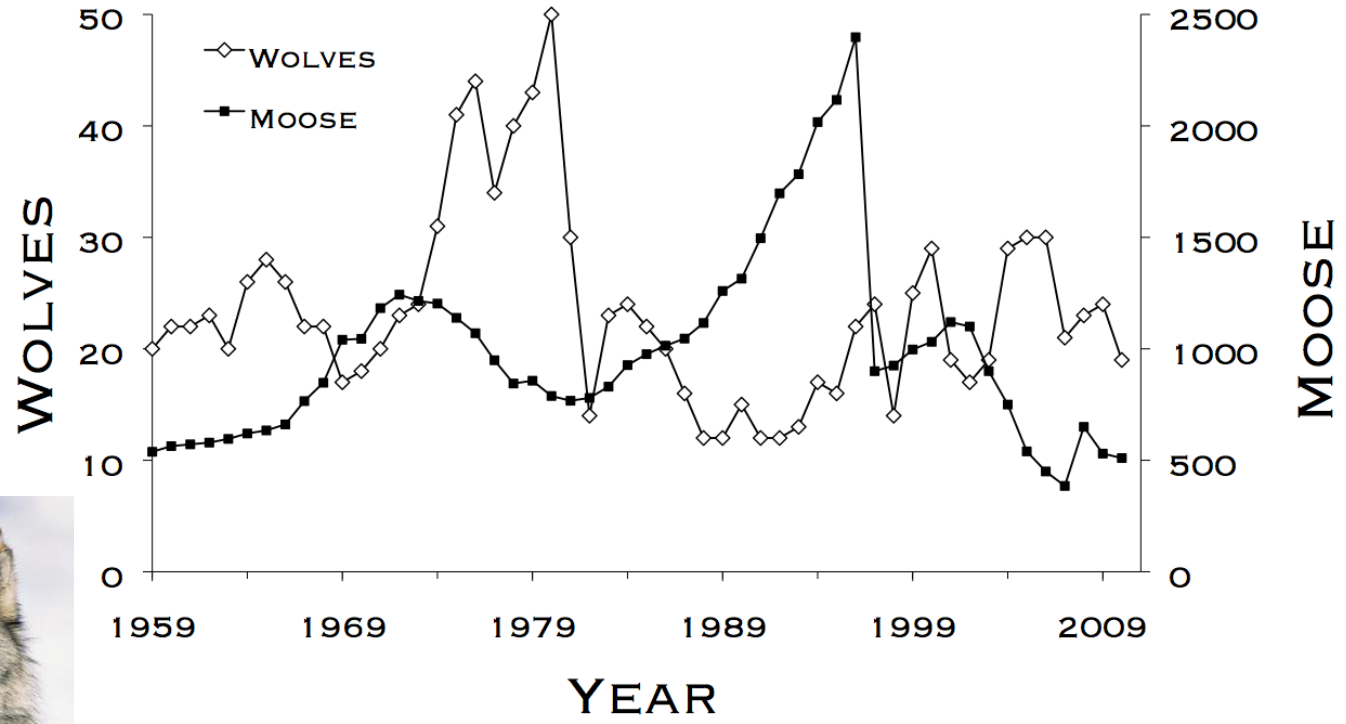
# Population Ecology

- What is a population?
- What is a species?
- Population ecology studies the size and composition of populations
- Basic types of growth curves
  - Exponential
  - Logistic
    - K = carrying capacity (maximum sustainable population size)



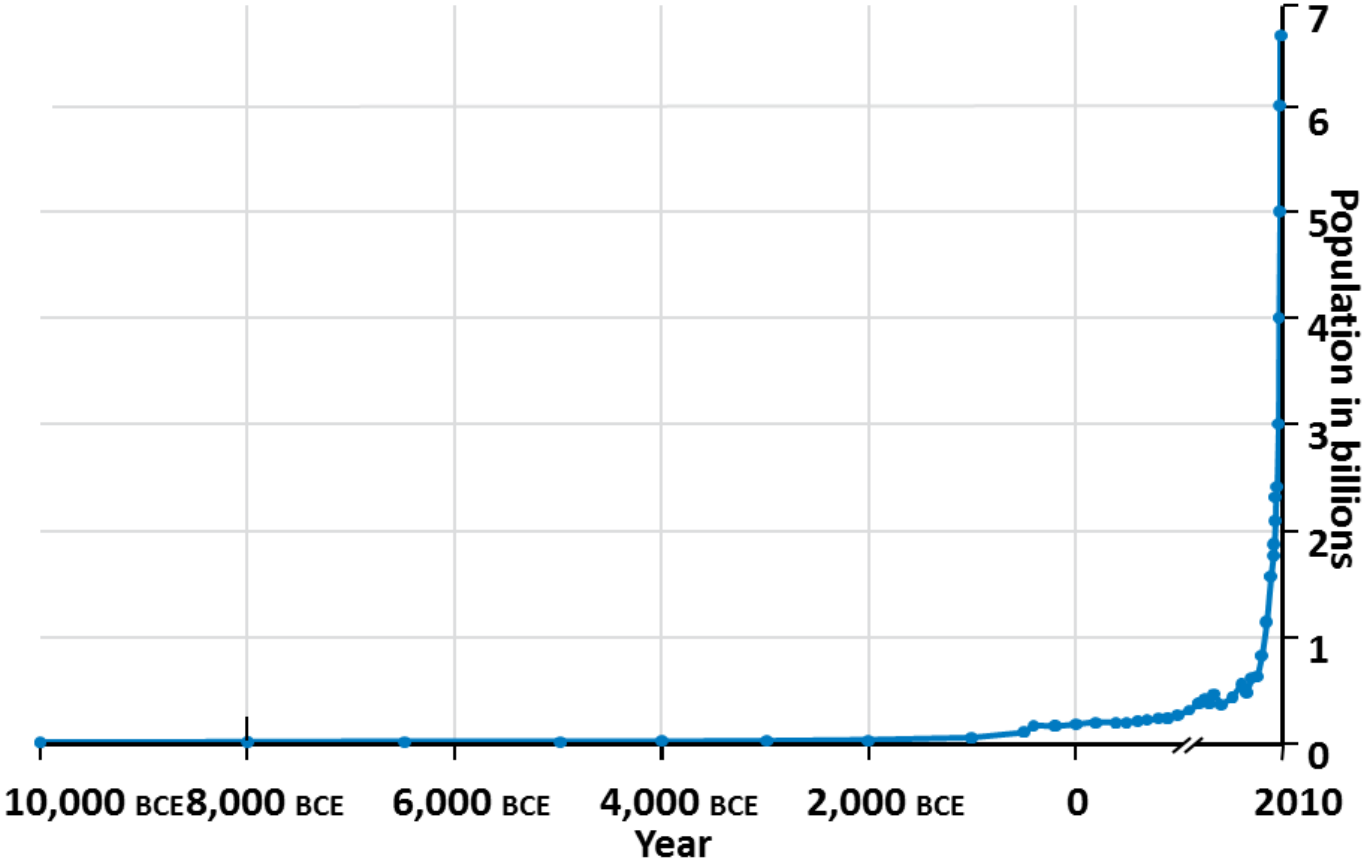



# Population Ecology



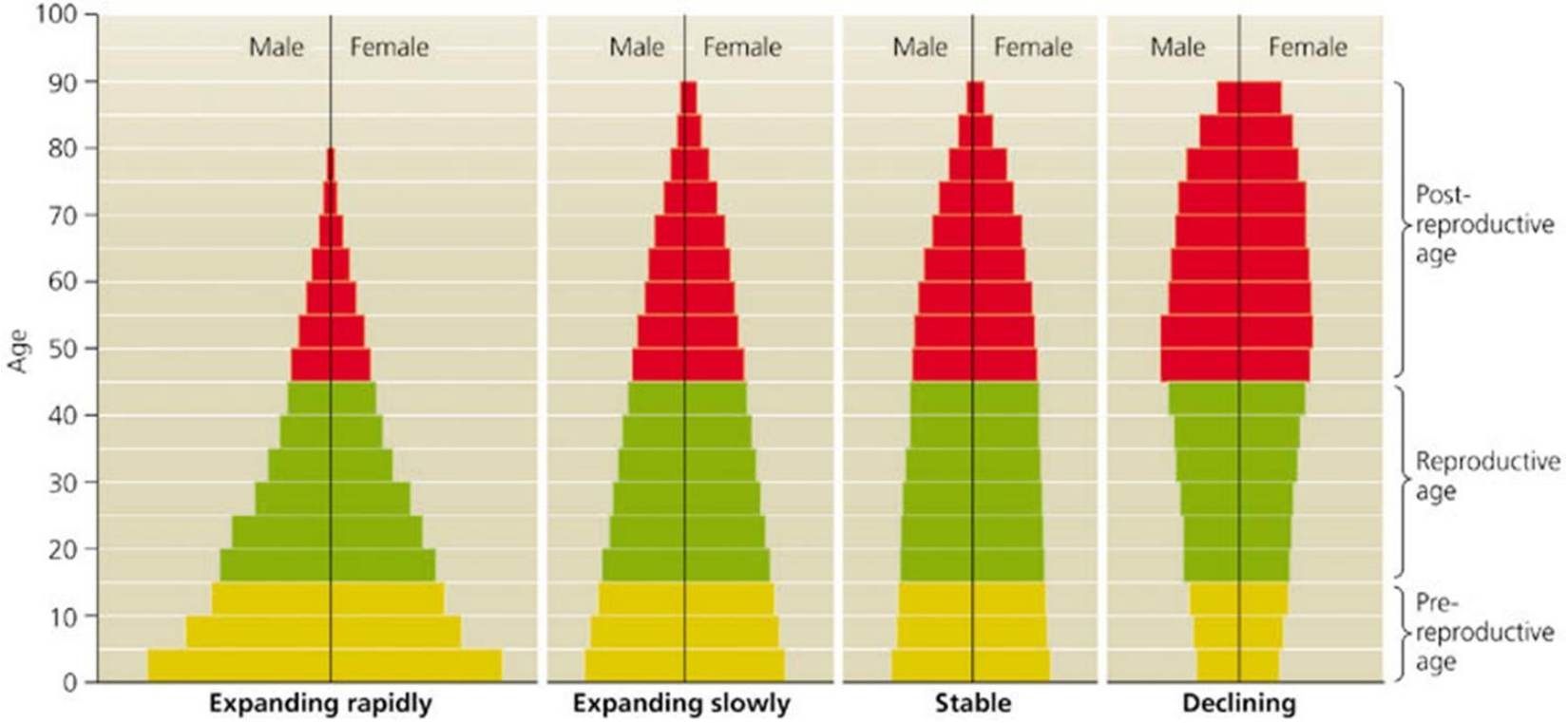

# Population Ecology

- Human population growth



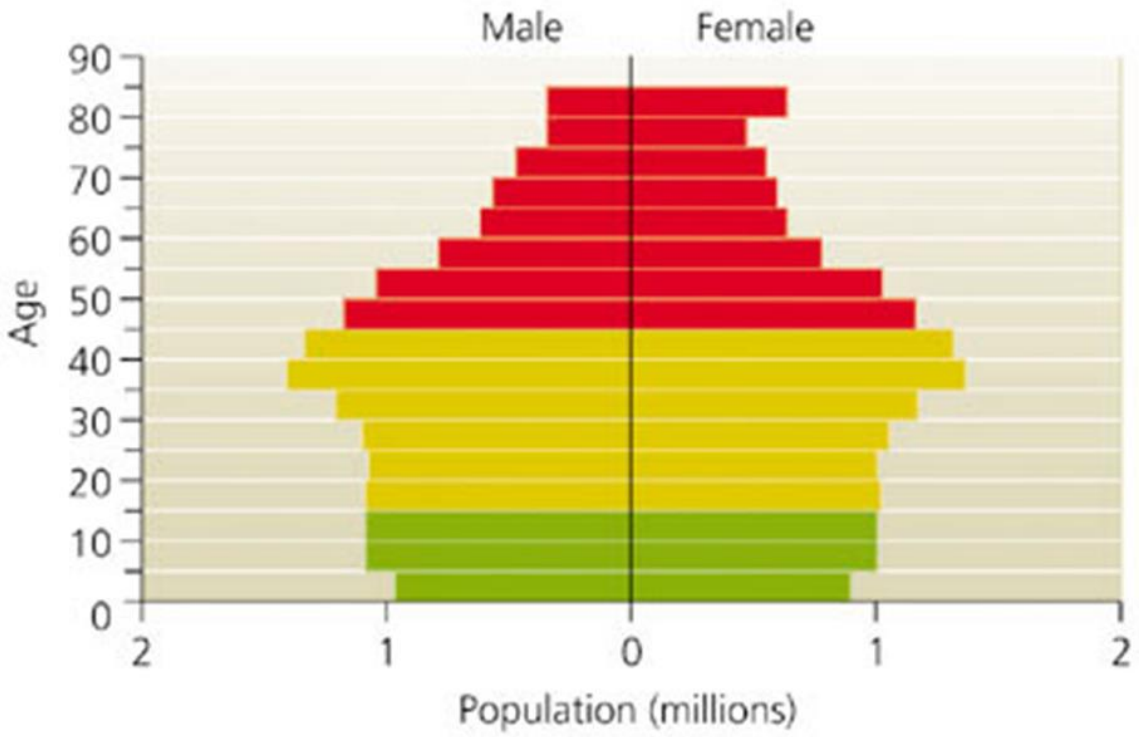
# Population Ecology

- Composition of populations: age structure diagrams
  - Age
  - Sex
  - Life stage



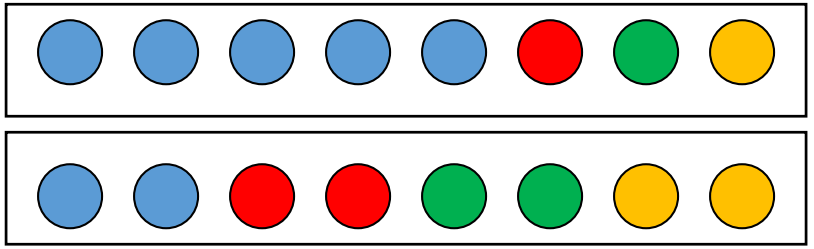
# Population Ecology

- Canada, year 2000



# Community Ecology

- What is an ecological community?
- Community ecologists are interested in the composition and structure of communities
  - Which species, in what proportions?
  - Also called community structure
- Diversity
  - Richness = # species
  - Evenness = relative # individuals of each species
  - Each circle is an individual
  - Color represents species



# Community Ecology

- Species interactions
  - Characterized by whether the interaction has a positive or negative effect on each species

–,– Competition. Both species are harmed

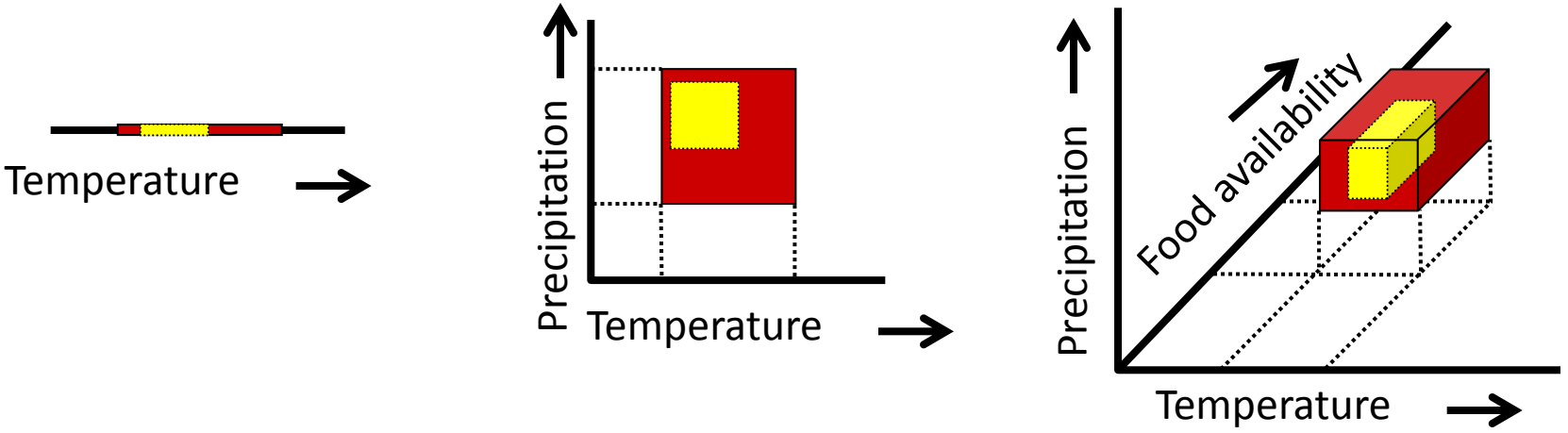
+,– Predation and parasitism. One species benefits, the other is harmed

+,+ Mutualism. Both species benefit

+,0 Commensalism. One species benefits, the other is not harmed.

# Community ecology

- Niche: How a species fits into its environment and community.... i.e., its “profession”
- Fundamental niche - if not restricted by other species
- Realized niche - if interacting with other species

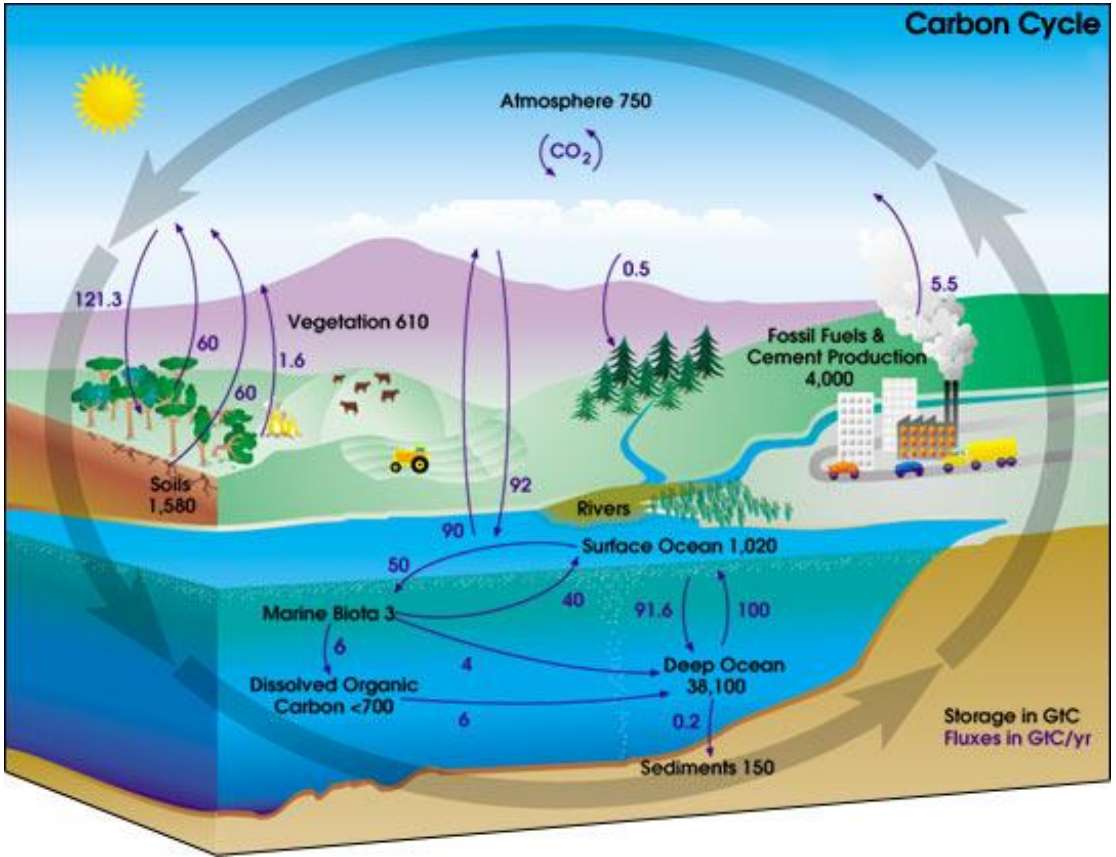


# Community Ecology

- Succession: development of a community to an equilibrium of species composition
- Community assembly - how do interactions affect community composition?
- http://www.fs.usda.gov/mountsthelens

# Ecosystem Ecology

- What is an ecosystem?
- Ecosystem ecologists are interested the movement of energy and nutrients (elements)

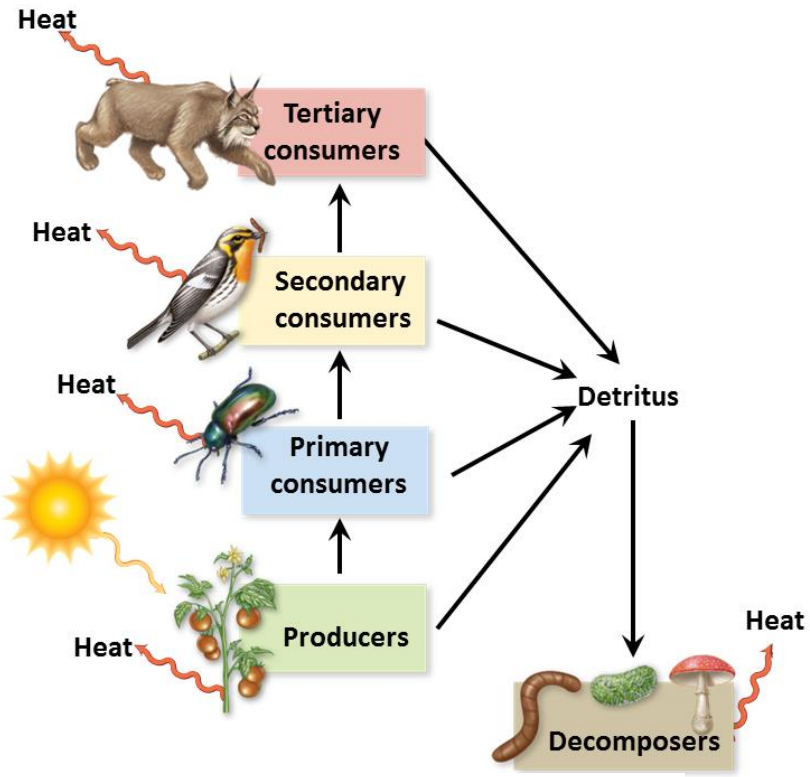


# Ecosystem Ecology: Energy Flow

- Laws of thermodynamics apply to living systems
  1. Energy cannot be created or destroyed, but can change forms
  2. Entropy tends to increase.

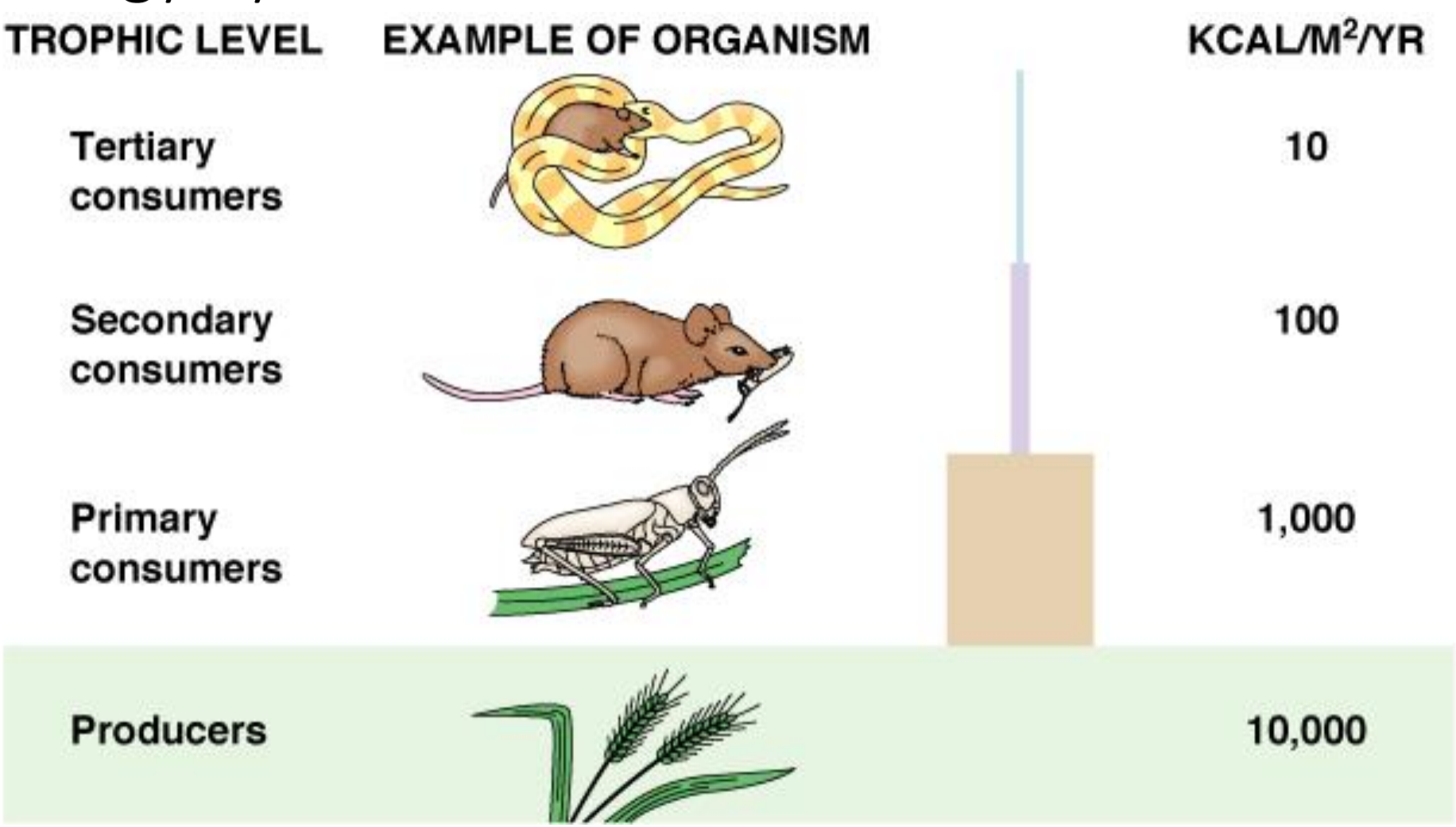
  Entropy is a measure of disorder

  (energy transfers are inefficient)
- What is the ultimate source of energy for nearly all ecosystems?
- 10% rule (90% lost as heat!)

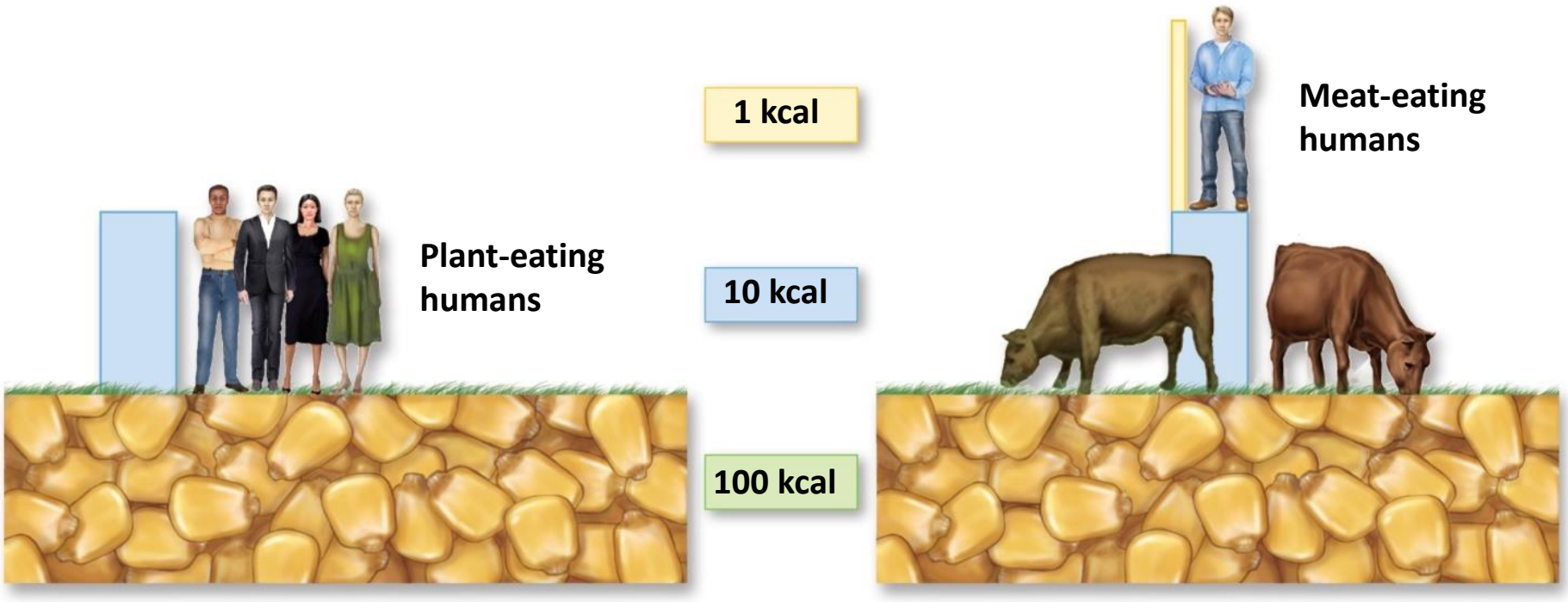


# Energy Pyramid

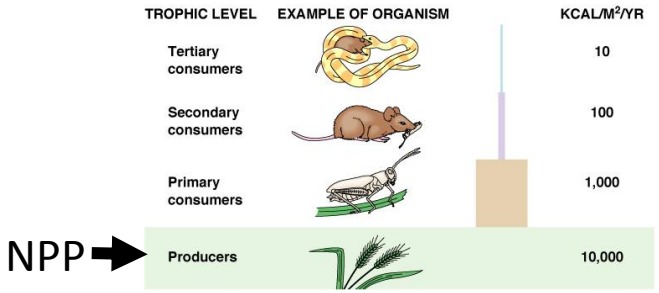
Why only 10%?



# Why is meat a luxury for some human societies?



# Ecosystem Ecology: Energy flow




- GPP: Gross Primary Production
- NPP: Net Primary Production
- NPP varies among biomes. Why?

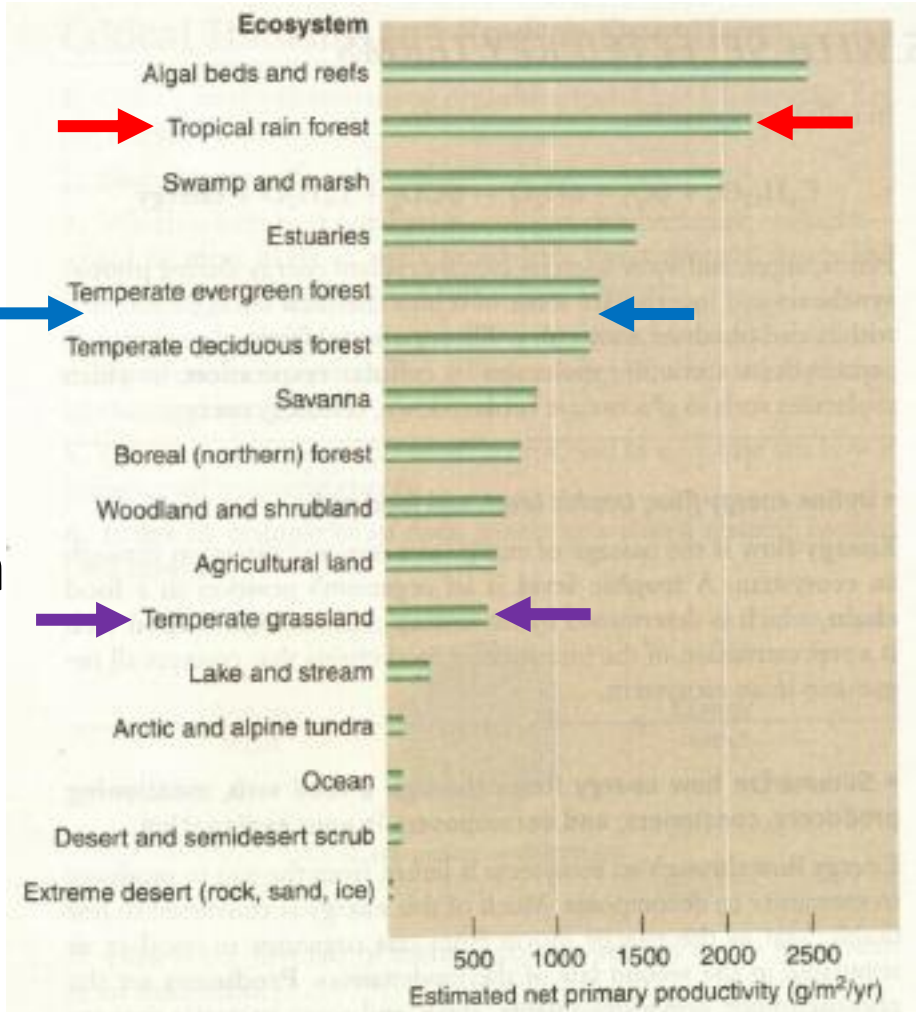
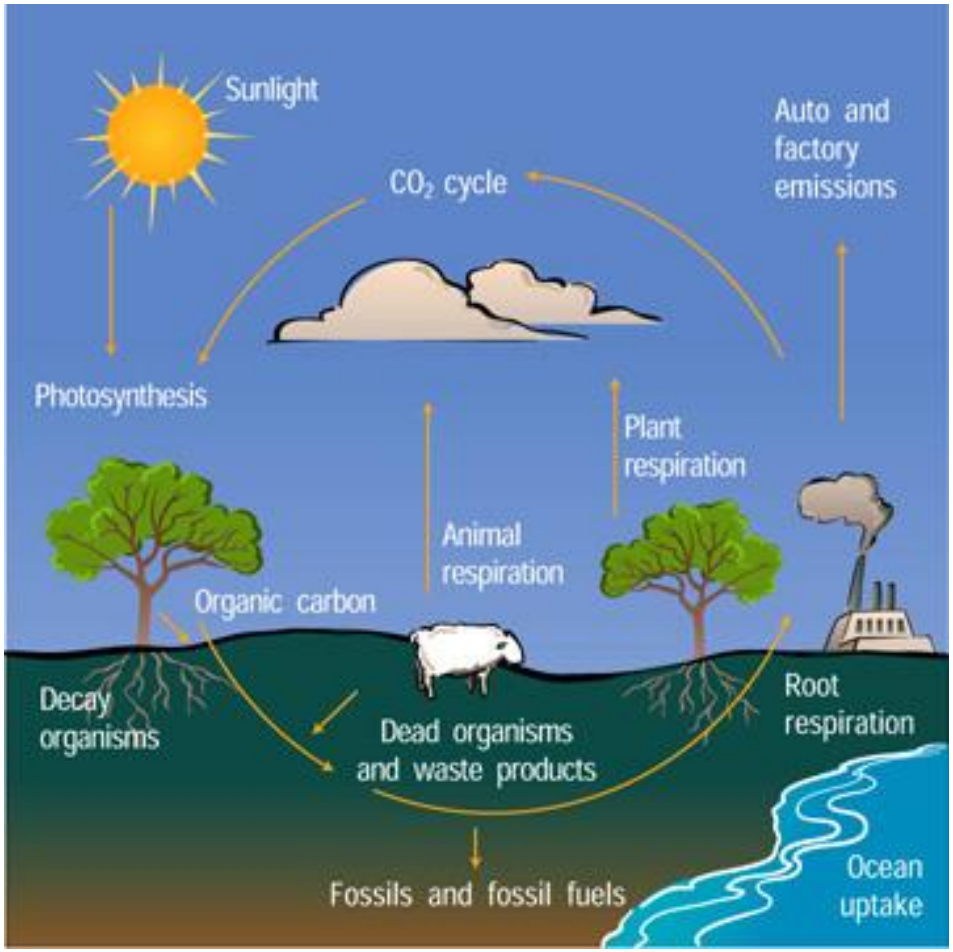
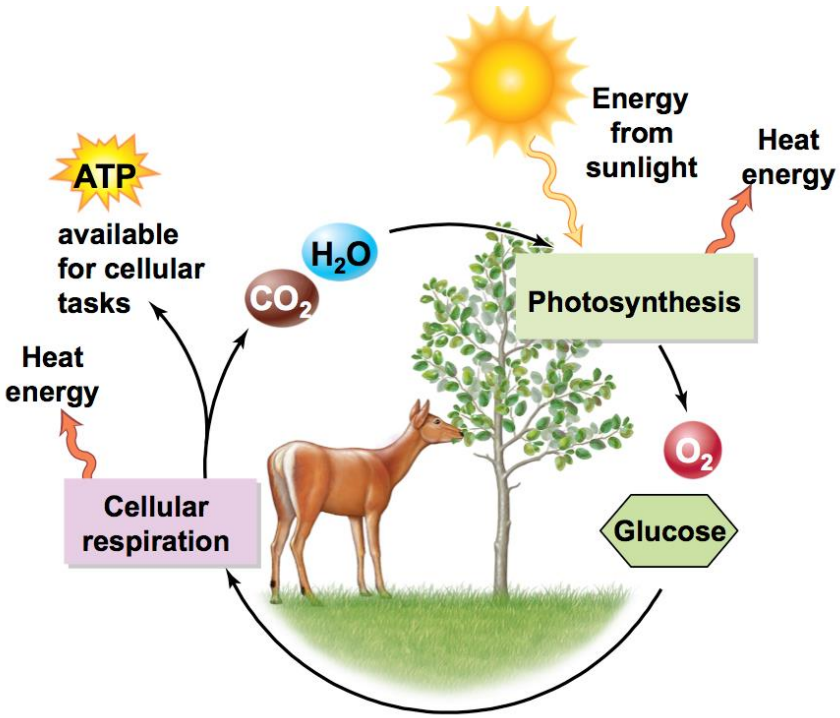


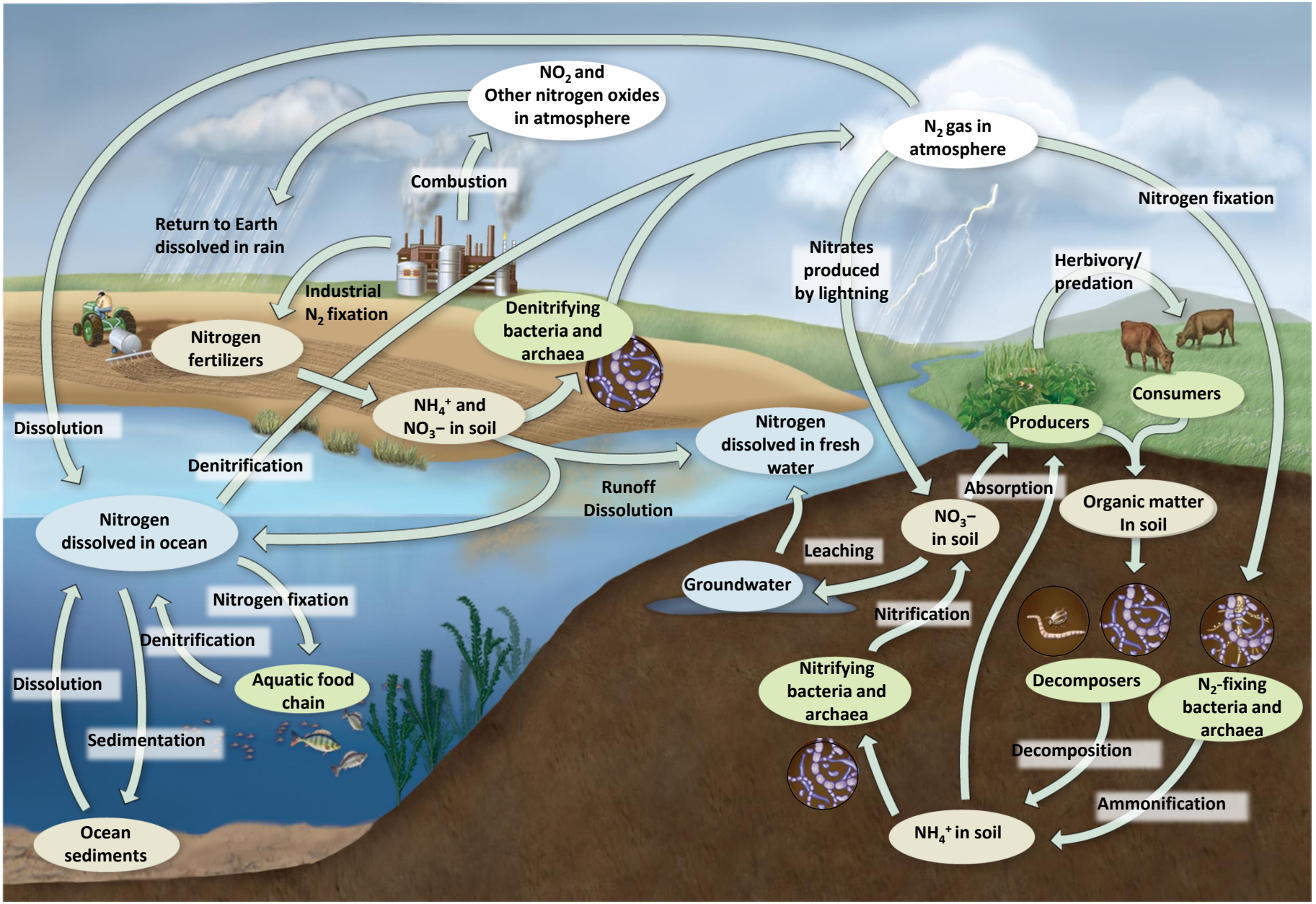

**Figure 3.16 Estimated annual net primary productivities (NPP) for selected ecosystems.** NPP is expressed as grams of dry matter per square meter per year (g/m²/yr). (After R.H. Whittaker, *Communities and Ecosystems*, 2nd edition. New York: Macmillan [1975])

# Ecosystem Ecology: Nutrient Cycling

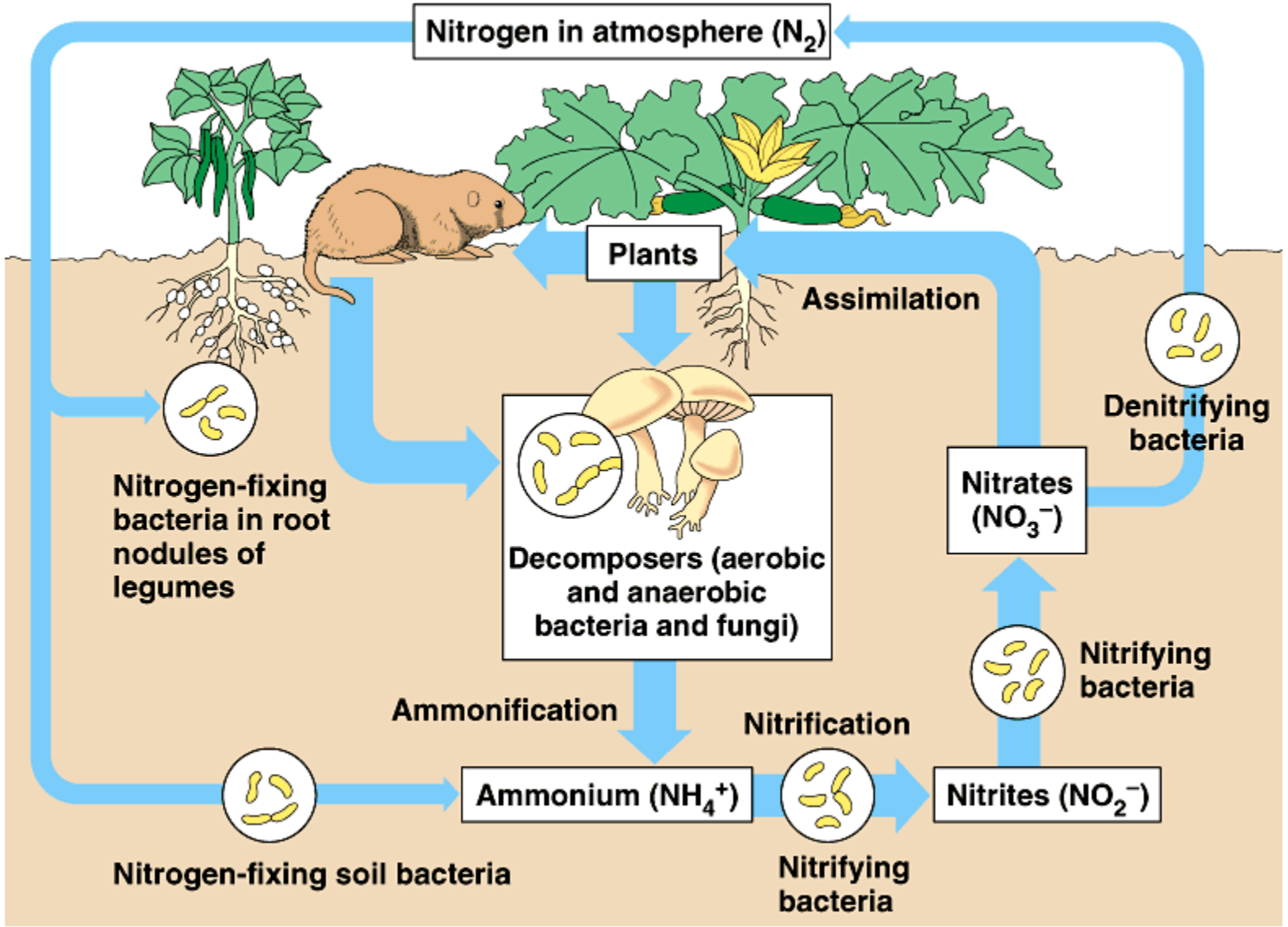


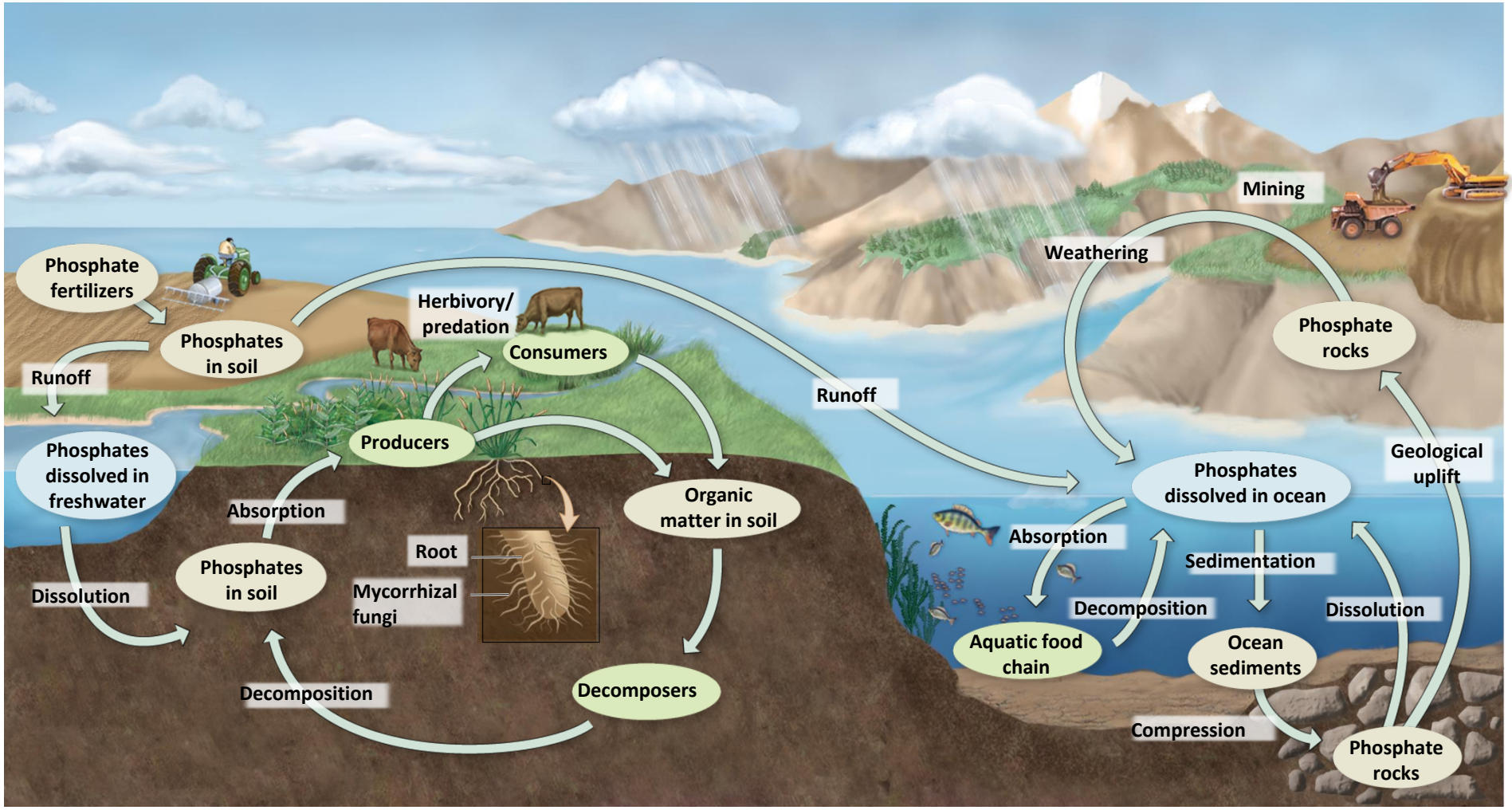
# Nitrogen Cycle



# Nitrogen Cycle

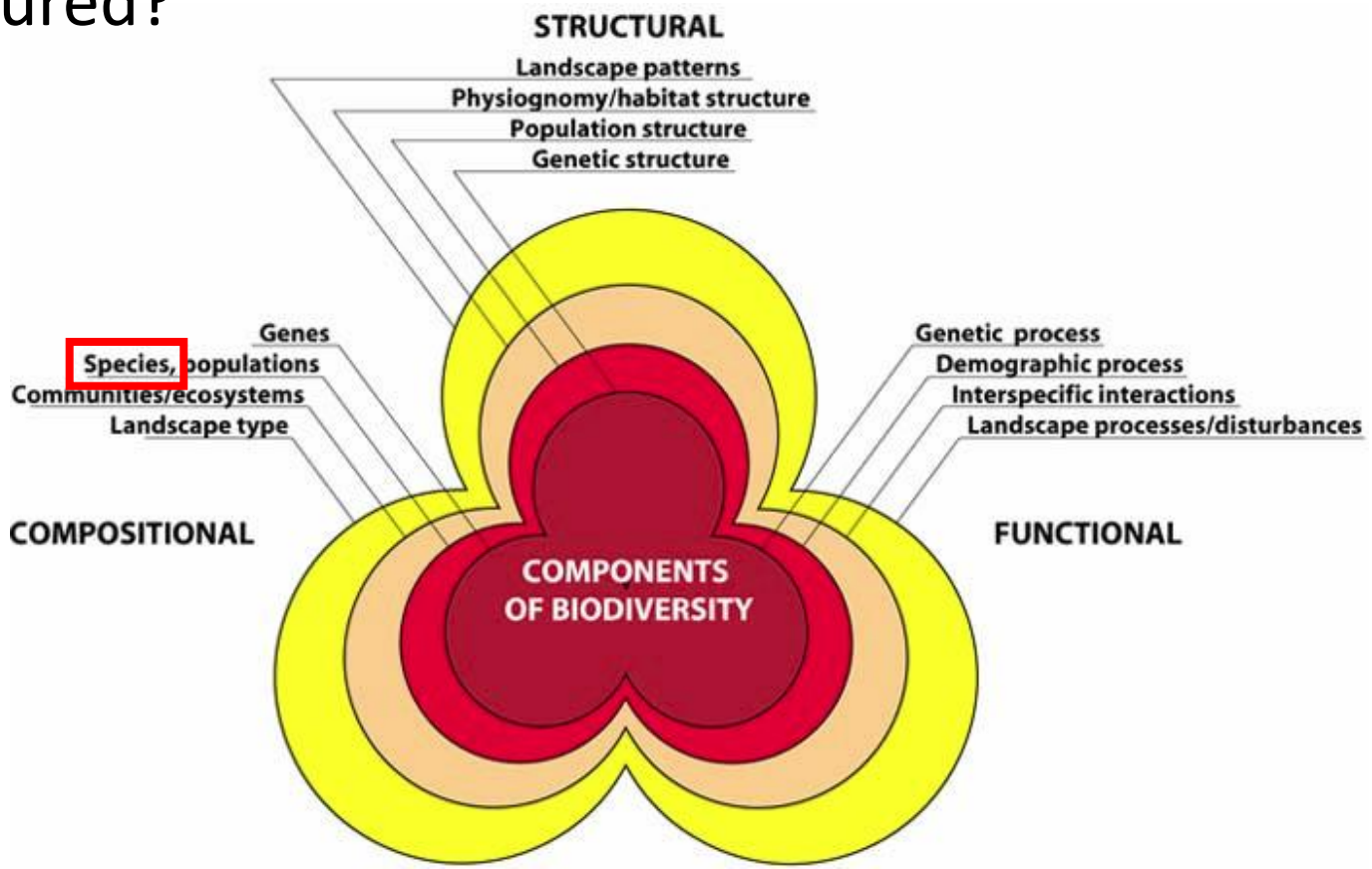


# Phosphorus Cycle



# Biodiversity

- What is biodiversity?
- How is it measured?




Global Terrestrial Observing System,
Food and Agriculture Organization, United Nations
www.fao.org/gtos/

# Biodiversity

- How many species are there on earth?
- Estimates of 30-100 million species.
- ~5% known to science (“described”), although some groups of taxa are better known (butterflies, birds).
- Most recent numbers (described):
  - 99,000 fungal species
  - ~300,000 plants....?
  - 1,552,319 animal species

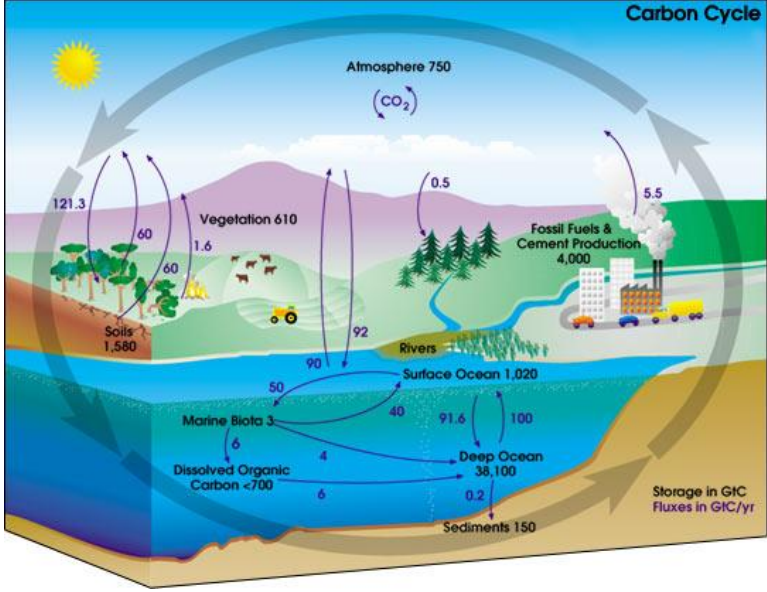
# Biological Collections

- Specimen-based / collections-based research
- Museums - a lot more than what you see in the public exhibits
- Types of data: morphology, genetics/genomics, isotopes, parasites
- Variability within a species
- Time series
- Land use change


# Soils

- Soils are complex and living
- Mixture of solids, air, and water
- Home to an incredible about of biodiversity
  - Microbes (bacteria, archaea, fungi, algae), plants, animals from tiny to large
- Hard to study!
- One of the last frontiers - much is unknown

# Soils




Ecosystem services:

- Carbon and water storage
- Nutrient cycling
- Substrate for plant growth and human development
- Raw materials for human use (e.g., pottery, bricks)
- Cultural/recreational uses
- Biodiversity

# Soil biodiversity

- One part of my research: document what organisms exist (diversity) and where they live (distribution)
- Organisms: earthworms and millipedes (and some other stuff…). “Macrofauna”
- You get to take part in this research when you visit Olympic National Park

# Sampling soil biodiversity

- Goal: document the millipede diversity of Olympic National Park
- Methods: *a priori* location choice, timed hand collection
  - Pick a location. "*a priori*" means without prior knowledge
  - Search for 30 person-minutes (1 person for 30 minutes, or 2 for 15 min, or 3 for 10 min)
    - This gives equal effort to each location
  - Collect all millipedes
  - Record collection information









TN: Blount Co.
Great Smoky Mountains Institute at Tremont
Hardwood stand south of tent platforms
Hand collection
18 June 2008
Coll: B. A. Snyder

# Millipede vs. Centipede

- 2 pairs legs/segment
- 1 pair legs/segment

http://www.qvmag.tas.gov.au/zoology/multipedes/