Chapter 3

Interactions Between the Living and Non-Living World

- **Ecosystem-** A particular location on Earth distinguished by its particular mix of interacting **biotic** and **abiotic** components.

Ecosystem Boundaries

- Some ecosystems, such as a caves and lake have very distinctive **boundaries**. However, in most ecosystems it is difficult to determine where one ecosystems stops and the next begins.

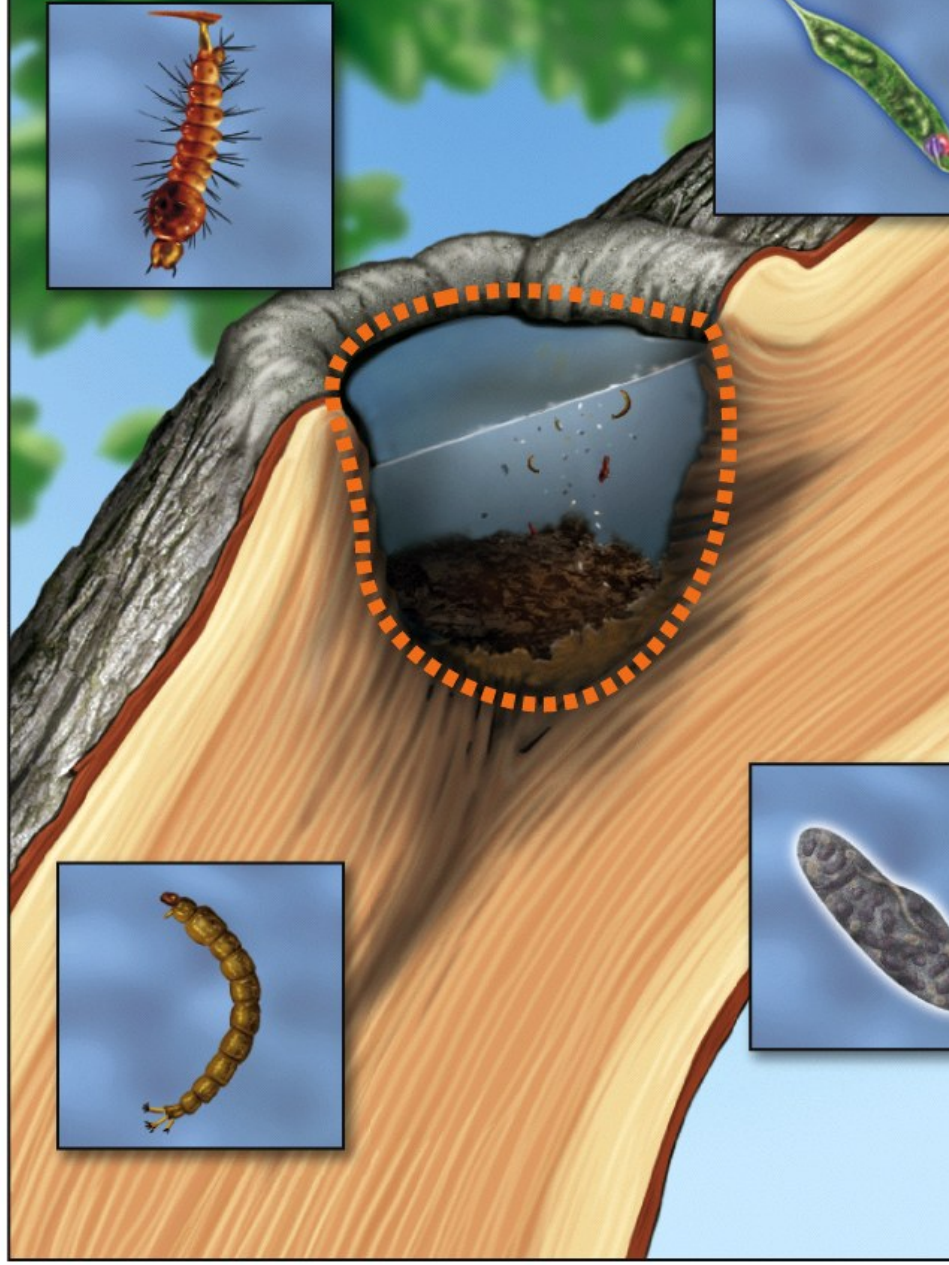


Figure 3.2b
Environmental Science

Ecosystem Processes

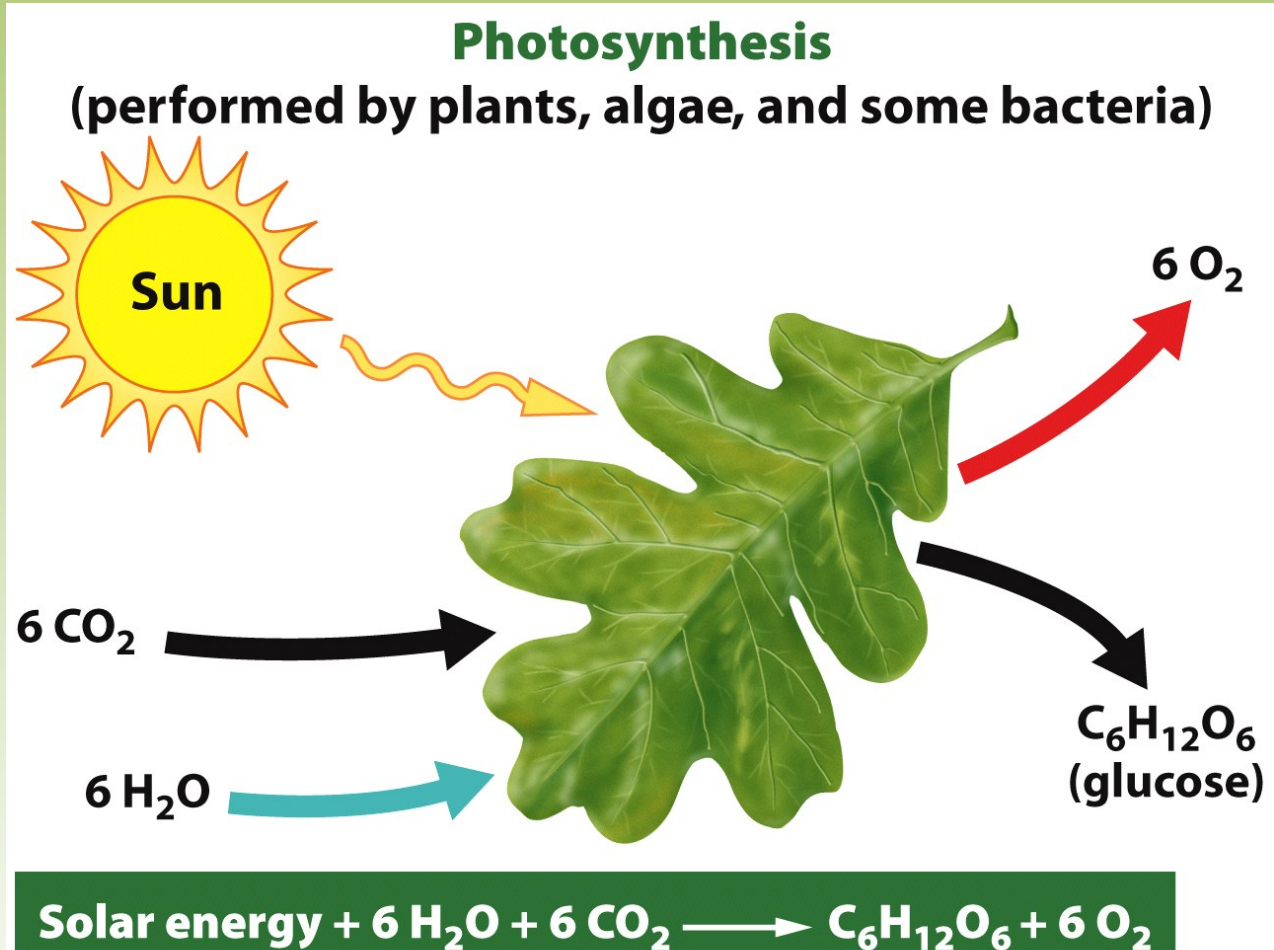
- Even though it is helpful to distinguish between two different ecosystems, ecosystems interact with other ecosystems

Energy Flows through Ecosystems

Figure 3.3

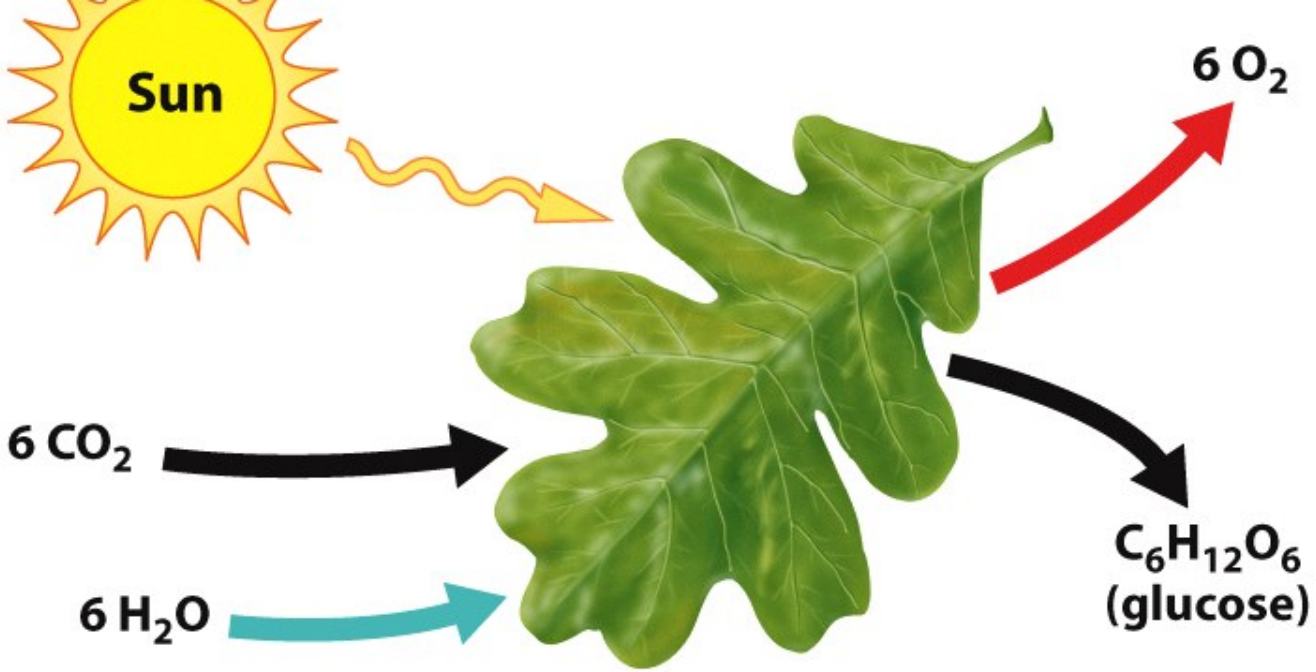
Photosynthesis and Respiration

- **Producers (autotrophs)** are able to use the suns energy to produce usable energy through the process called **photosynthesis**.



Photosynthesis and Respiration

- **Cellular respiration** is the process by which other organisms gain energy from eating the tissues of producers.



Solar energy + 6 H_2O + 6 CO_2 ⟶ $C_6H_{12}O_6$ + 6 O_2

Respiration
(performed by all organisms)

Energy + 6 H_2O + 6 CO_2 ⟵ $C_6H_{12}O_6$ + 6 O_2

Webs

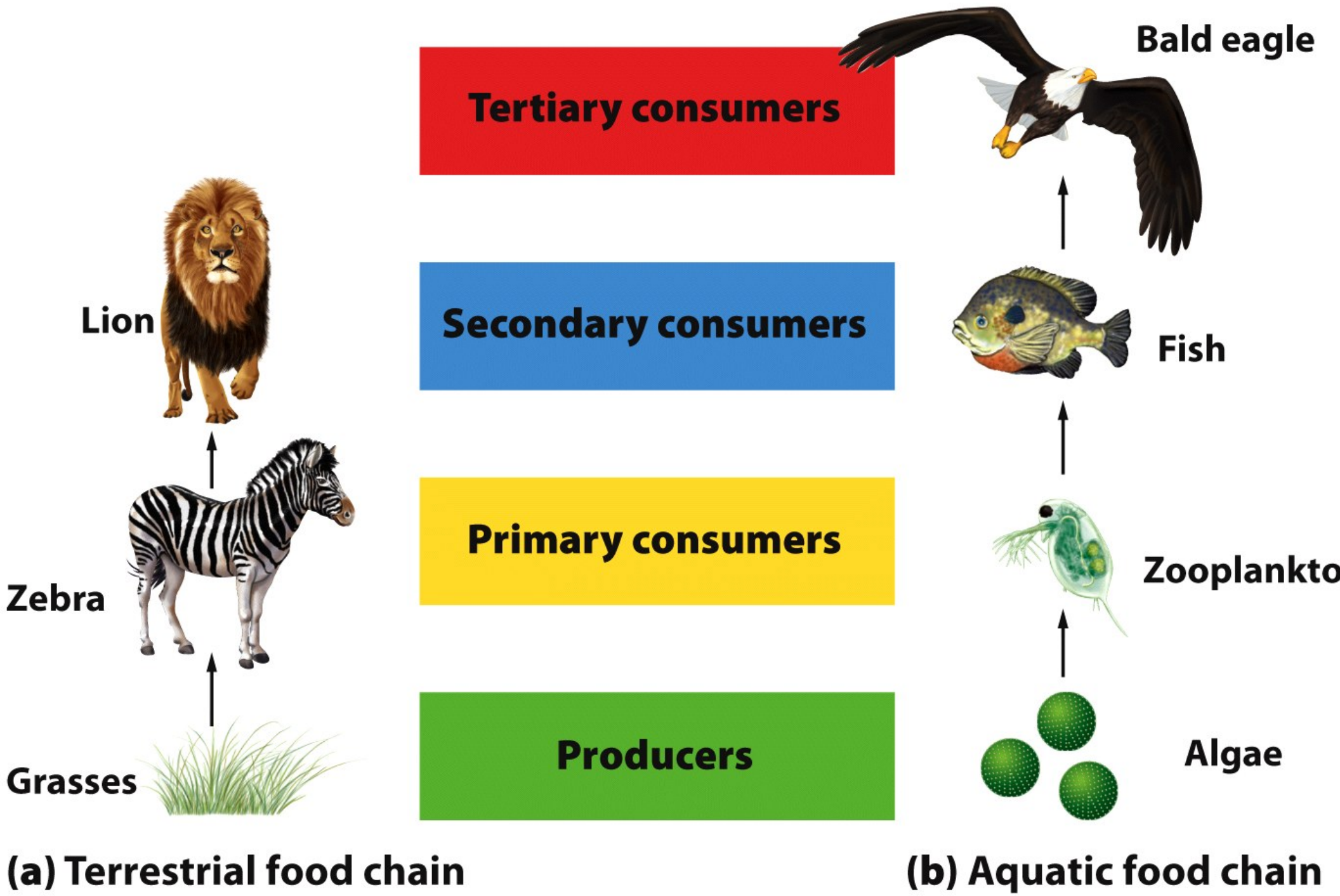
Consumers (heterotrophs)- obtain energy by consuming other organisms.

Primary Consumers (herbivores)- consume producers.

Secondary Consumers (carnivores)- obtain t energy by eating primary consumers.

Tertiary Consumers (carnivores)- eat second consumers

Simple food Chains…show one Set of feeding relationships.

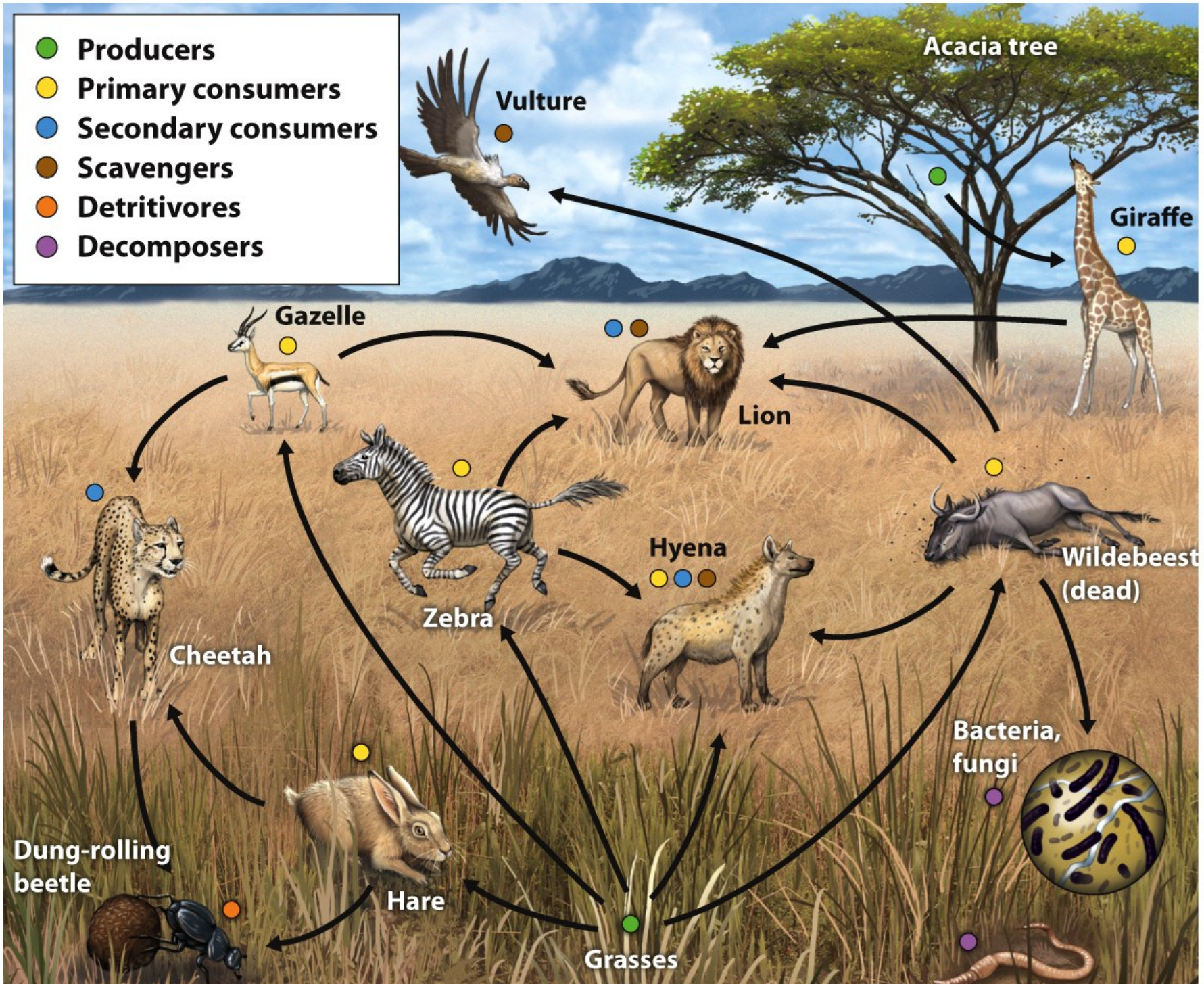


ood Chain- The sequence of consumption fro
roducers through tertiary consumers.

ood Web- A more realistic type of food chain
hat takes into account the complexity of natur

he food web shows all of the actual (and
otential) feeding relationships…the
nterconnected food chains.

African Savanna Food Web



pecialized Consumer

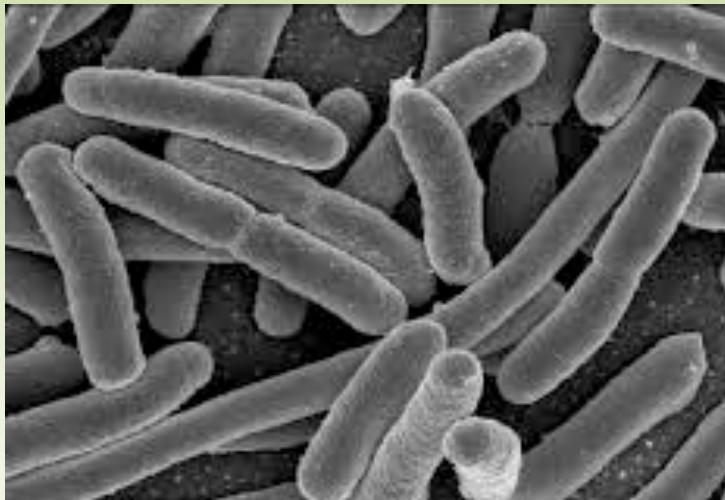
nnivores

Scavengers

pecialized Consumer

tritivores

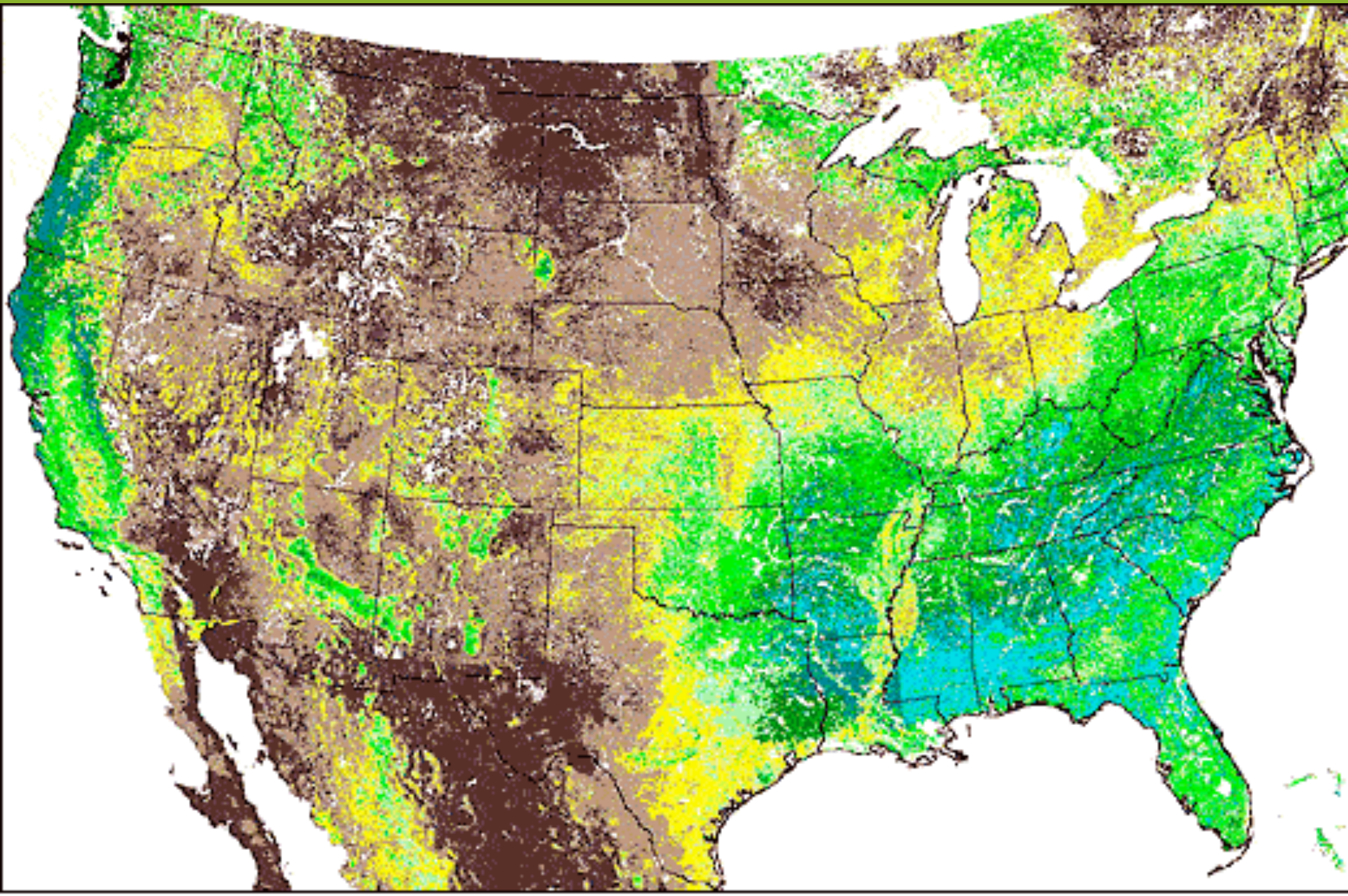
Decomposers



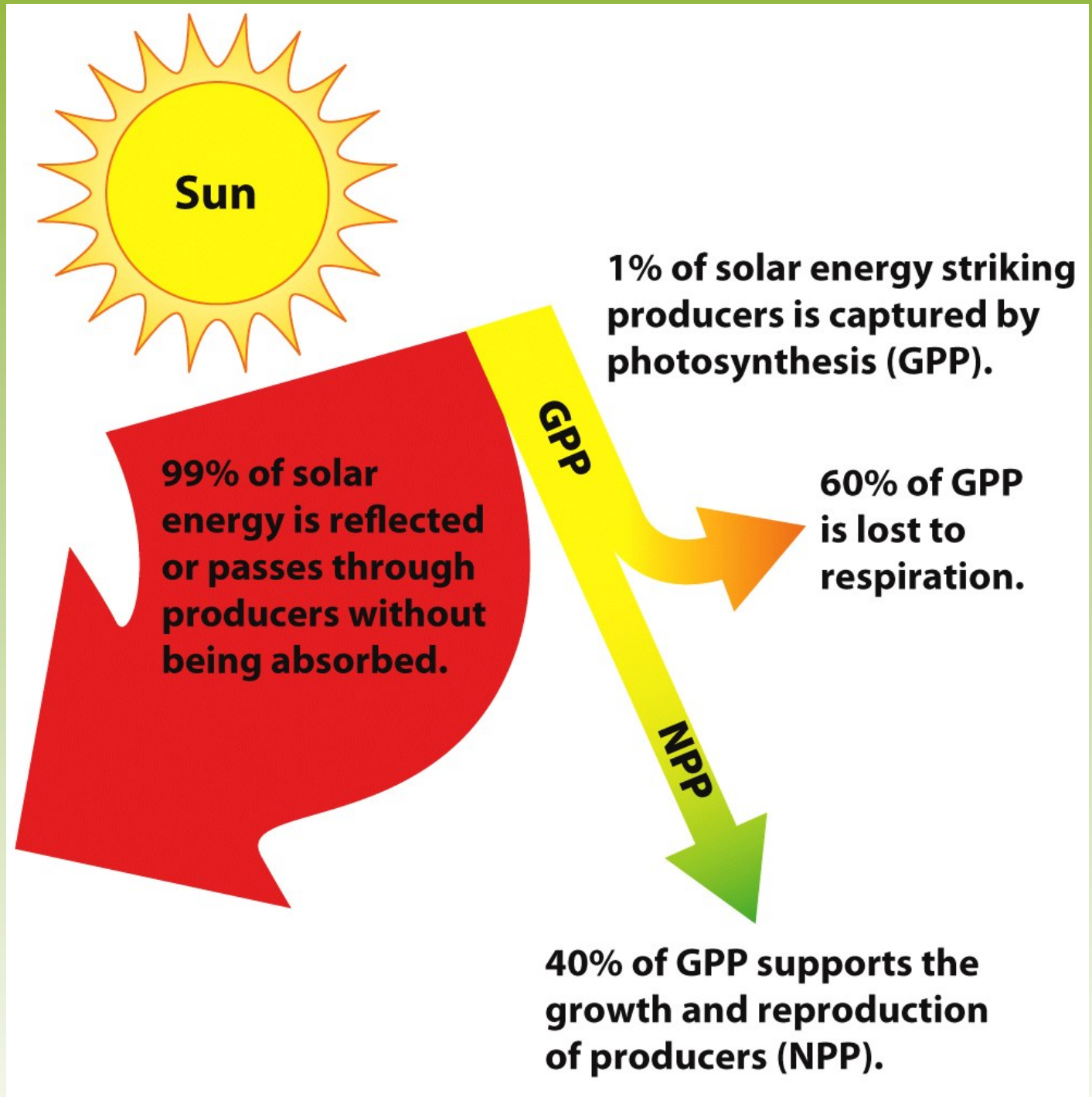
Ecosystem Productivity

- Gross primary productivity (GPP)- The total amount of solar energy that the producers in an ecosystem capture via photosynthesis over a given amount of time.

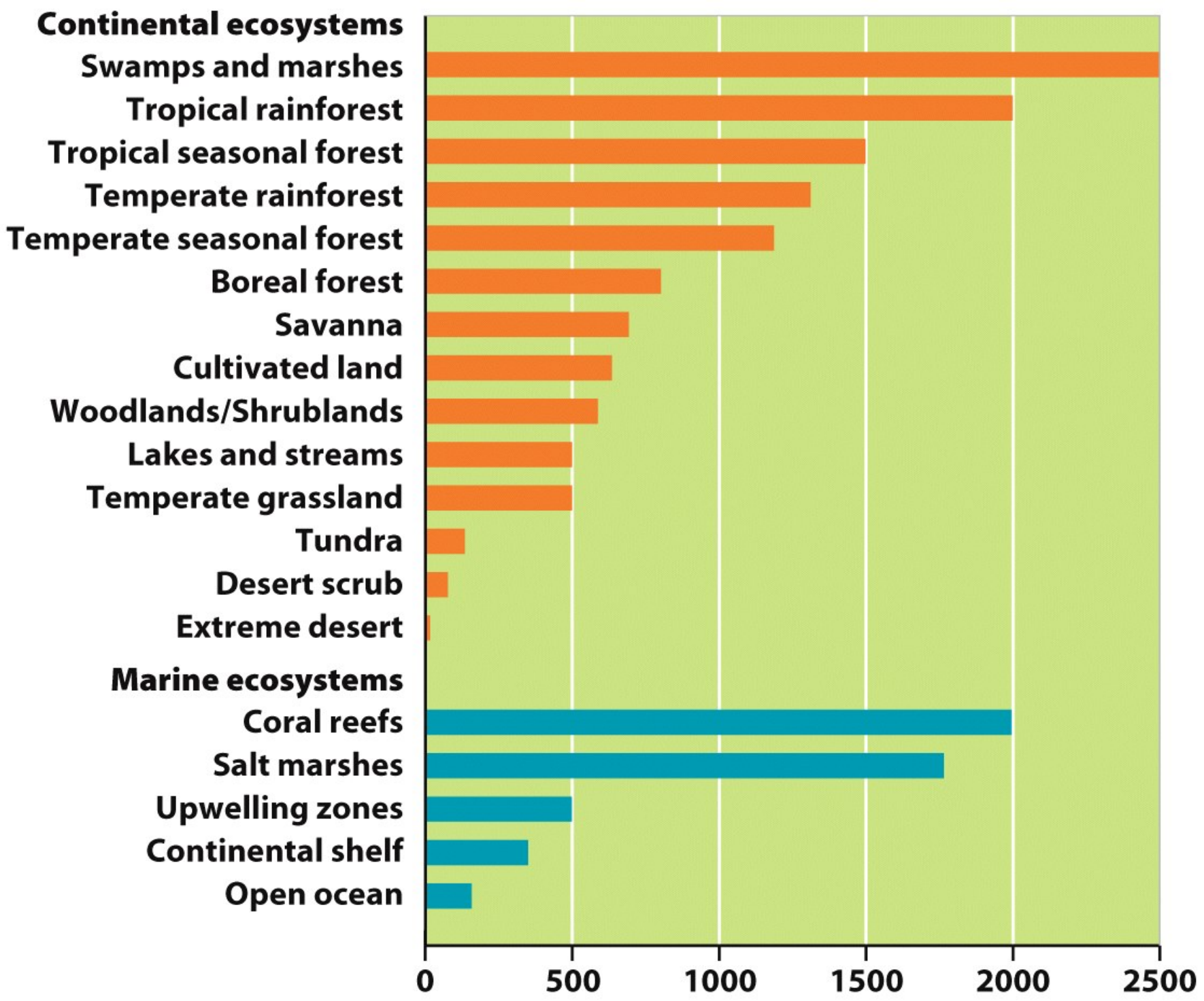
- Net primary productivity (NPP)- The energy captured (GPP) minus the energy respired by producers.


Gross Primary Productivity (gC/m²)

What becomes of incoming solar radiation?



Comparisons of NPP



Productivity is related to…

- 1. Sunlight
- 2. Water
- 3. Nutrients
- 4. Warm temperatures *

Energy Transfer Efficiency and Troph Pyramids

omass- The energy in an ecosystem is measur rms of biomass.

anding crop- The amount of biomass present osystem at a particular time.

ological efficiency- The proportion of consu ergy that can be passed from one trophic leve other.

ophic pyramid- The representation of the stribution of biomass among trophic levels.

Energy Transfer Efficiency
The 10% Rule

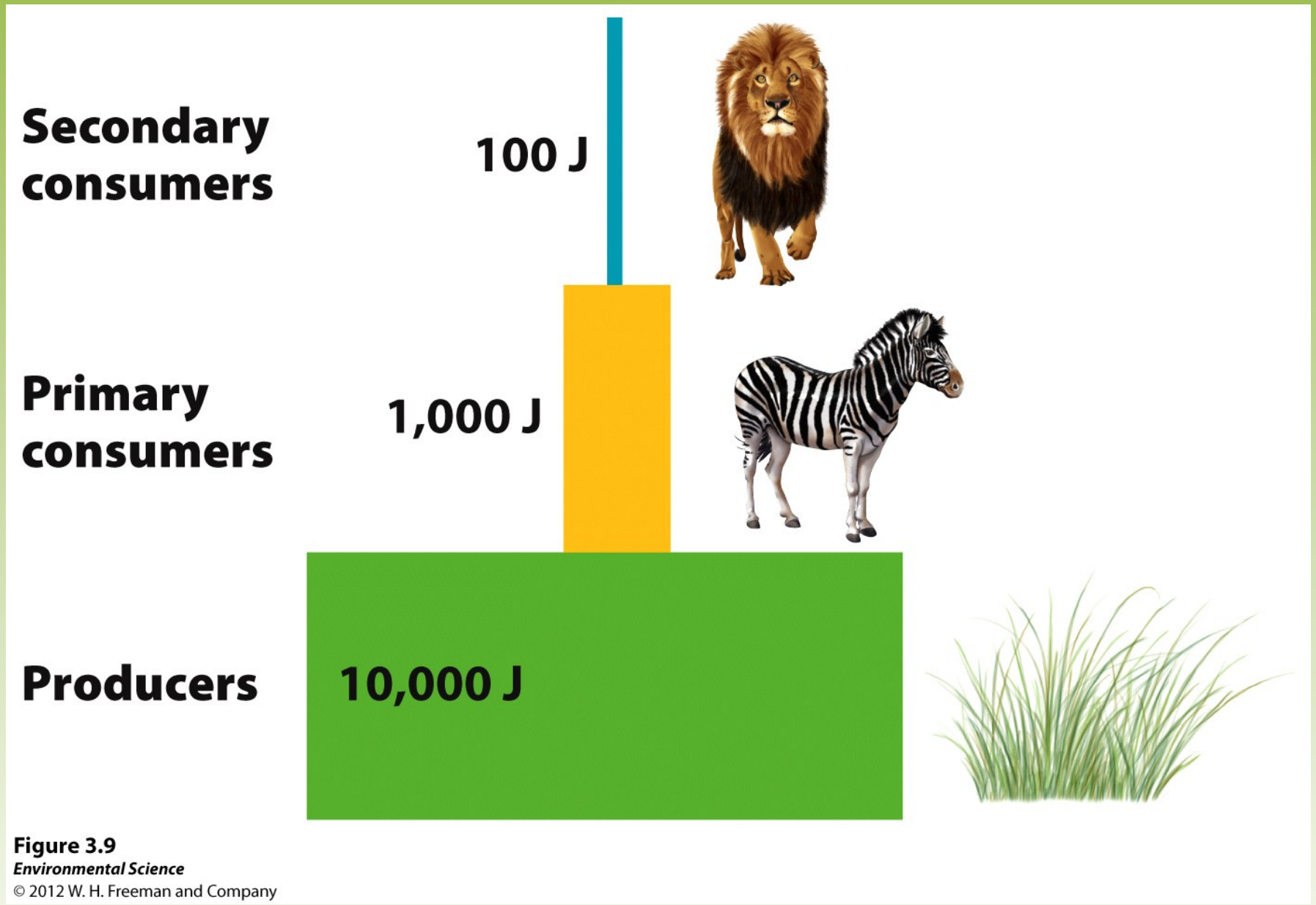
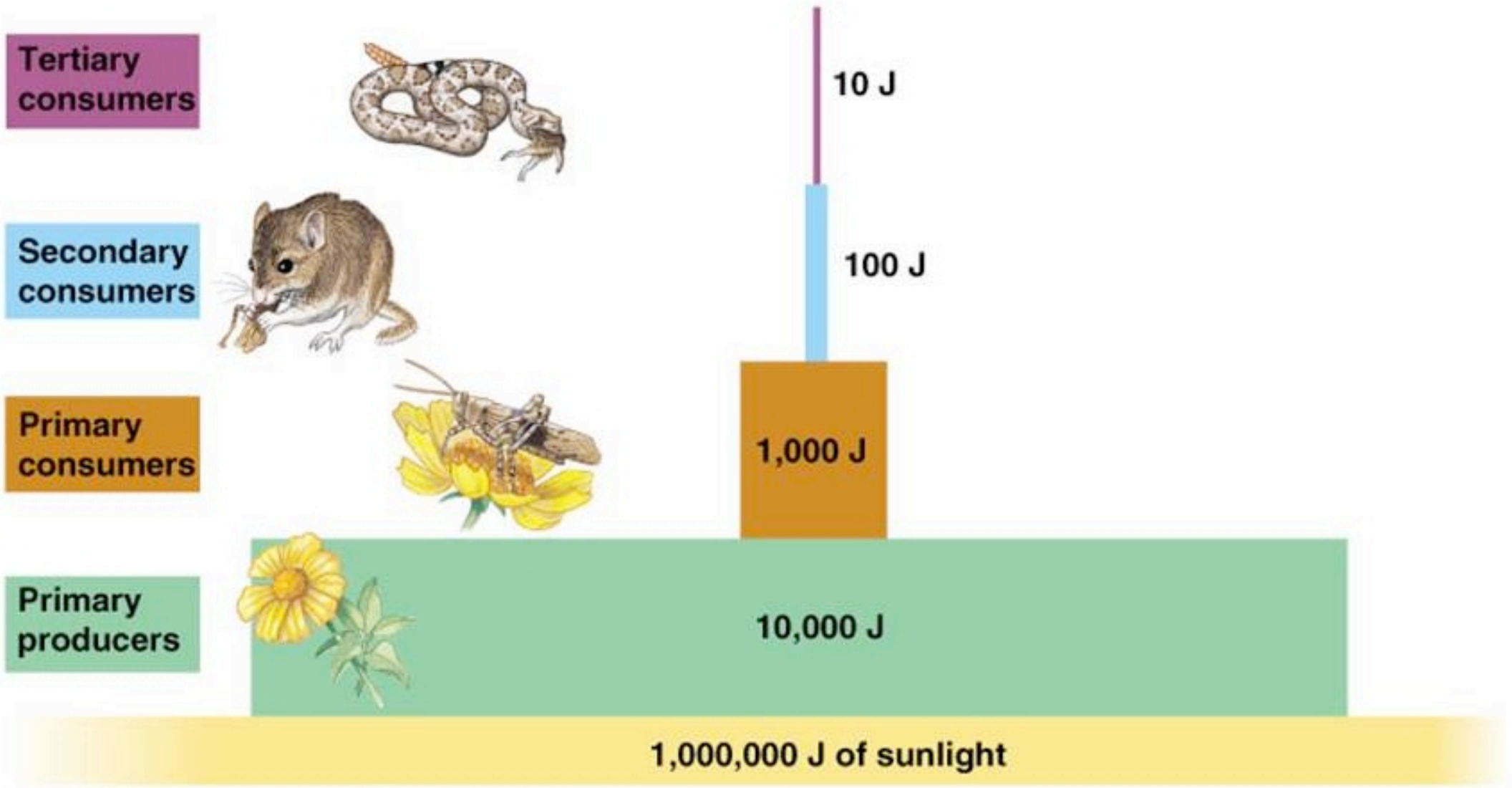
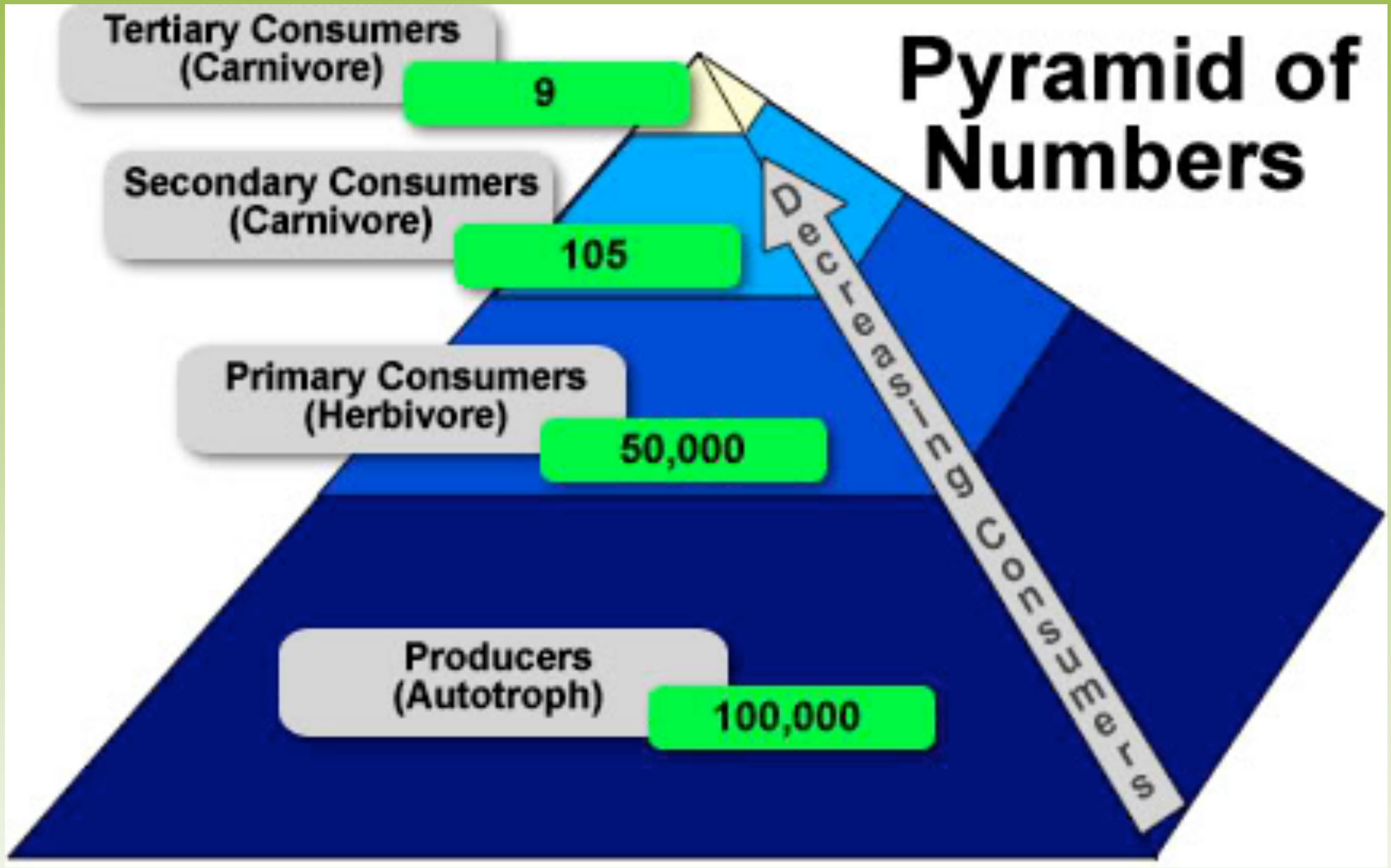


Figure 3.9
Environmental Science

Trophic Pyramid Energy / Biomass



Pyramid of Numbers



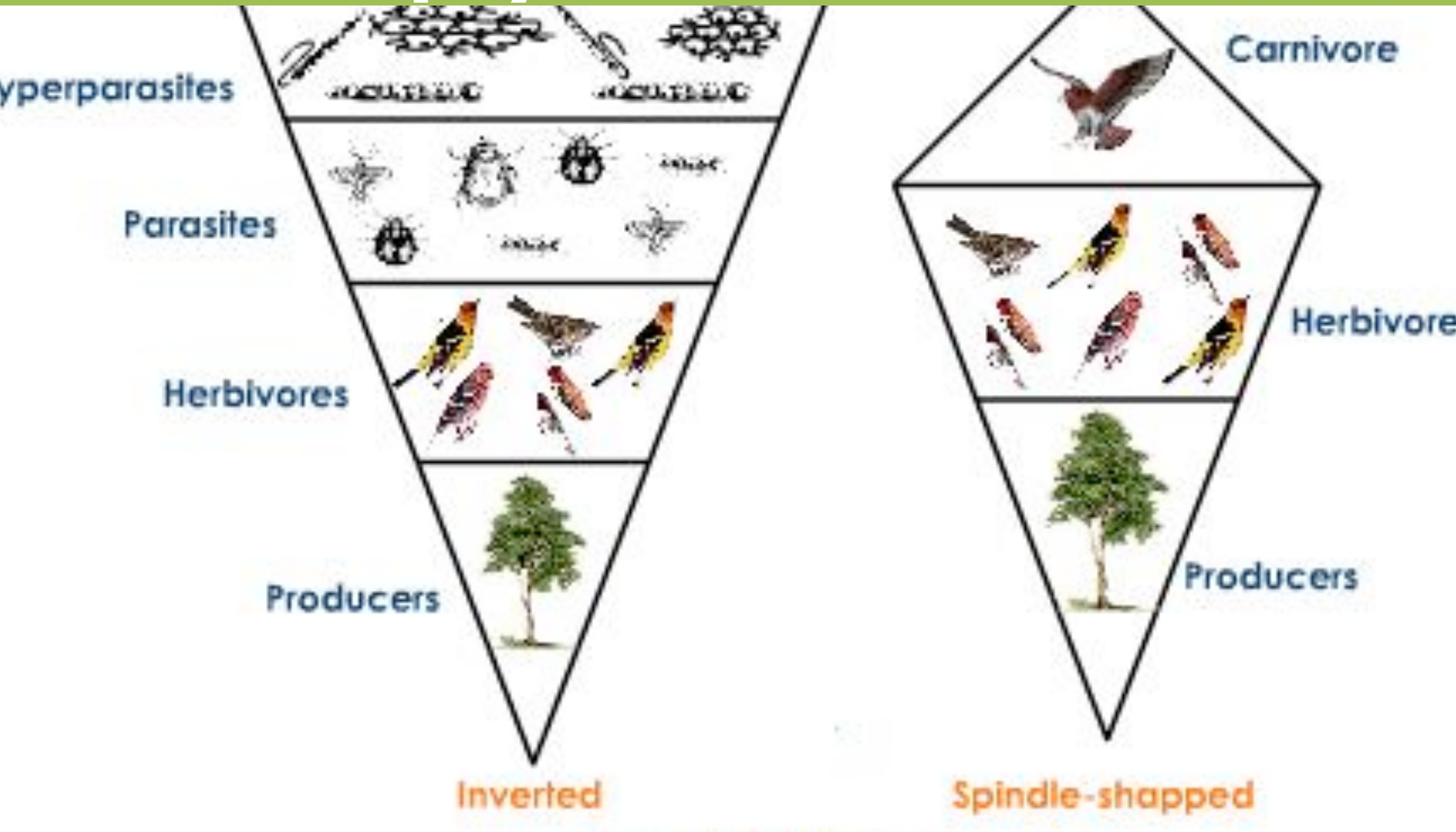
Inverted Pyramid of Numbers

Woodpecker
(Secondary consumer)

Insects
(Primary consumer)

Oak tree
(Producer)

Other inverted pyramids



Matter cycles through the biosphere

osphere- The combination of all ecosystems o
rth.

ogeochemical cycles- The movement of matt
thin and between ecosystems involving biolo
ologic and chemical processes.

The “Bio” in Biogeochemical

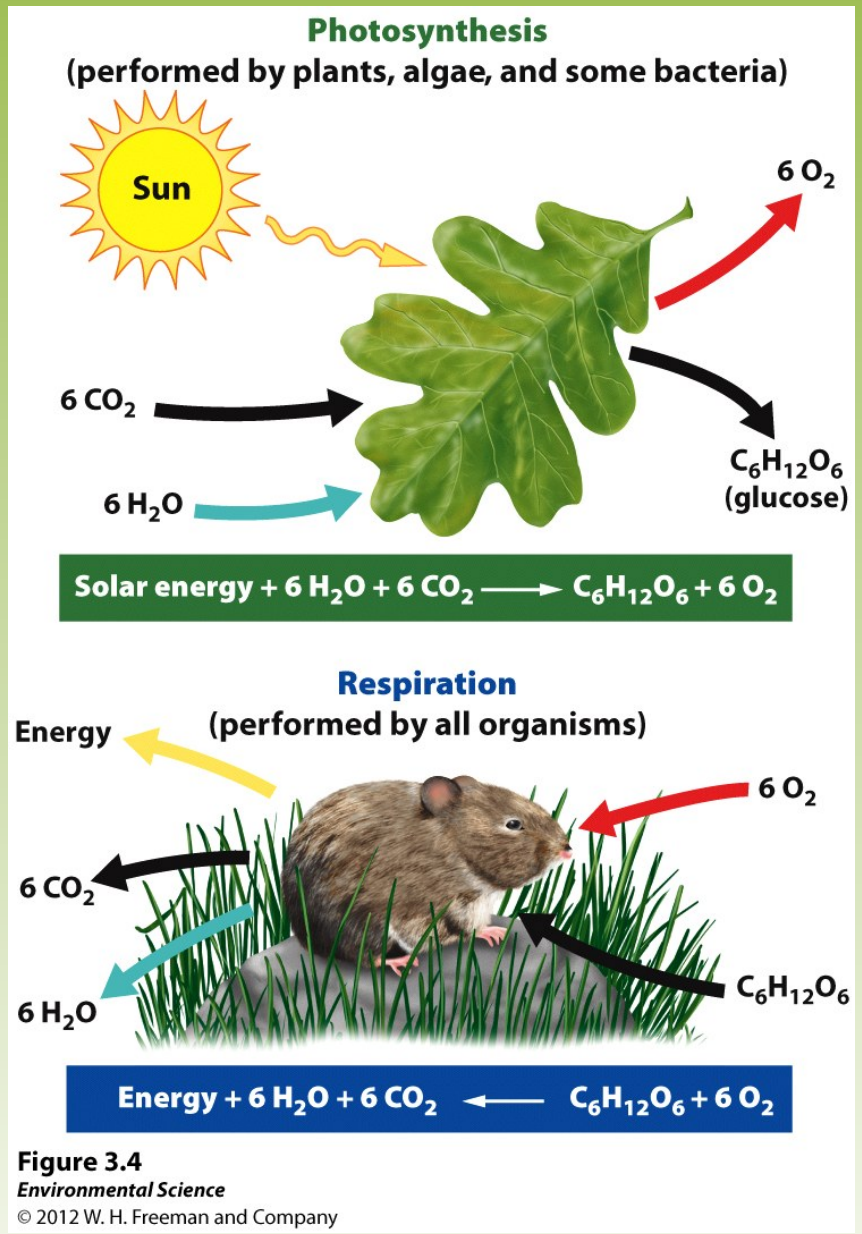
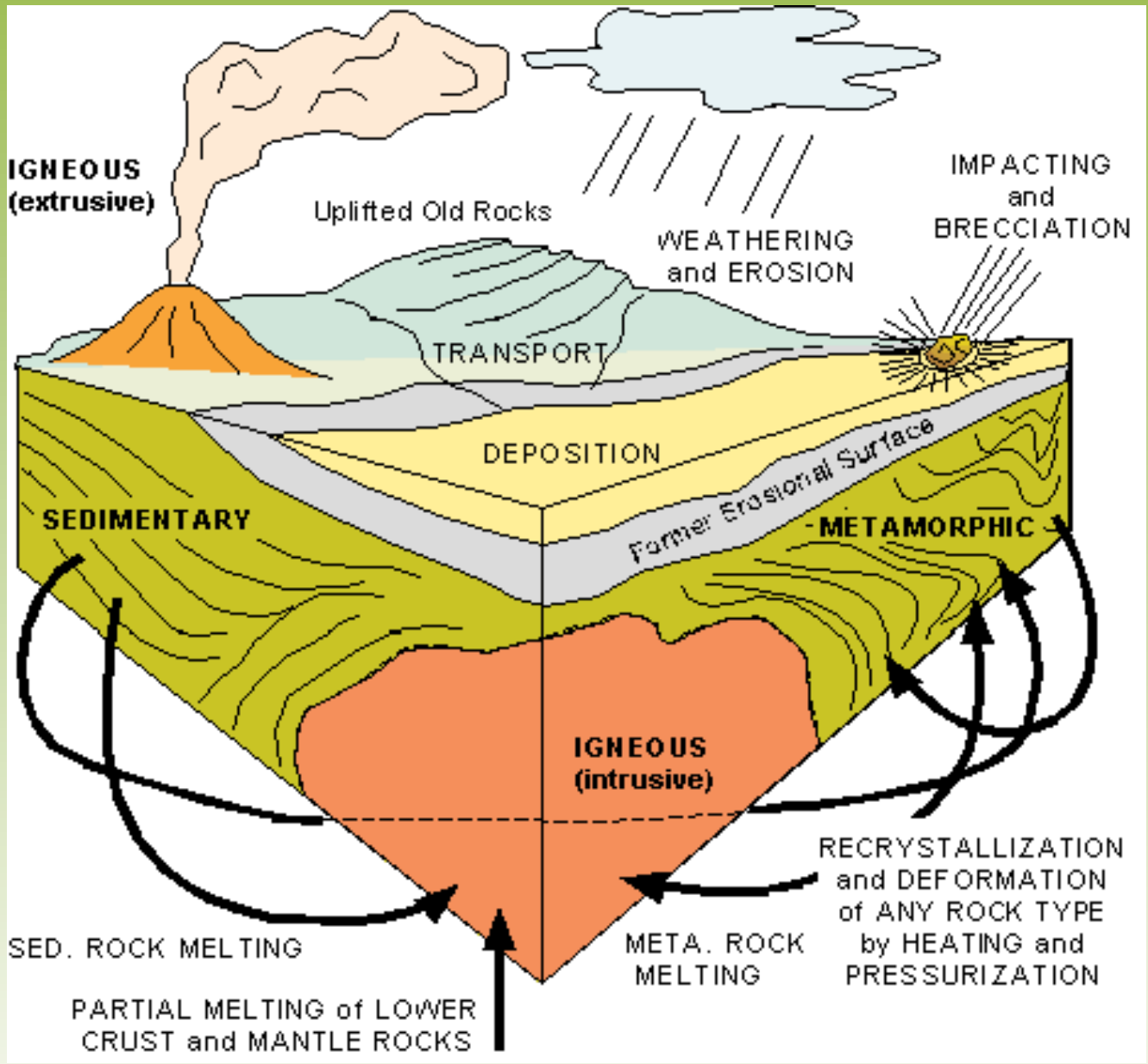
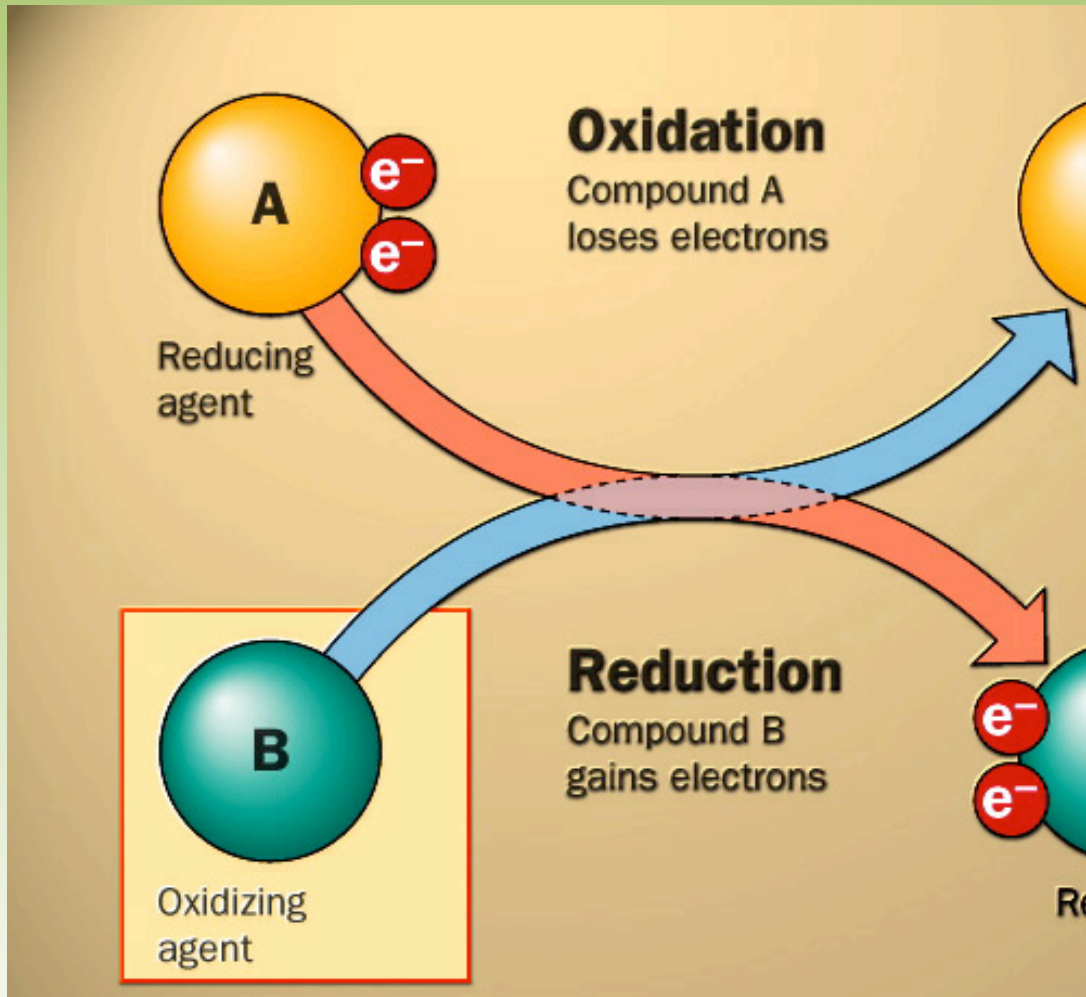


Figure 3.4
Environmental Science

The "Geological" in Biogeochemical

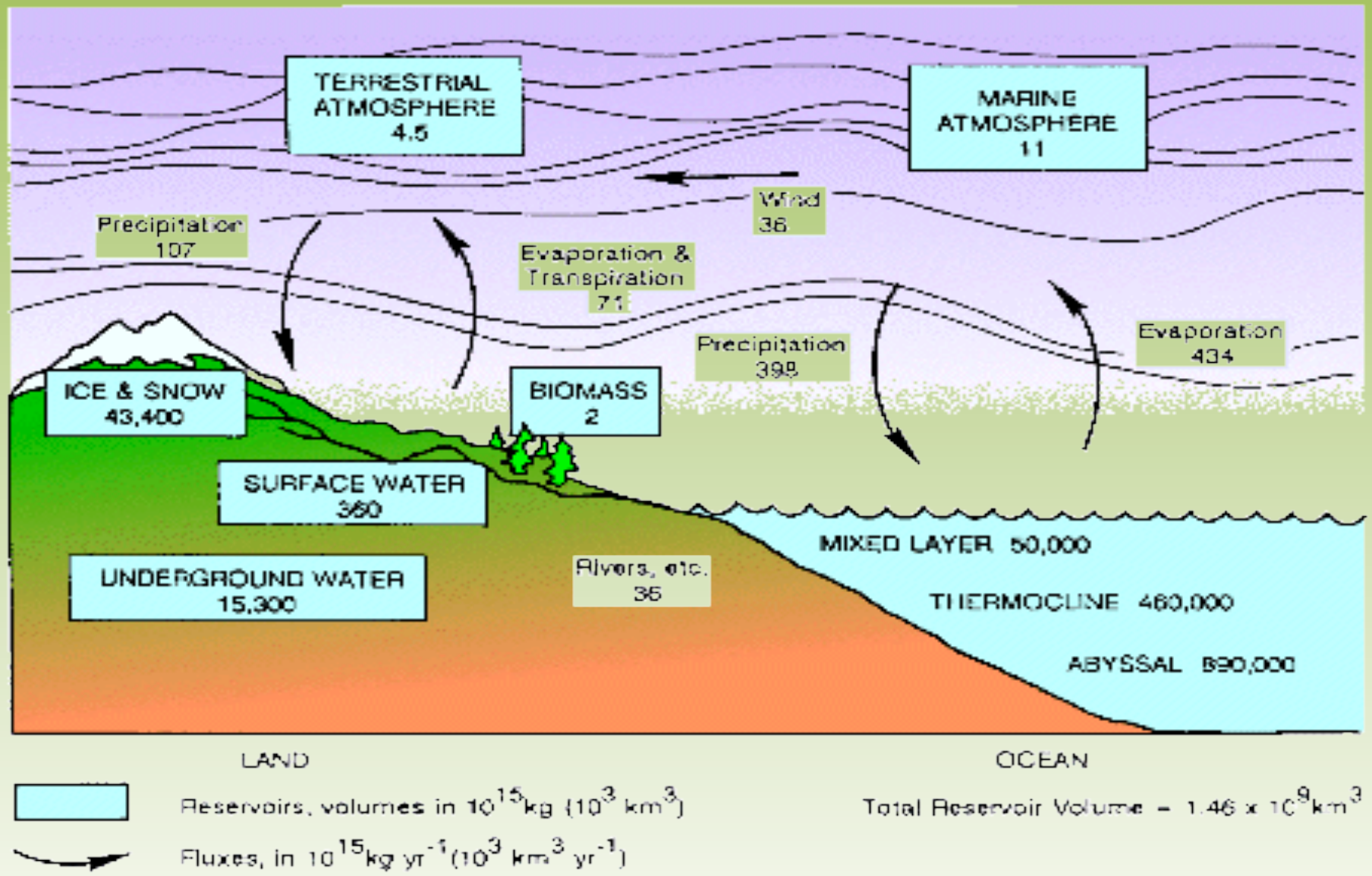


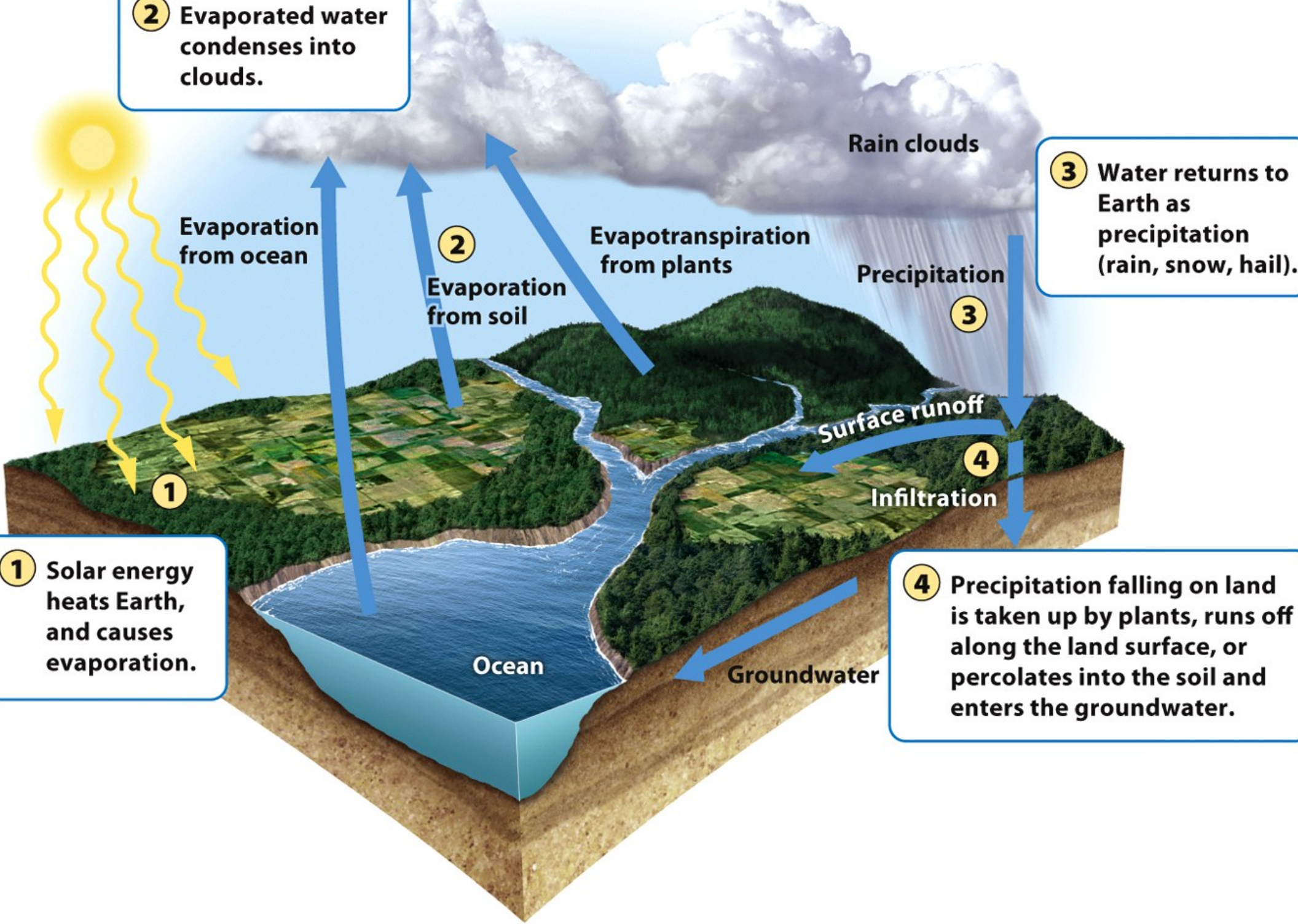
The "Chemical" in Biogeochemical



The Hydrologic Cycle

- The movement of water through the biosphere.



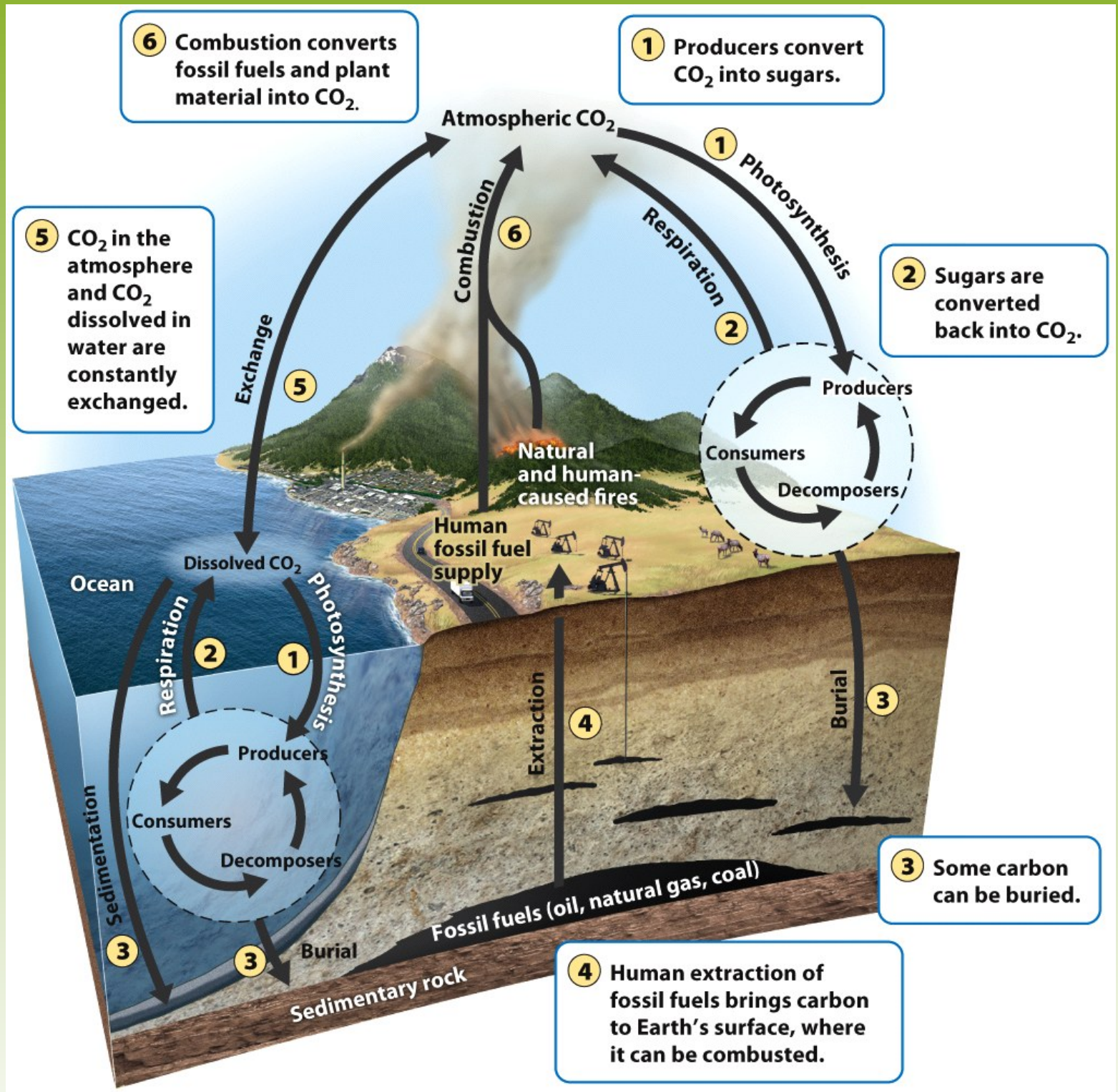


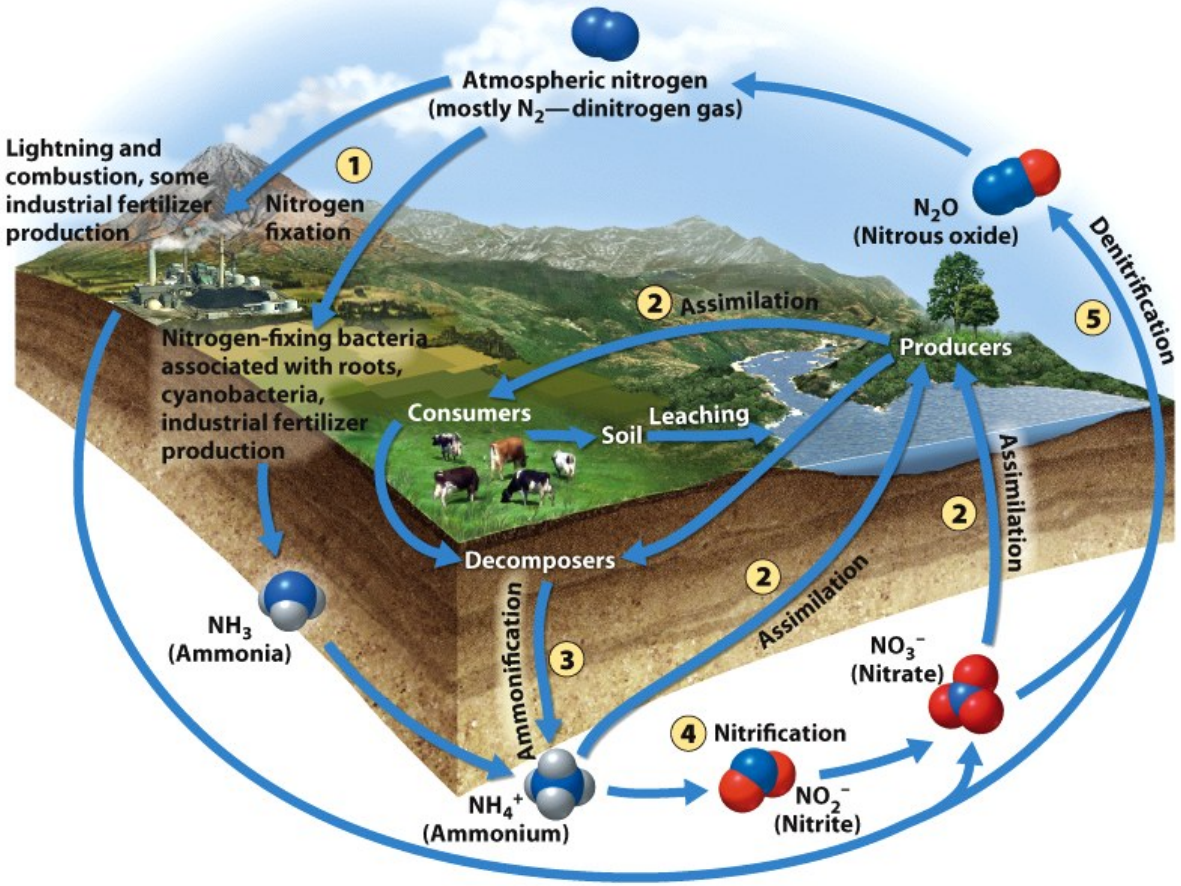
igure 3.10
nvironmental Science

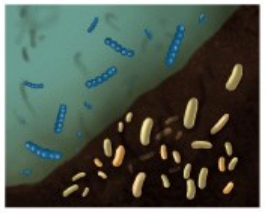
The Hydrologic Cycle

- Transpiration- The process where plants release water from their leaves into the atmosphere.
- Evapotranspiration- The combined amount of evaporation and transpiration.
- Runoff- When water moves across the land surface into streams and rivers, eventually reaching the ocean.

The Carbon Cycle





1 Nitrogen Fixation	2 Assimilation	3 Ammonification	4 Nitrification	5 Denitrification
Nitrogen fixation converts N_2 from the atmosphere. Biotic processes convert N_2 to ammonia (NH_3), whereas abiotic processes convert N_2 to nitrate (NO_3^-).	Producers take up either ammonium (NH_4^+) or nitrate (NO_3^-). Consumers assimilate nitrogen by eating producers.	Decomposers in soil and water break down biological nitrogen compounds into ammonium (NH_4^+).	Nitrifying bacteria convert ammonium (NH_4^+) into nitrite (NO_2^-) and then into nitrate (NO_3^-).	In a series of steps, denitrifying bacteria in oxygen-poor soil and stagnant water convert nitrate (NO_3^-) into nitrous oxide (N_2O) and eventually nitrogen gas (N_2).
				

The Phosphorus Cycle

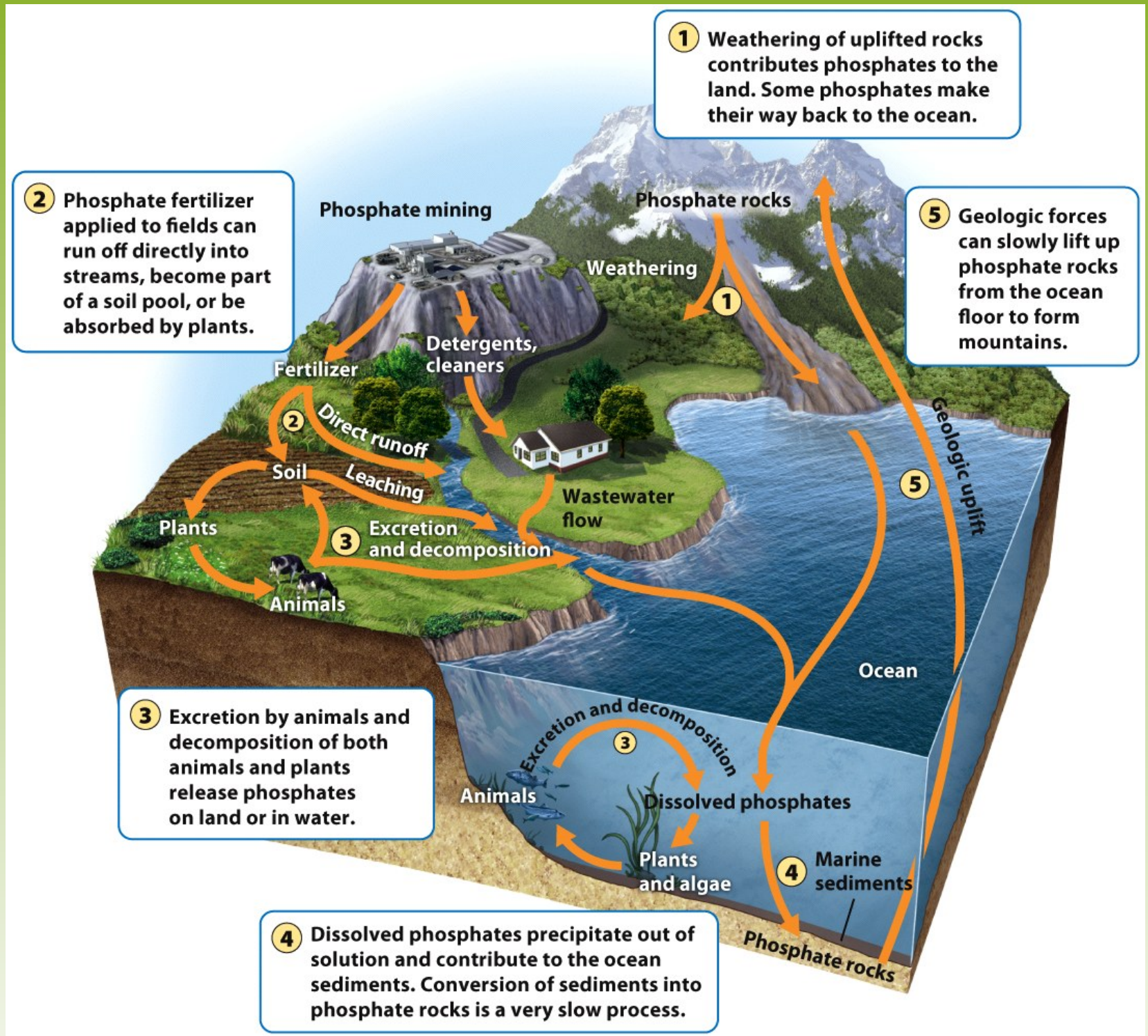


Figure 3.13

Ecosystems respond to disturbance

- Disturbance- An event caused by physical, chemical or biological agents that results in changes in population size or community composition.

mpany

Watershed Studies

- Watershed- All of the land in a given landscape that drains into a particular stream, river, lake or wetland.


River

Figure 3.16

5b

e Intermediate Disturbance Hypothe

- The intermediate disturbance hypothesis- states that ecosystems experiencing intermediate levels of disturbance are more diverse than those with high or low disturbance levels.

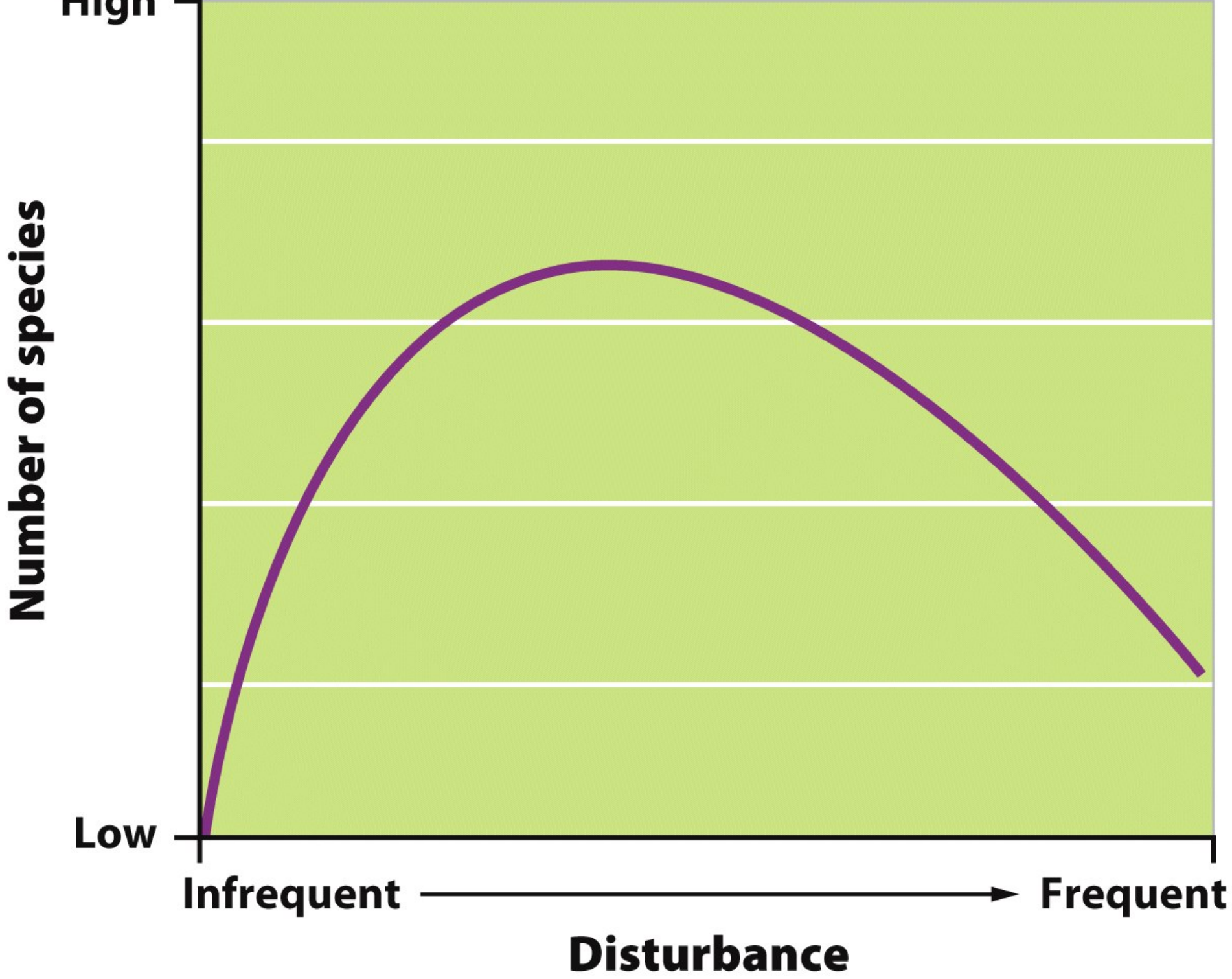


Figure 3.19
Environmental Science

Resistance versus Resilience

sistance- A measure of how much a disturban
n affect its flows of energy and matter.

silience- The rate at which an ecosystem retur
its original state after a disturbance.

storation ecology- A new scientific discipline
t is interested in restoring damaged ecosyste

Ecosystems Provide Valuable Services

Figure 3.21

rovisions- Goods that humans can use directly.

egulating services- The service provided by natural sys
hat helps regulate environmental conditions.

upport systems- The support services that natural
cosystems provide such as pollination, natural filters and
ontrol.

esilience- Resilience of an ecosystem ensures that it wi
ontinue to provide benefits to humans. This greatly dep
n species diversity.

ultural services- Ecosystems provide cultural or aesthe