Chapter 3 AND 4
Ecosystem Ecology
AXES Paragraph Read P.57 ESBB

Key Objectives

- STD's should understand cycles in nature, Food webs, the water (hydrologic) cycle and ways macronutrients (carbon, nitrogen, phosphorus and sulfur) can cycle.

- STD's need to understand how things cycle, parts and names of each cycle, and phases of matter

- STD's must be able to identity and describe what happens during each step in the nitrogen cycle.

- STD's need to understand the 10% rule. 10% of the biomass from one level will move to the next level of the trophic pyramid.

- STD's know different biomes and the amount of biomass a particular biome has while applying that information to biodiversity and the law of conservation of matter. Then apply to biodiversity loss and habitat destruction.

Agenda 2/7

1. Read Reversing the Deforestation of Haiti AXES P. 32NB P 57 ESBK

2. WU – Academic Content: Biotic, Abiotic, Food chain, Food Web, Energy Pyramid, Ecosystem, Ecological Hierarchy of Organization

3.HW CH 3 MC P. 33 NB

4.HW CH 3 Voc & FRQ P. 35 NB

5.Go over Quiz

6. Geologic Timeline

7. Ecology Project

9/11 Ecosystem Ecology CH 3

Obj. TSW apply their knowledge of erosion to real world events and develop a better understanding of healthy ecosystems. P. 36 NB

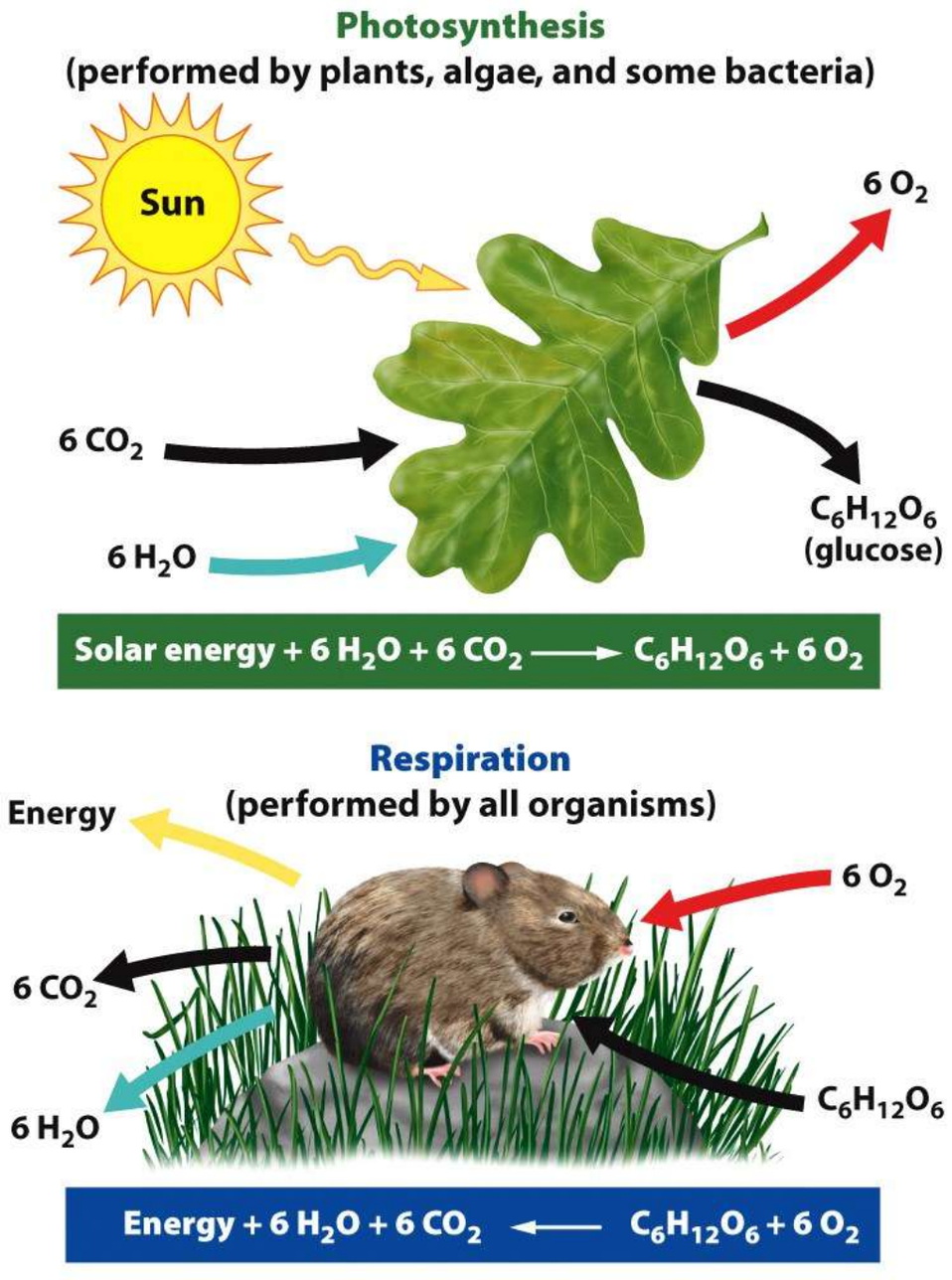


Figure 3.4
Environmental Science

How are Ecosystems different from communities?

Explain the relationship between Photosynthesis & Cellular Respiration.

Energy flows through ecosystems, explain the relationship between Trophic levels, Food Chains, and Food Webs.

Ecosystem Ecology Examines 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.

Communities vs. Ecosystems

- ***Community-*** Just living things; made up of all the individual animal species living within a specific geographical area

  - Ex: Tide pool community= Fish, crabs, algae, etc.

- ***Ecosystem-*** Living and Nonliving; “ “ PLUS all abiotic (non-living) factors which they interact with

  - Ex: All animals above PLUS seawater, rocks, minerals, wind, sunlight, etc.

Photosynthesis and Respiration

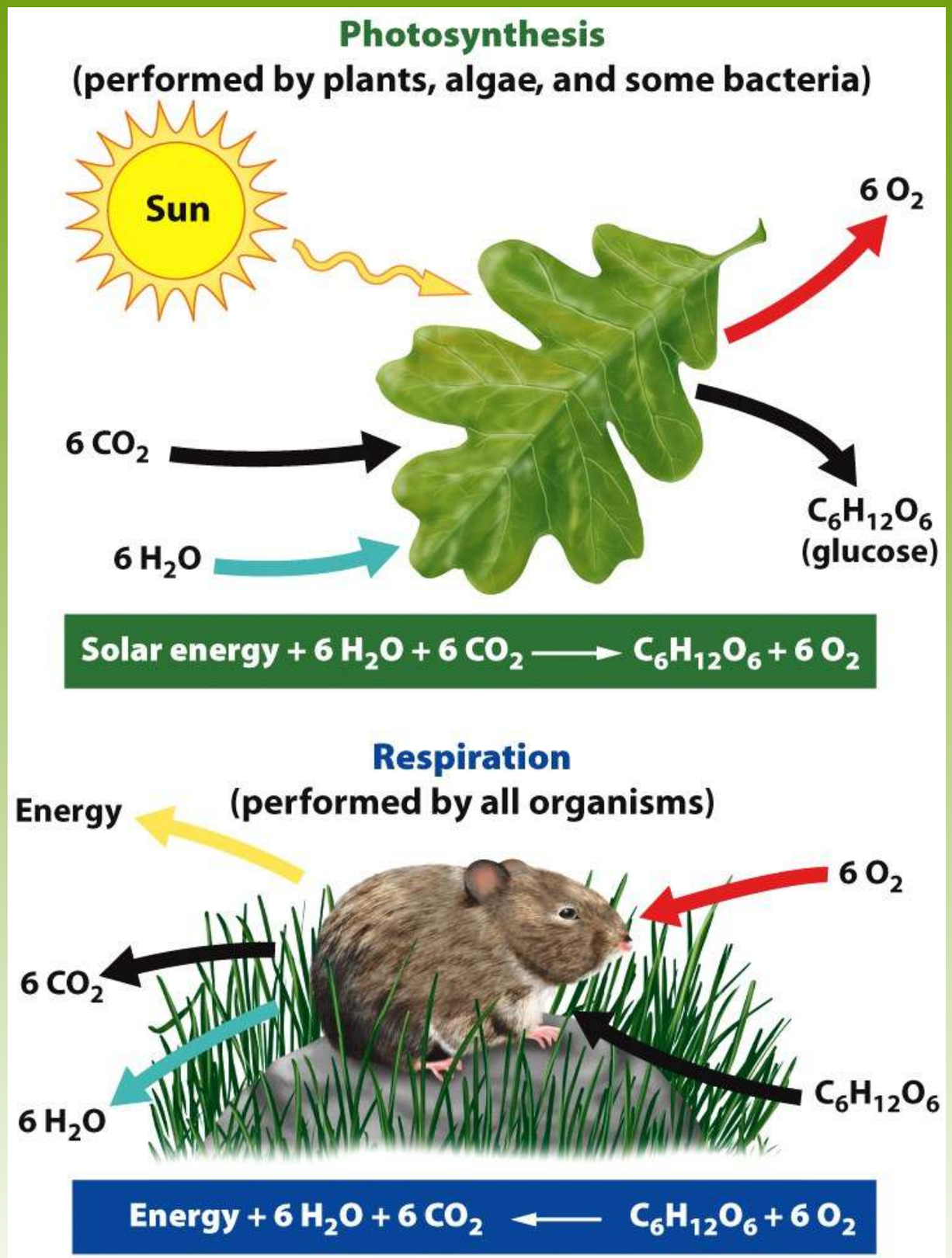


Figure 3.4
Environmental Science

Autotroph vs. Heterotroph

- Autotroph: use sun's energy to produce usable forms of energy; make their own food

- Heterotroph: Incapable of photosynthesis and must obtain energy by consuming organisms

Photosynthesis and Respiration

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

- $6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$

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

- $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O + ATP$

Trophic Levels

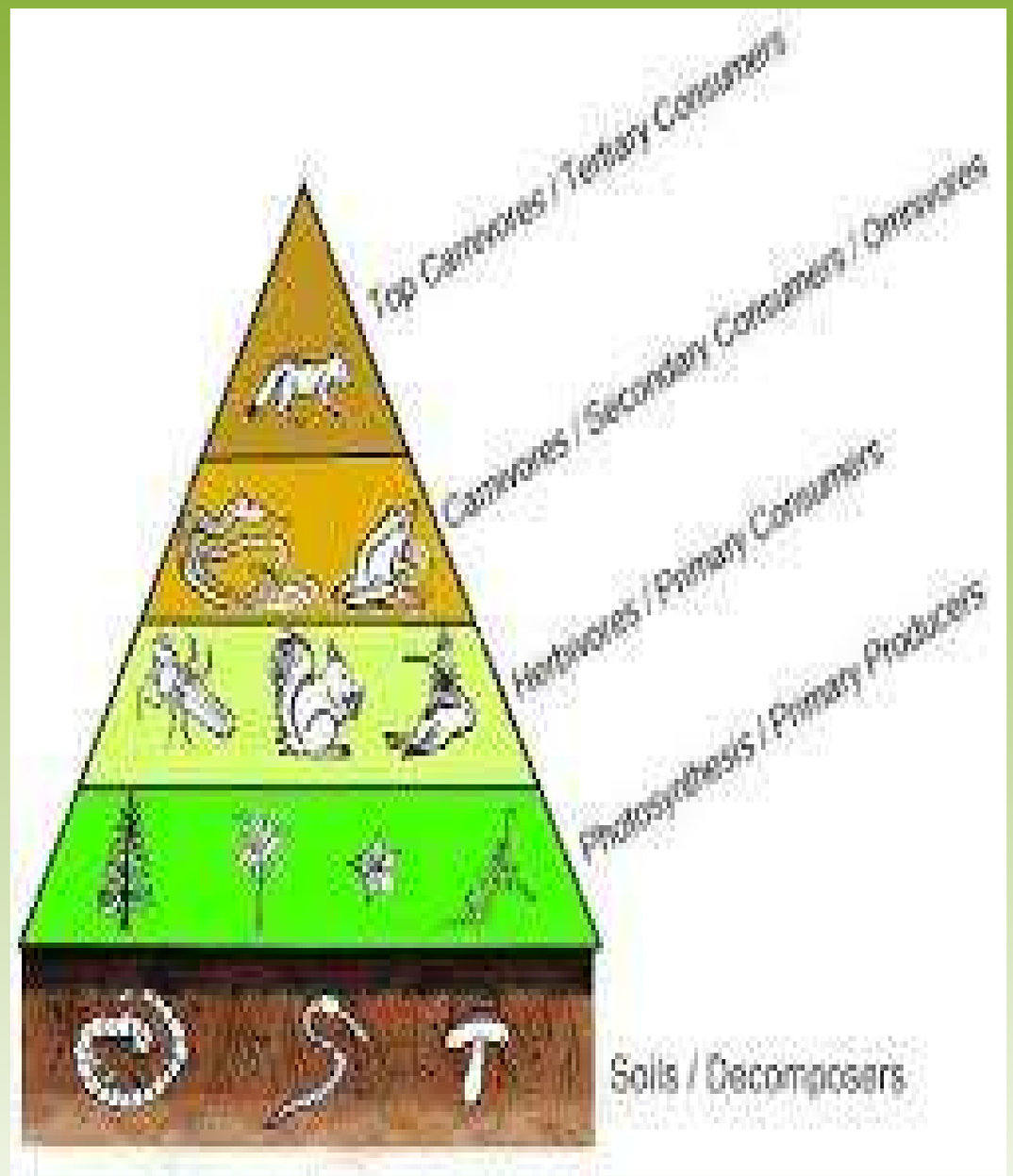
- ***Trophic Structure:*** Shows the feeding relationships b/t organisms that influence the structure and dynamic of the ecosystem

- ***1) Producers***: Autotrophs, Photosynthetic organisms, get energy from sun, EX: Plants, algae

- ***2) Primary Consumers:*** Herbivores, get energy from eating other plants, EX: Zebra, Horse

- ***3) Secondary/ Tertiary Consumers:*** Carnivores, feed on primary consumers, EX: Snakes, frogs

- ***4) Decomposers:*** Detritivores, consume dead matter, EX: Worms, slugs



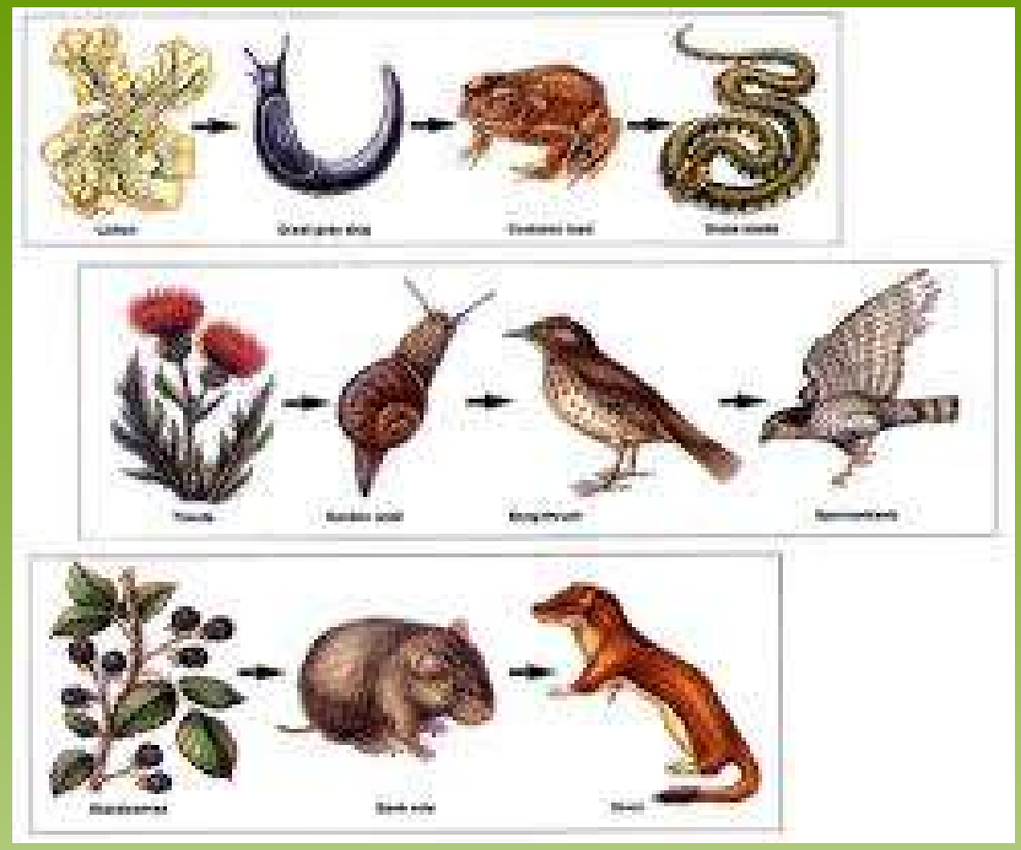
Food Chain vs. Food Web

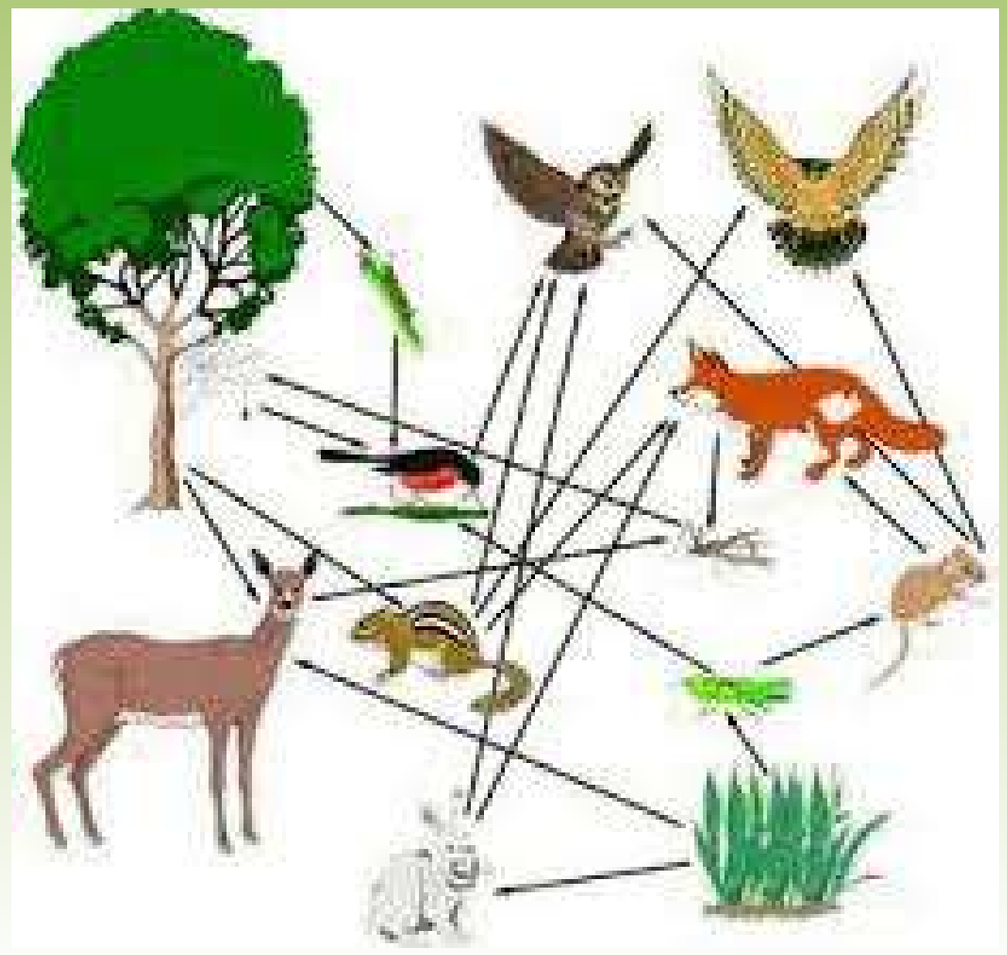
- ***Food Chain-*** The sequence of consumption from producers through tertiary consumers

  - ***Linear relationship***: Shows energy traveling up the trophic levels from producers to primary consumers, etc.

- ***Food Web-*** A more realistic type of food chain that takes into account the complexity of nature

  - Interlinked set of food chains; More complex



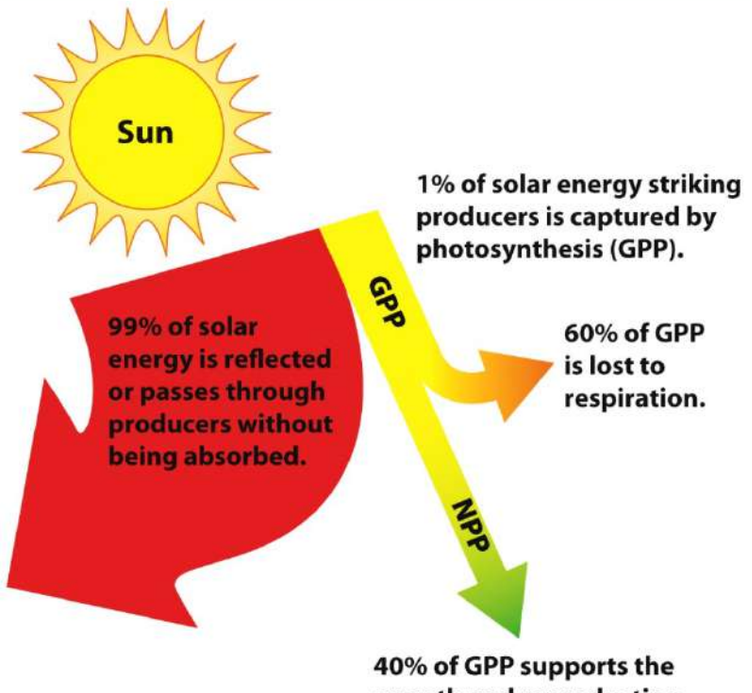


Agenda 2/10

- WU – Ecological efficiency & productivity
- Notes CH 3
- CH 3 MC Study Guide P. 33 NB
- Ecosystem PPT/Poster Project (CH 4)
- Wed. ESCE Lauren & Sarina
- Excel Data Activity

9/12 Energy Flow through Ecosystems CH 3

Obj. TSW explain Ecosystem productivity, Ecological efficiency & the Carbon Cycle. P. 38 NB



1. What determines the **productivity of an ecosystem**, explain & write the equation.

2. A trophic pyramid is used to show the distribution of biomass. How is **Ecological Efficiency** of an ecosystem measured?

3. Explain the Carbon Cycle & write the 6 processes that drive the cycle.

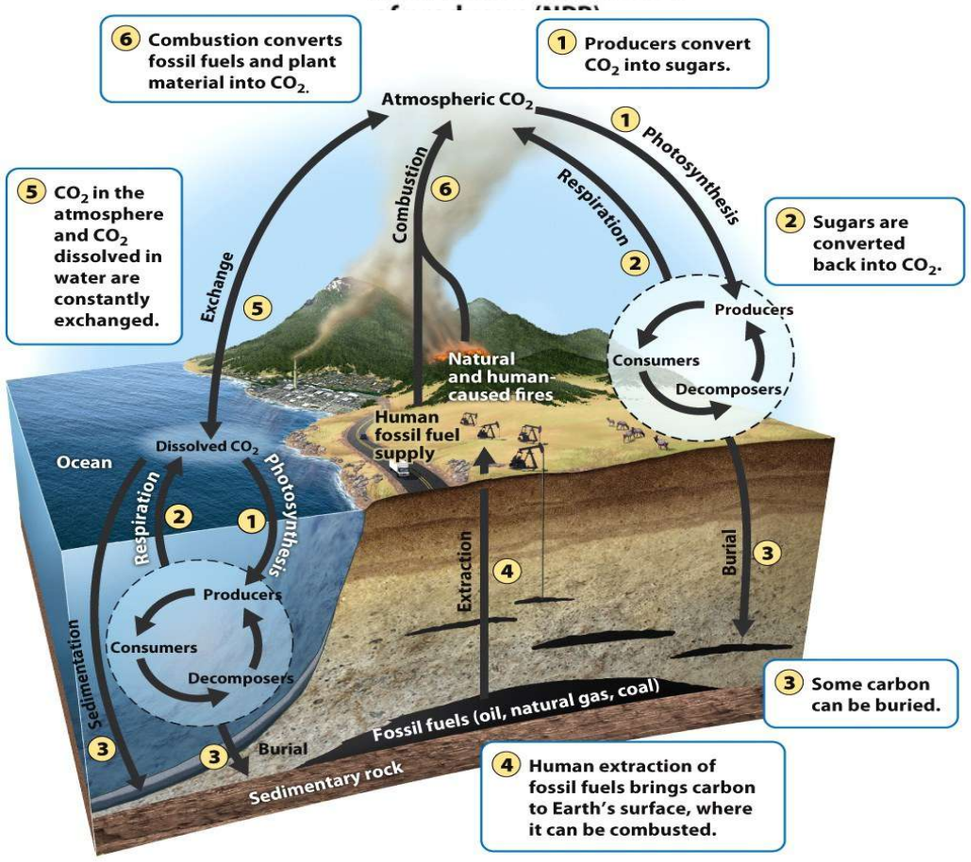


Figure 3.11
Environmental Science

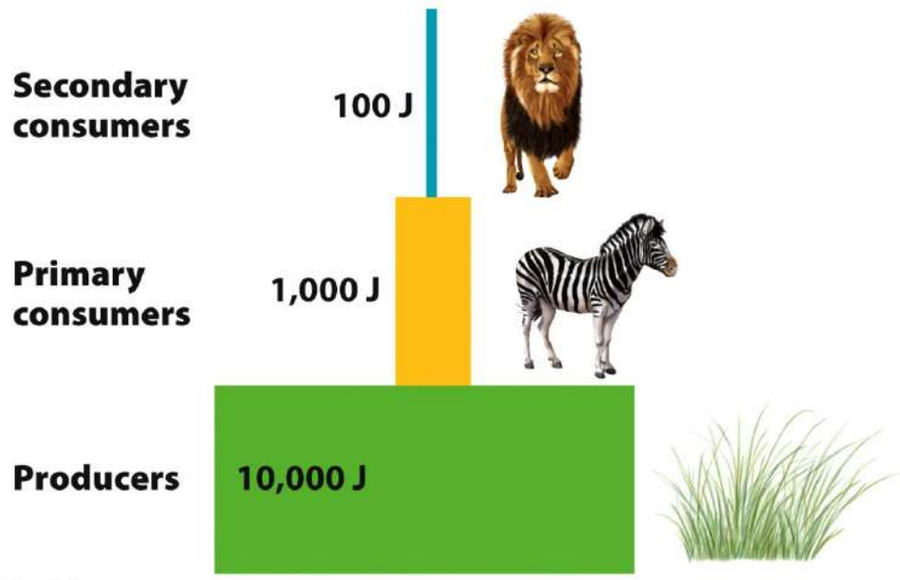


Figure 3.9
Environmental Science

Opening story

- Haiti is a good example of how economics is being used to solve an environmental problem – Mango trees to decrease erosion, and flooding, yet help the people be self sustaining.

Unnumbered 3 p57
Environmental Science

Ecosystem Productivity

- Amount of energy available in an ecosystem determines how much life the ecosystem can support

- 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.

- **NPP = GPP – Respiration by Producers**

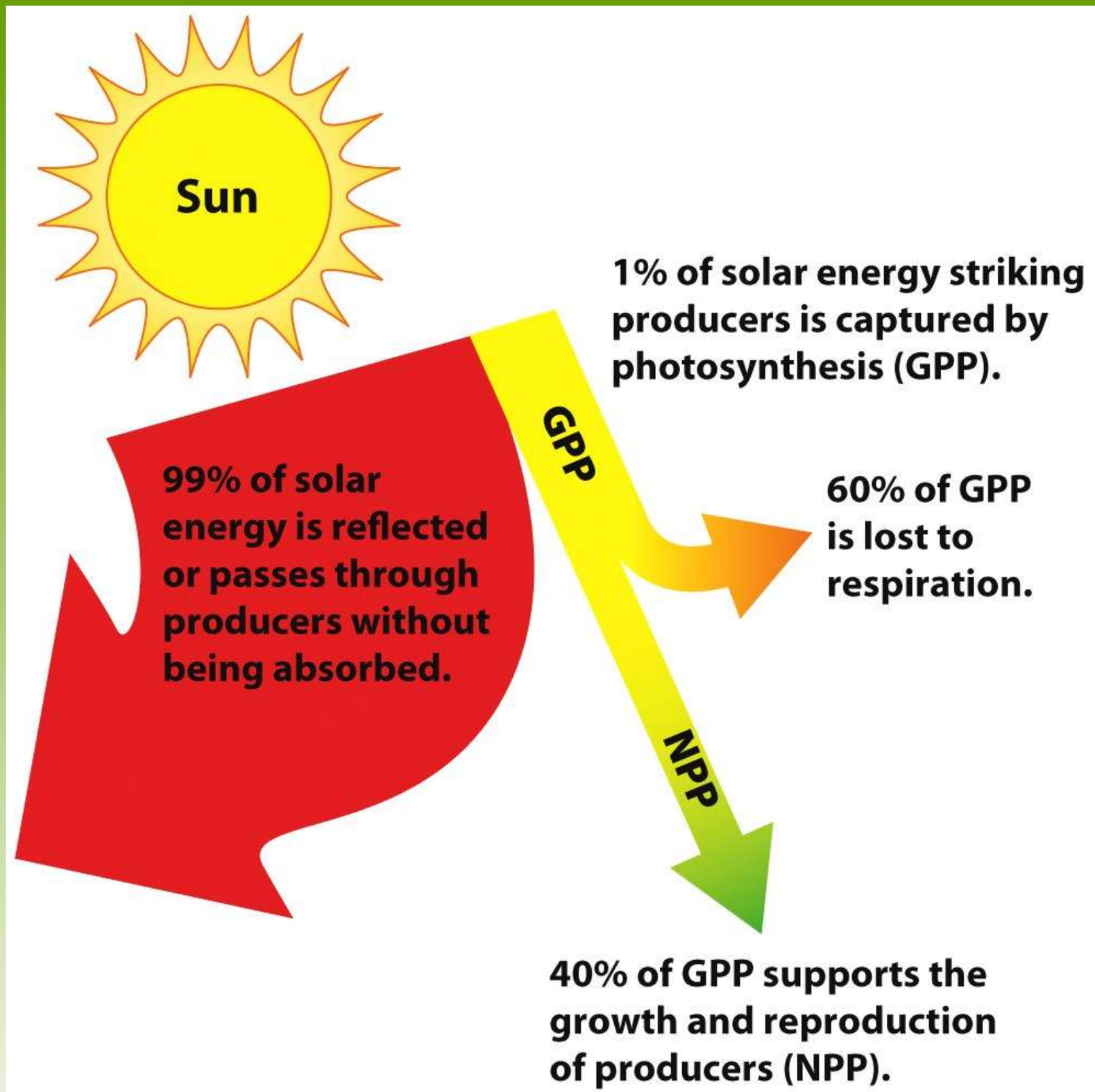


Figure 3.7
Environmental Science

Net Primary productivity varies amount ecosystems

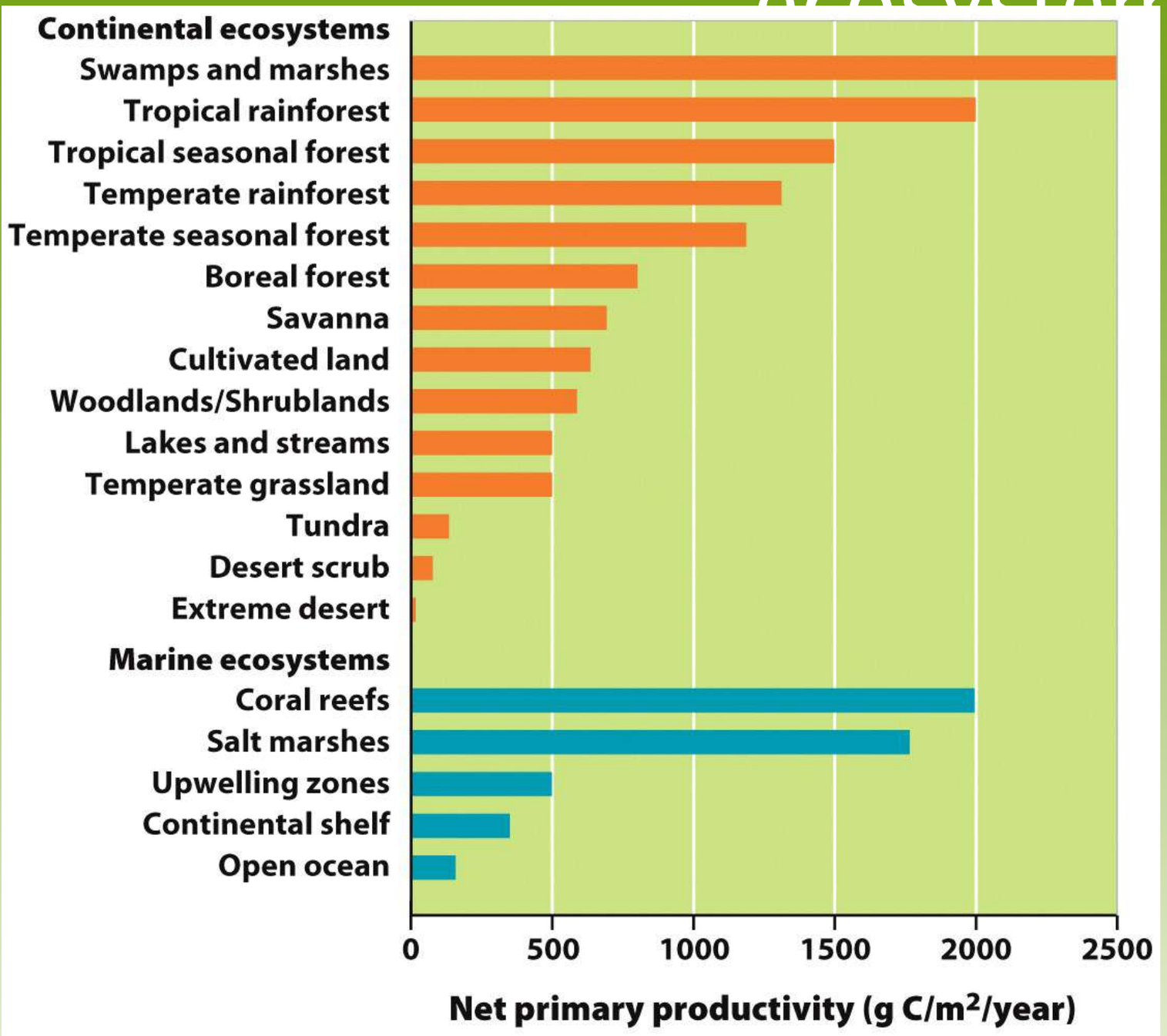


Figure 3.8
Environmental Science

How do the different ecosystems compare?

What correlation can be drawn between the type of ecosystem and its productivity?

Productivity is highest where temperatures are warm and water and solar energy are abundant.

Wetlands, Coral Reefs

Energy Transfer Efficiency and Trophic Pyramids

- **Biomass-** The energy in an ecosystem is measured in terms of biomass.

- **Standing crop-** The amount of biomass present in an ecosystem at a particular time.

- **Ecological efficiency-** The proportion of consumed energy that can be passed from one trophic level to another.

- **Trophic pyramid-** The representation of the distribution of biomass among trophic levels.

Do the Math

How much energy is available for the third trophic level lions in the Serengeti ecosystem If the Producers have 10,000 joules of energy and there is a 10% **ecological efficiency** for each level?

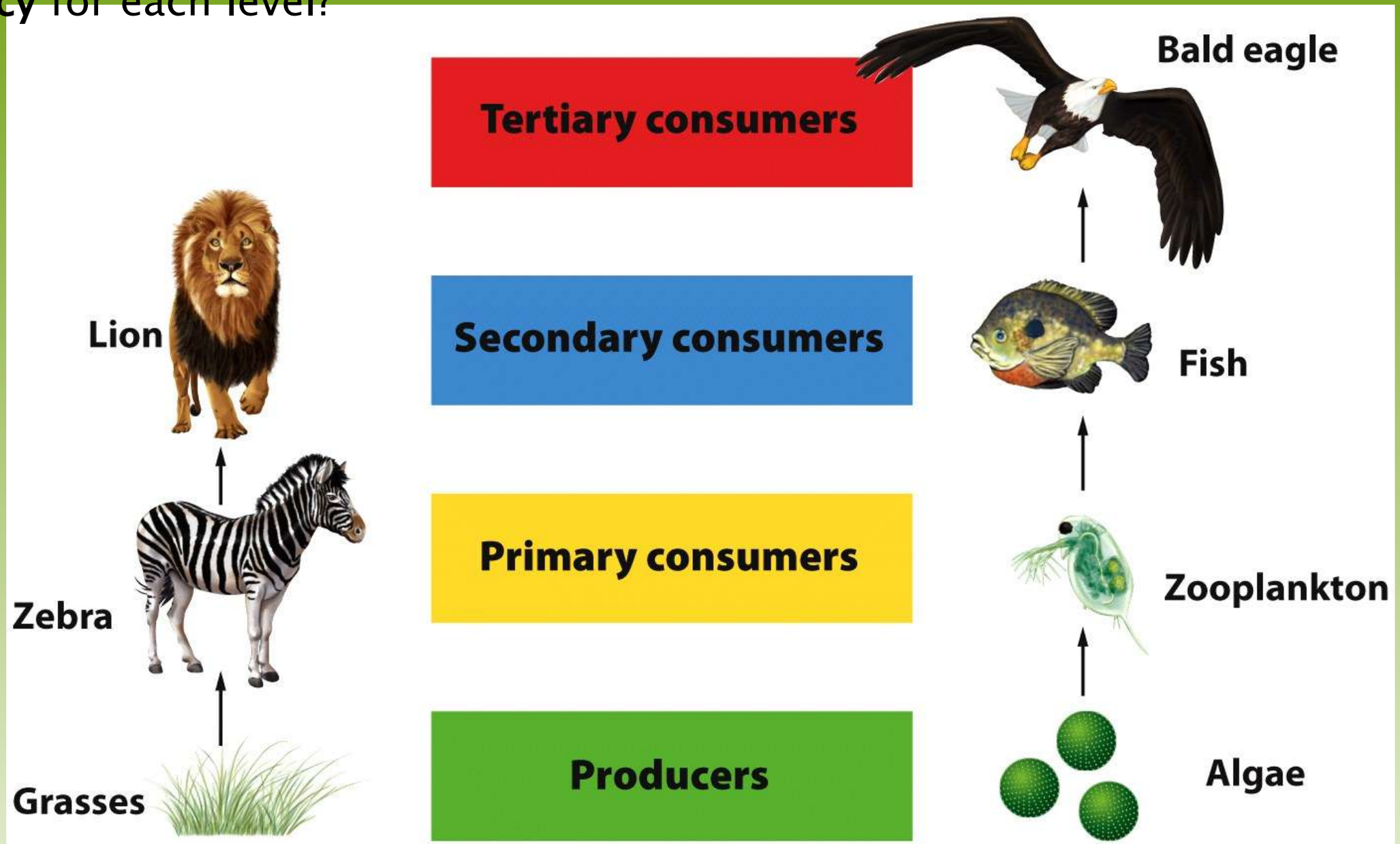


Figure 3.5
Environmental Science

Do the Math
Trophic Pyramid
10% Ecological Efficiency

Actual ecological efficiencies range from 5 – 20% across different ecosystems.

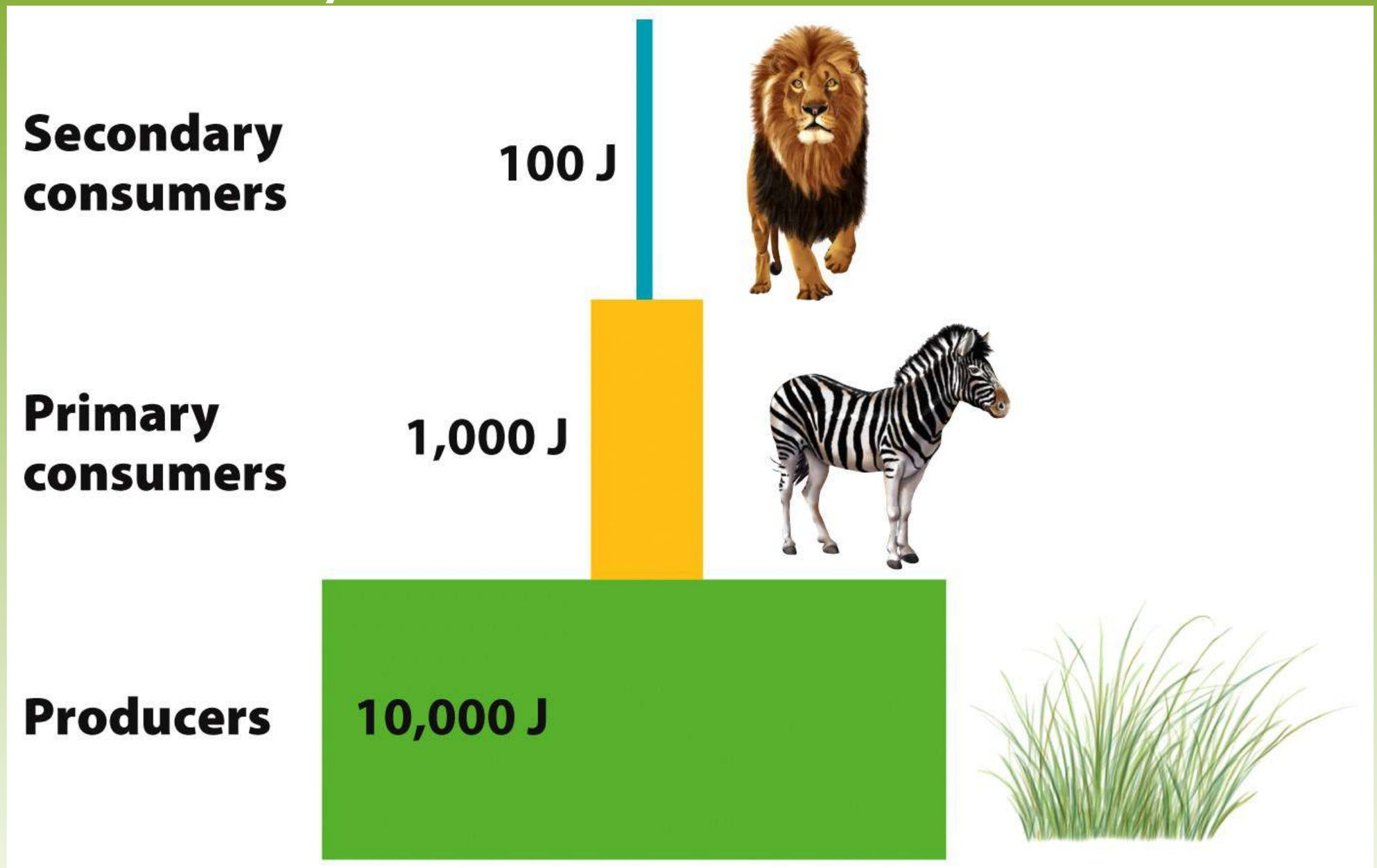


Figure 3.9
Environmental Science

Problem # 2

Using the given pyramid of energy flow, calculate the amount of energy that moves through each trophic level. Start with the first trophic level grass at 100,000 kcals.

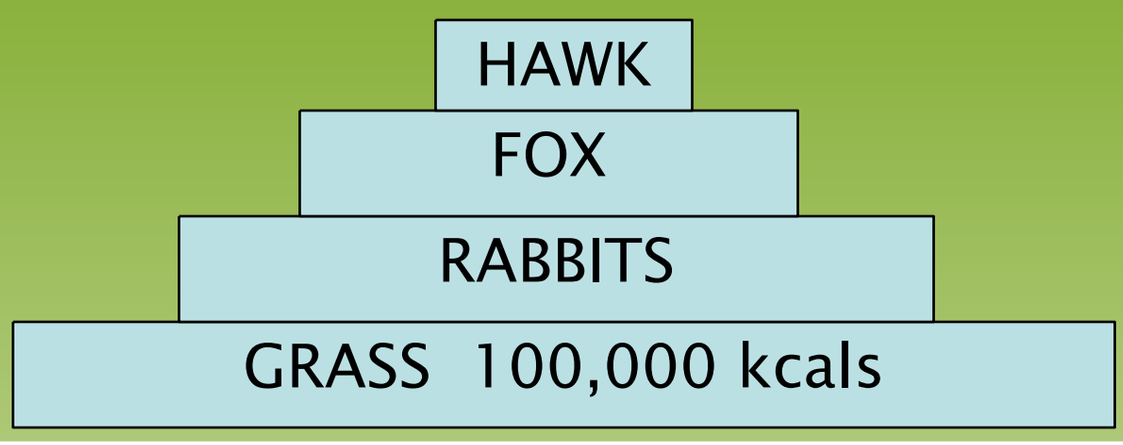


Table showing the transfer of energy through each trophic level

Between trophic levels	Percentage of energy efficiency	Energy in kcals that moves to the next trophic level?	
		Calculation	Rounded answer
Grass to Rabbits	12% efficiency		
Rabbits to Fox	14% efficiency		
Foxes to Hawks	8% efficiency		

Energy Efficiency through trophic levels

Table showing the transfer of energy through each trophic level

Between trophic levels	Percentage of energy efficiency	Energy in kcals that moves to the next trophic level?	
		Calculation	Rounded answer
Grass to Rabbits	12% efficiency		**12,000 kcals**
Rabbits to Fox	14% efficiency	1,680	**1700 kcals**
Foxes to Hawks	8% efficiency	134.4	**130 kcals**

The Carbon Cycle

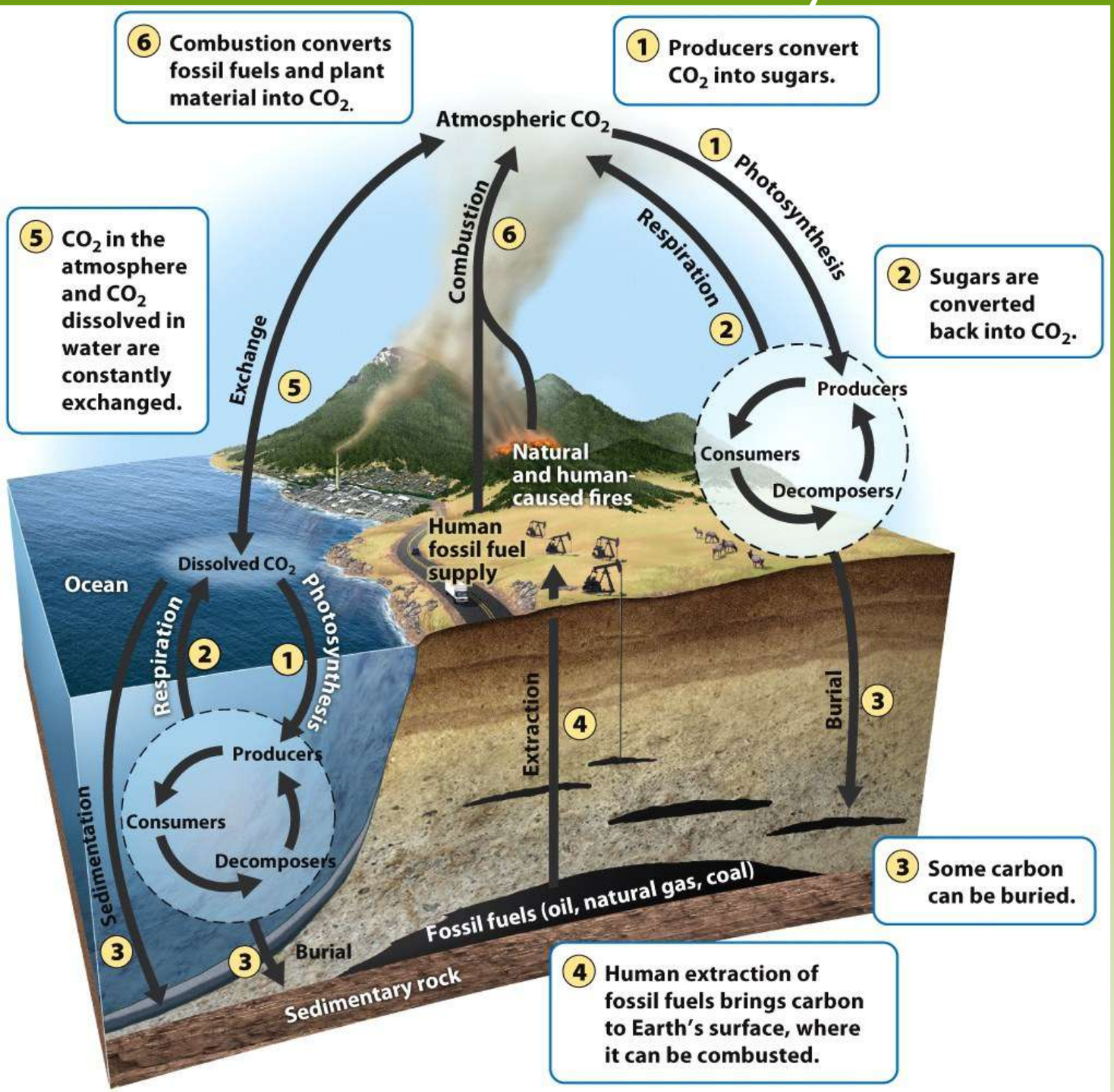


Figure 3.11
Environmental Science

- **Producers** take up Carbon from the atmosphere through CO2 during Photosynthesis and it moves up the trophic level to consumers.
- **Decomposers** also absorb CO2 during decomposition.
- Inorganic carbon **sediments** out of water to form sedimentary rock.
- Organic carbon can be **buried** and become fossil fuels.
- **Respiration** by organisms returns carbon back to the atmosphere and water.
- **Burning** of Fossil fuels – **combustion**, **released** CO2 back into the Atmosphere or water also.

2/11 Agenda

- WU
- Timeline due tomorrow
- Finish Excel Project
- Notes CH 3
- Nitrogen Fixation Game
- FRQ – Cycles (Carbon or Nitrogen)
- Quiz tomorrow CH 3 & 4

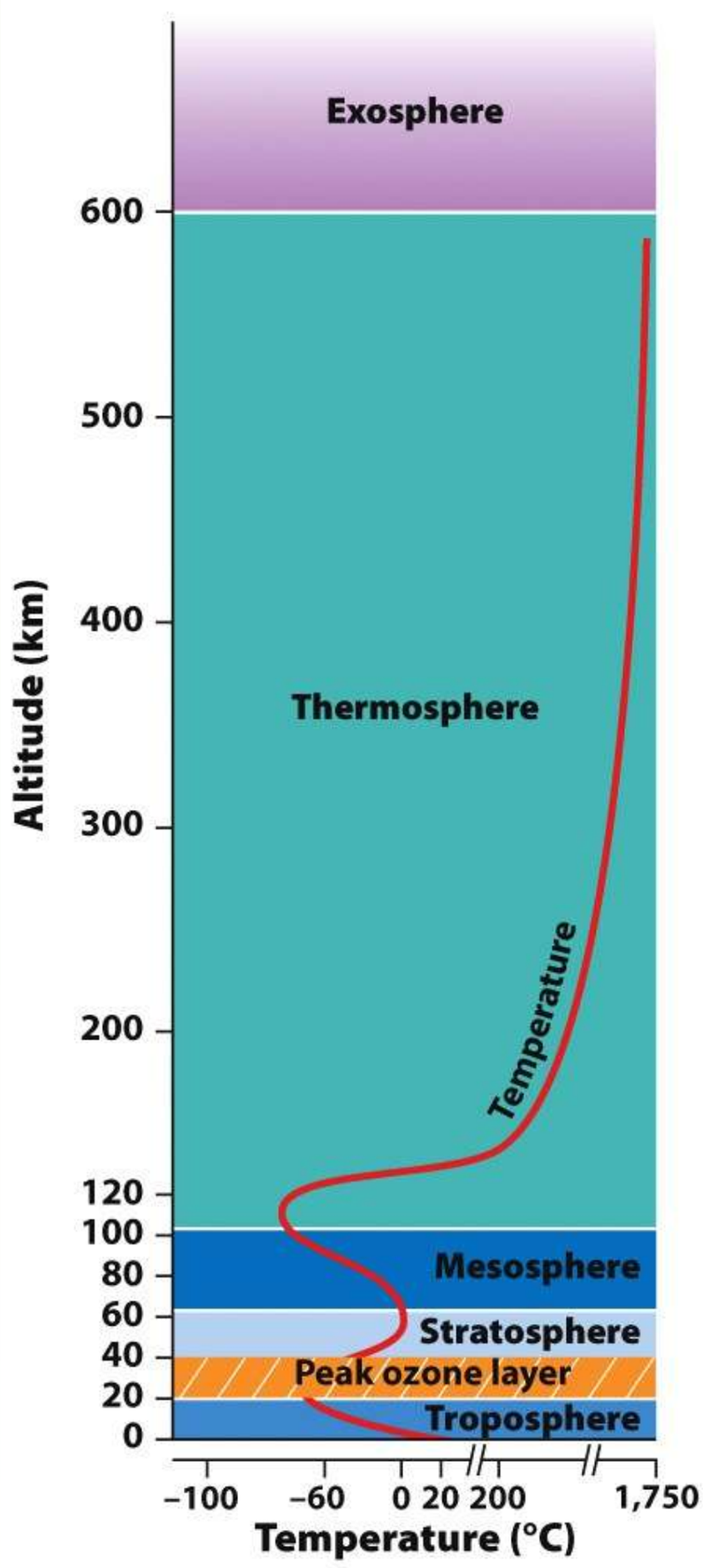
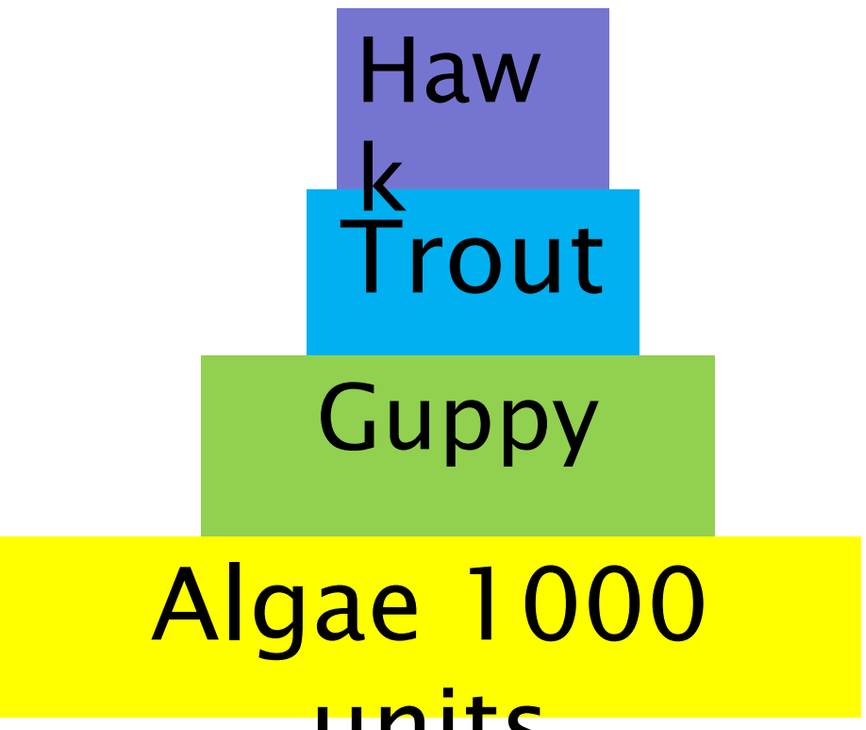


Figure 4.1
Environmental Science

9/15 Cycles in Nature CH 3

Obj. TSW learn the steps to the Carbon and Nitrogen Cycles by participating in a Nitrogen cycle game. P.40NB



1. List the four Biogeochemical cycles

2. List the 5 steps in the Nitrogen cycle with the products for each.

3. Calculate the Ecological efficiency of this ecosystem. 14% efficiency from P->C1, 15%efficiency from C1 -> C2, 8% efficiency from C2->C3

9/15 CH 3 & 4
Obj. TSW learn about ch 3 and 4
NB pg. 40

- 1. List the four Biogeochemical cycles
- 2. Calculate the Ecological efficiency of this ecosystem. 14% efficiency from P->C1, 15%efficiency from C1 -> C2, 8% efficiency from C2->C3
- 3. Compare & contrast Desert and Rainforest Biome with respect to temperature, precipitation and species.

Haw
k

Trout

Guppy

Algae 1000 units

Matter cycles through the biosphere

- **Biosphere-** The combination of all ecosystems on Earth; Region of our planet where life resides

- **Biogeochemical cycles-** The movement of matter within and between ecosystems involving:
  - 1. Biological 2. Geological 3. Chemical processes

- Refer to components that contain the matter (air, water, and organism) as **pools**

- Process that move matter between pools are known as **flows:**
  - **Hydrologic Cycle, Carbon Cycle, Nitrogen Cycle, Phosphorus Cycle**

Variations in Climate Determine the Dominant Plant Growth Forms of Terrestrial Biomes

- Climate affects the distribution of species around the globe.

- Organisms possess distinct growth forms due to adaptations to local temperature and precipitin patterns.

- Biomes- The presence of similar plant growth forms in areas possessing similar temperature and precipitation patterns.

Biomes

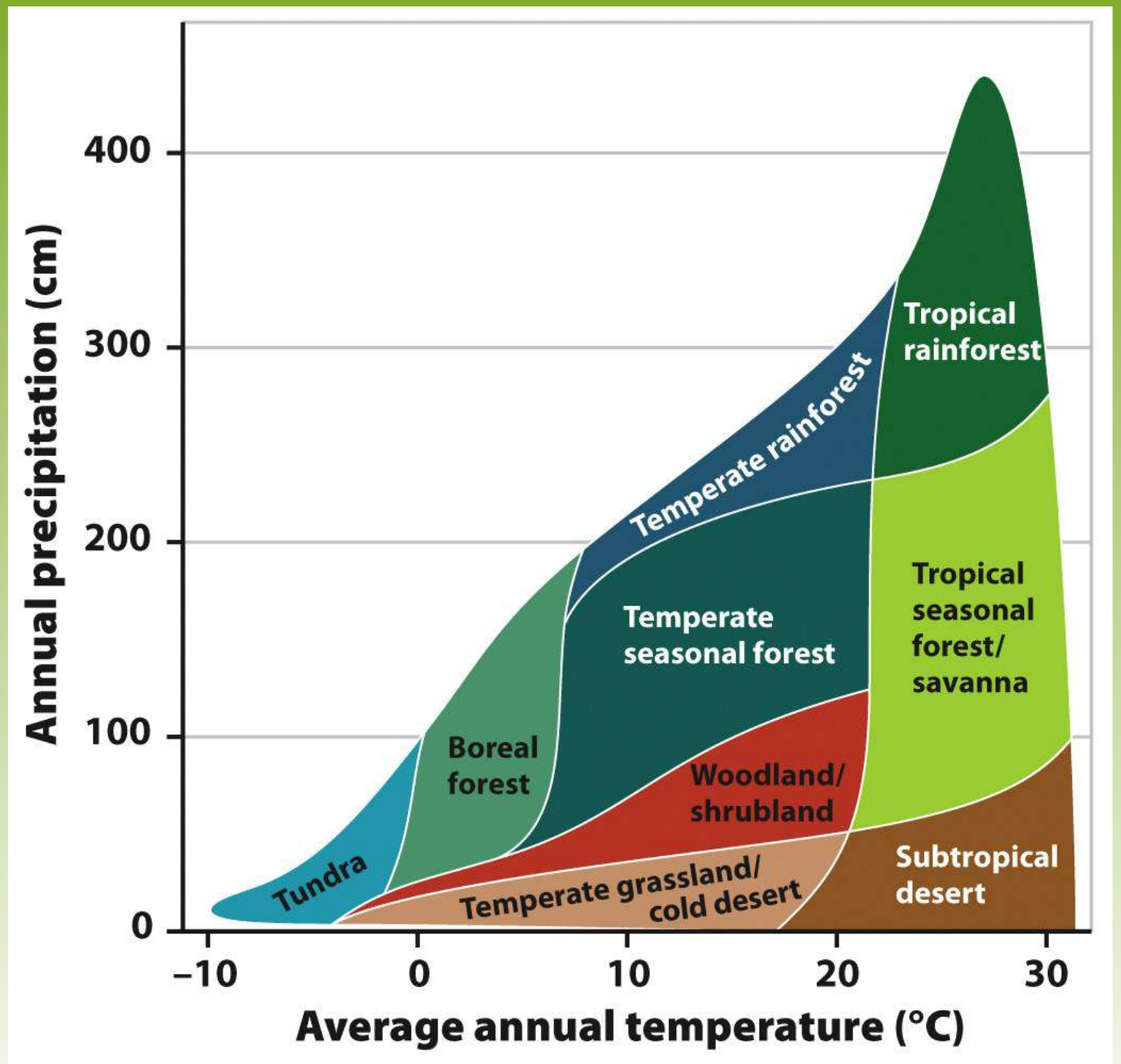


Figure 4.16
Environmental Science

Biomes are characterized by the amount of **precipitation** and **temperature.**

Desert vs. Rainforest

- **Desert**:
  - Large temperature variation: COLD at Night, HOT during day
  - Small amount of precipitation
- **Rainforest**:
  - Small temperature variation
  - Lots of precipitation

Temperate Grassland/Cold Desert

- This biome has the lowest average annual precipitation of any temperate biome.
- These are found in the Great Plains of North America, in South America, and in central Asia and eastern Europe.
- Cold, harsh winters and hot, dry, summers characterize this biome.
- Plant growth is constrained by both insufficient precipitation in summer and cold temperatures in winter.
- Plants include grasses and non woody flowering plants that are well adapted to wildfires and frequent grazing by animals.

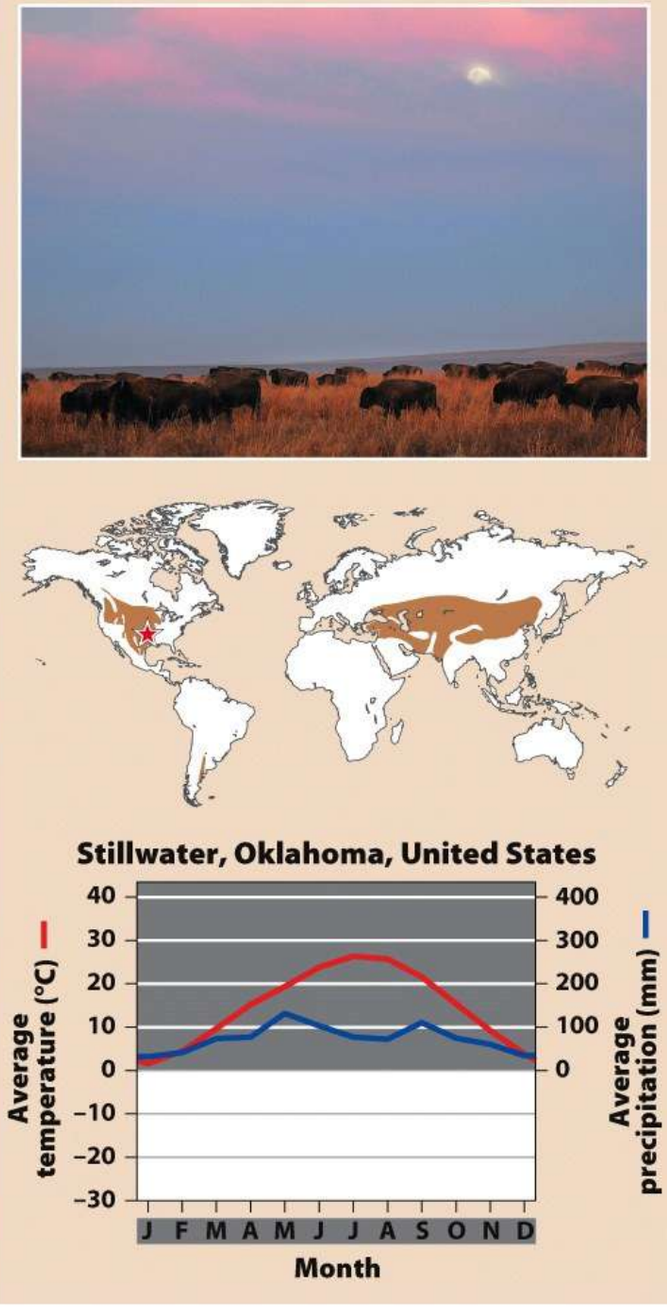


Figure 4.24
Environmental Science

Tropical Rainforest

- In the tropics, average annual temperatures exceed 20°C.
- This biome is located approximately 20° N and S of the equator.
- They are found in Central and South America, Africa, Southeast Asia, and northeastern Australia.
- Precipitation occurs frequently and this biome is warm and wet with little temperature variation.
- Tropical rain forests have more biodiversity per hectare than any other terrestrial biome and contain up to two-thirds of Earth's terrestrial species.

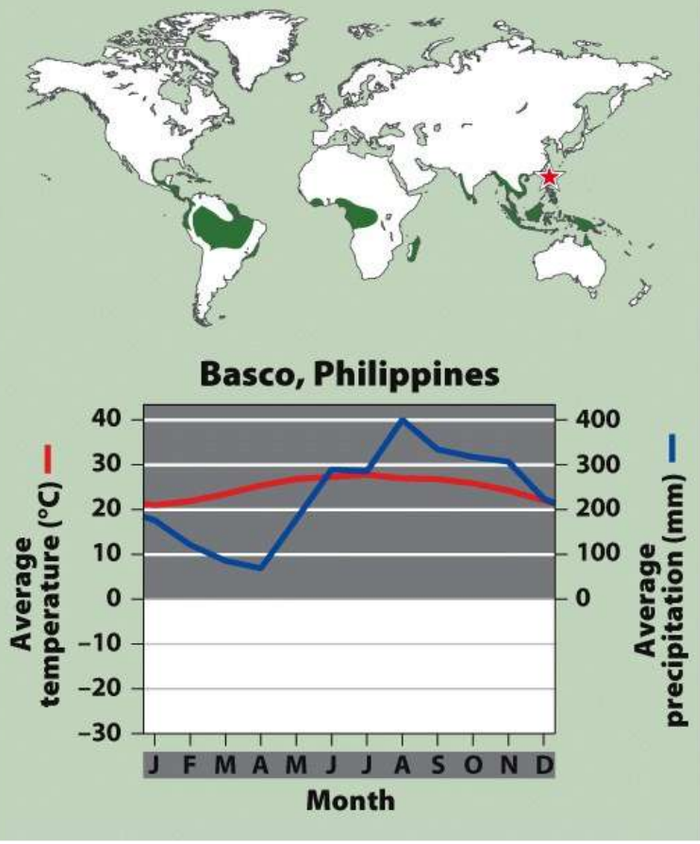
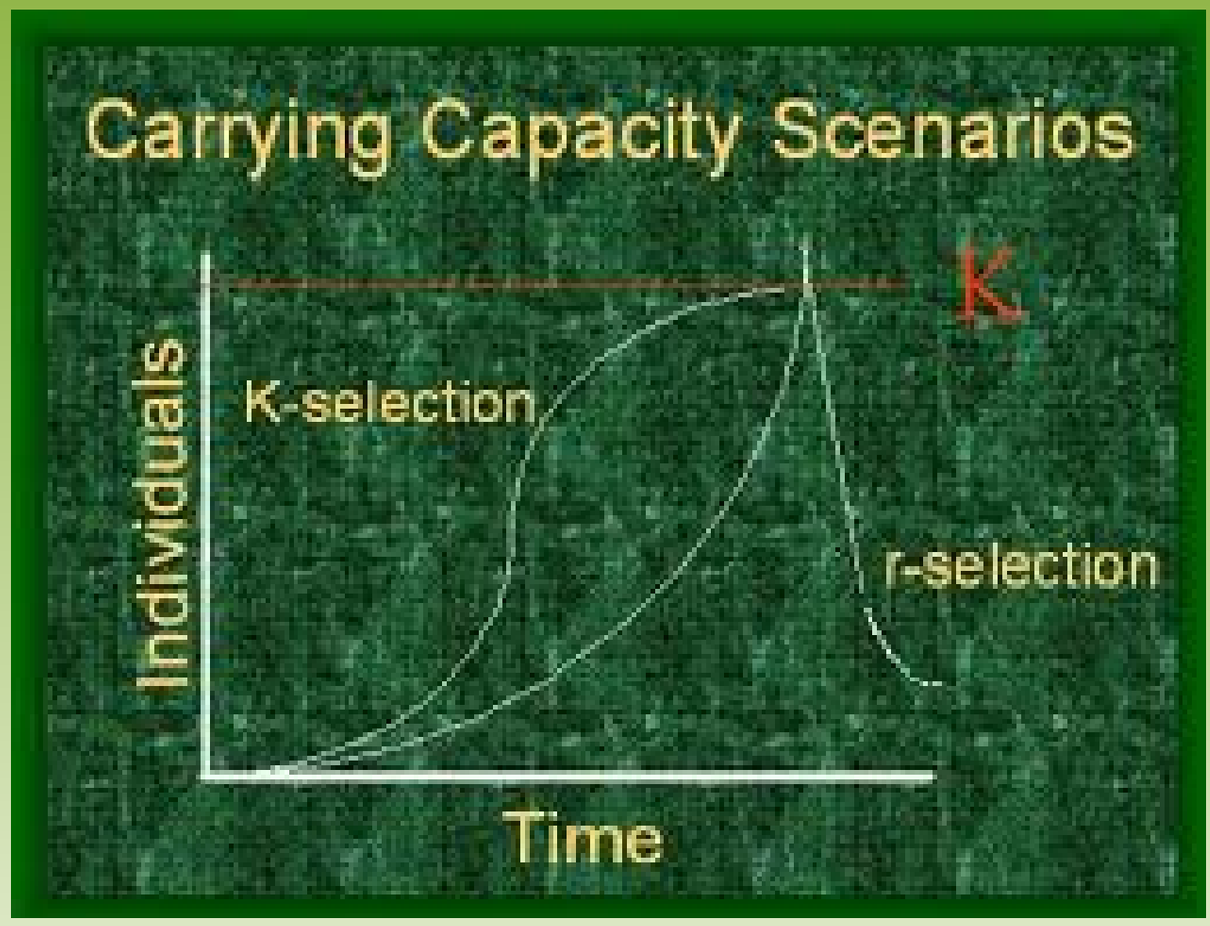


Figure 4.25
Environmental Science

Carry Capacity (CH. 6 Preview)

- The max. # of individuals of a given species that an area's resource can sustain indefinitely w/o sig. depleting or degrading those resources (K)
  - Will vary based on the species & resources avail. In habitat
- Knowing K for a species, what its limiting resource is, helps us predict how many individuals an environment can sustain



Oh, Deer! Activity – Include in your Project

What do you think happens to a population when resources change?

- ½ of you will start as **RESOURCES**; ½ of you start as **DEER.**
  - Each generation the **resources** choose if you are "**water**," "**food**," or "**shelter.**"

Water = hands on throatFood = hands on stomach Shelter = make a tent shape with hands

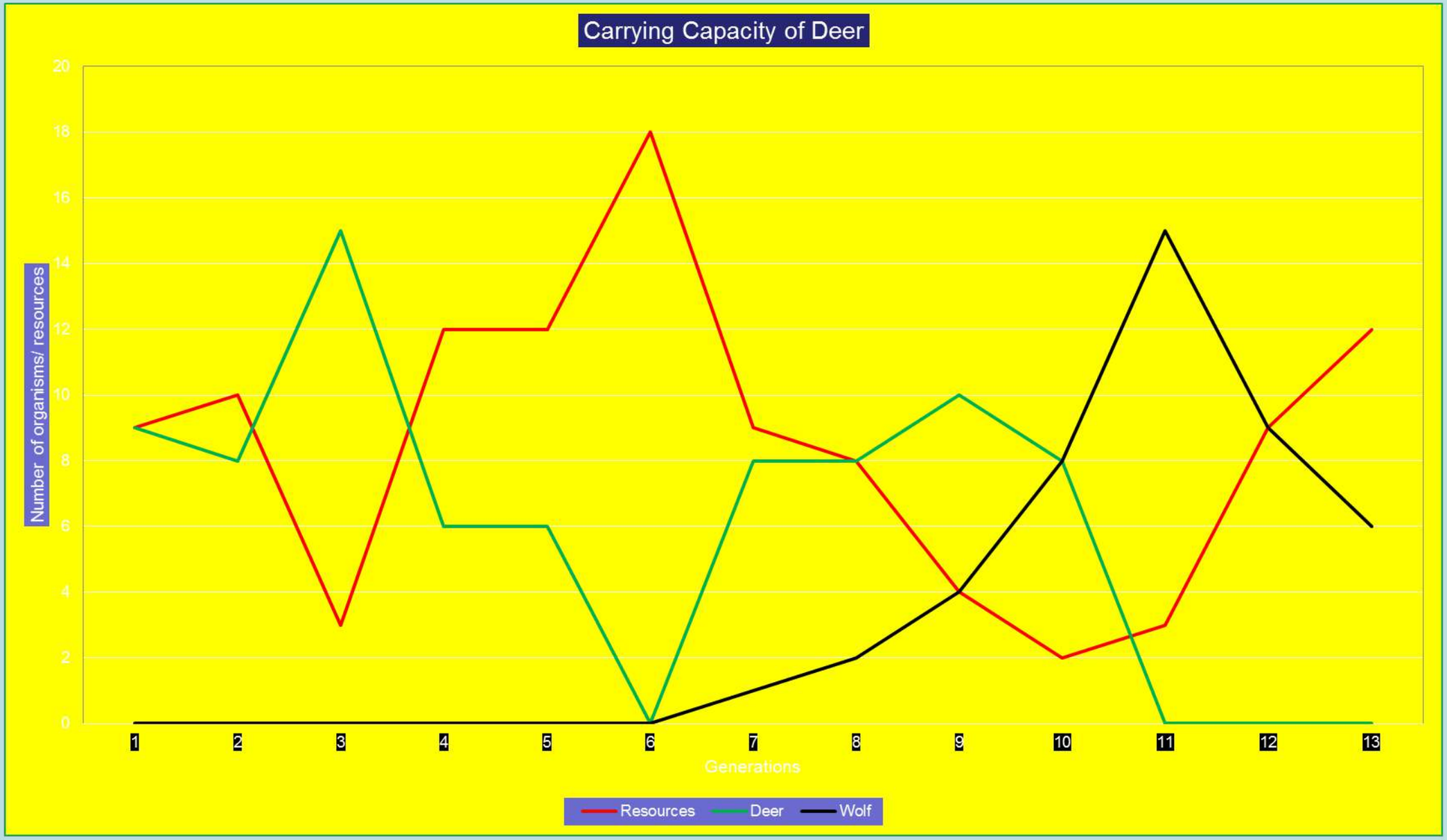
  - Each generation the **deer** choose if you're searching for "**water**," "**food**," or "**shelter.**"

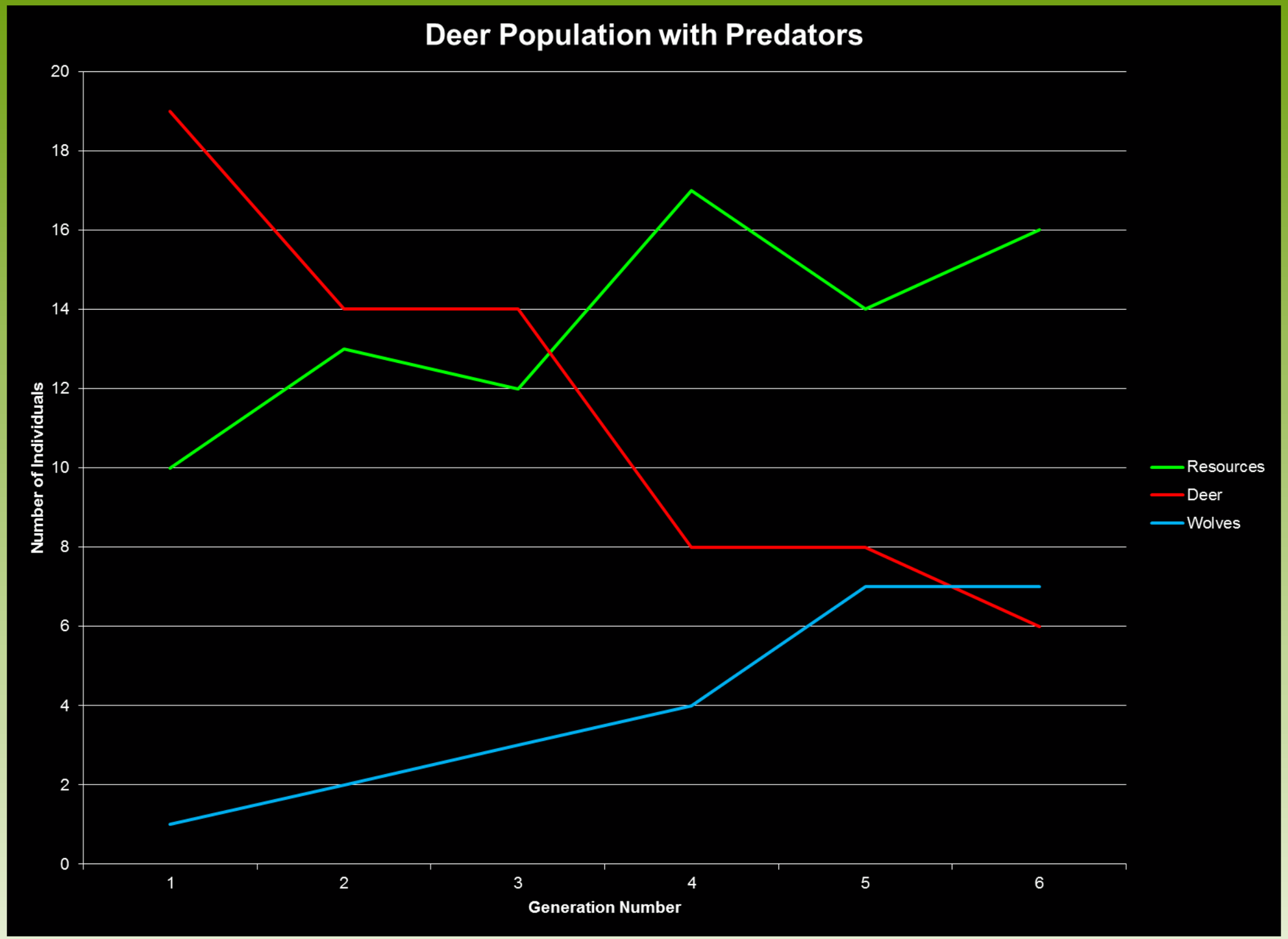
Water = hands on throatFood = hands on stomach Shelter = make a tent shape with hands

All deer and all resources will start in lines facing AWAY from each other.

- When we say go, deer will race to get to the resource they need! **NO CHEATING**! **Stick to the resource that you started with**!
- If a deer "catches" the resource that they were looking for, the resource they caught becomes a deer for the next generation! (The deer that got the resource "reproduced" and the resource became its offspring).
- **If a deer does NOT get the resource** they were looking for, **they die.** ☹ Any dead deer become a resource during the next generation.
- Before each generation we will record the # of deer and the # of resources, and see what happens over time!
- **Predators!** One person will be **the Wolf.** The Wolf will stand in the middle between the resources & the deer. If the wolf catches you then you become a wolf also.
- Environmental Impact: Fire?, Flood?, Clear Cutting

Carrying Capacity

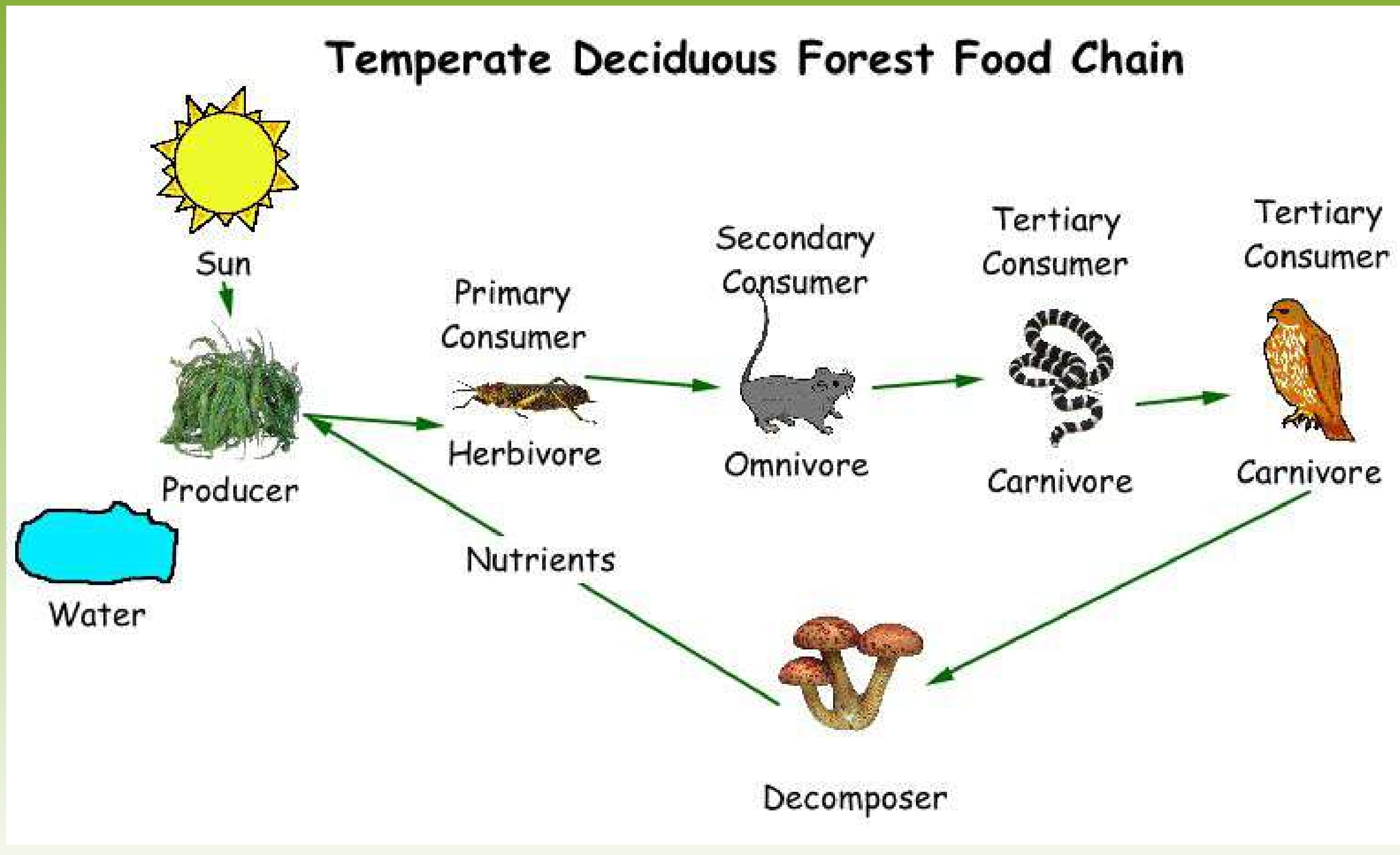



Deer Population with Predators
Number of Individuals
20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
Generation Number
Resources
Deer
Wolves

Ecosystem Boundaries

- Some ecosystems, such as a caves and lakes have very distinctive boundaries. However, in most ecosystems it is difficult to determine where one ecosystems stops and the next begins.
- Even though it is helpful to distinguish between two different ecosystems, ecosystems interact with other ecosystems.

Energy Flows through Ecosystems



Trophic Levels, Food Chains, and Food Webs

- Consumers (heterotrophs)- obtain energy by consuming other organisms.
- Primary Consumers (herbivores)- consume producers.
- Secondary Consumers (carnivores)- obtain their energy by eating primary consumers.
- Tertiary Consumers (carnivores)- eat secondary consumers.

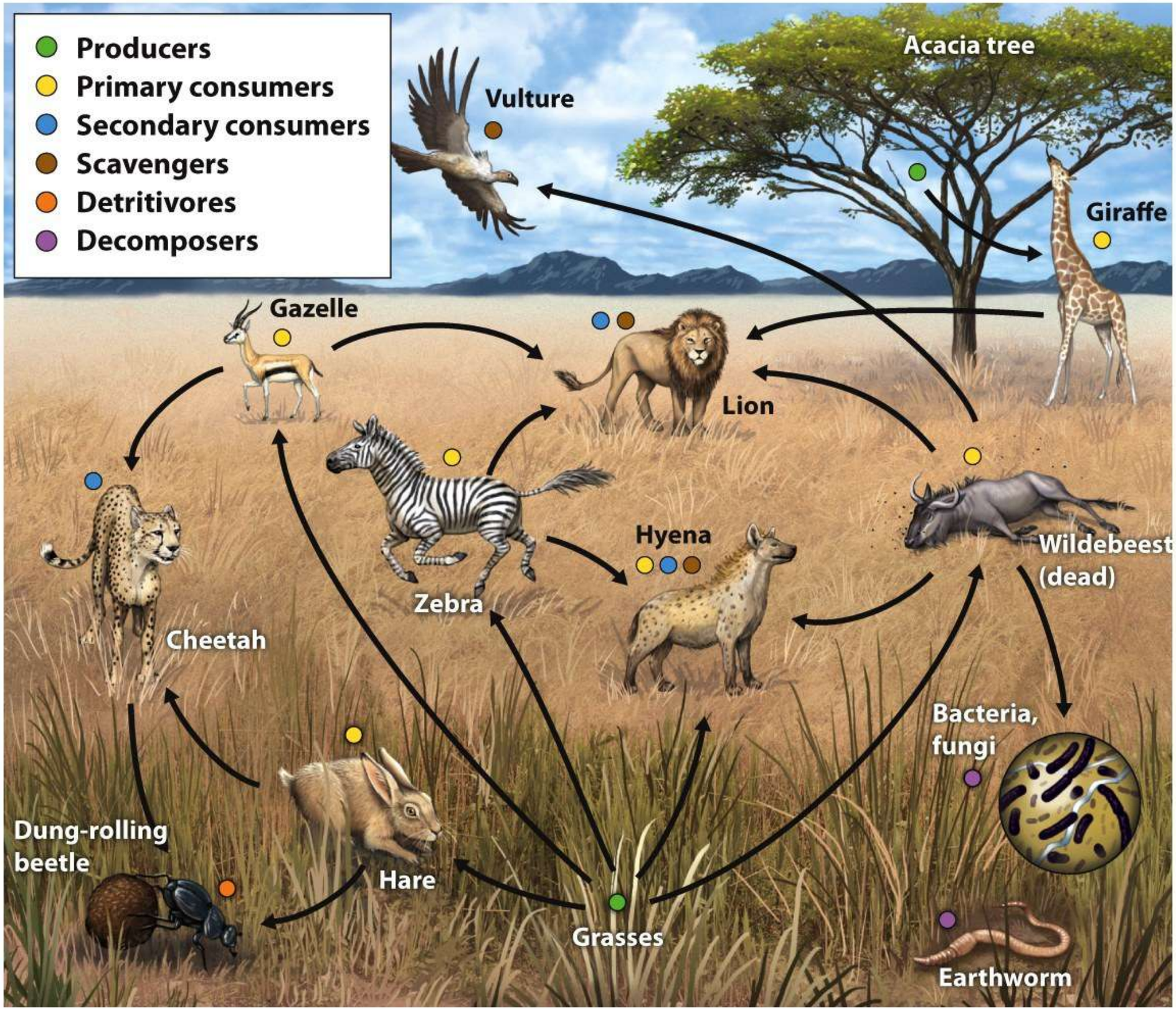


Figure 3.6
Environmental Science

The Hydrologic Cycle The movement of water through the biosphere.

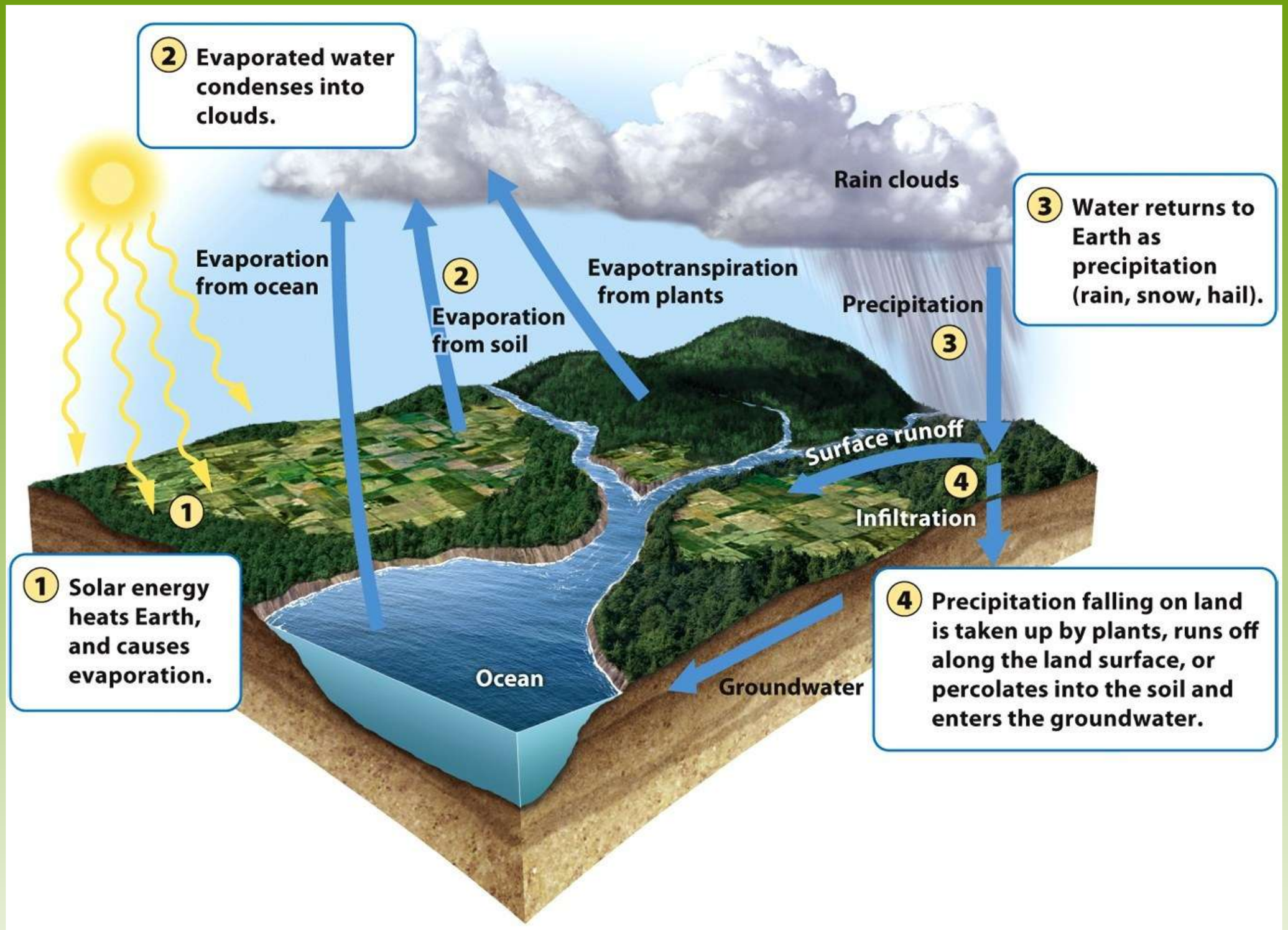


Figure 3.10
Environmental Science

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.

Agenda 9/9

1. Warm up
2. Concept Map
3. Ch 5 Study Guide
4. Activity: Ecosystems, Energy Pyramid/ Trophic Levels
5. Pass out Study Guide for tomorrow's Quiz
6. Go over Test Questions
7. Review Ecosystem Project

9/9 Ecosystems, Energy, & Biodiversity CH 3 & 4

Obj. TSW learn about how energy flows through the biotic and abiotic parts of an ecosystem to prepare for their Quiz tomorrow.

P. 30 NB

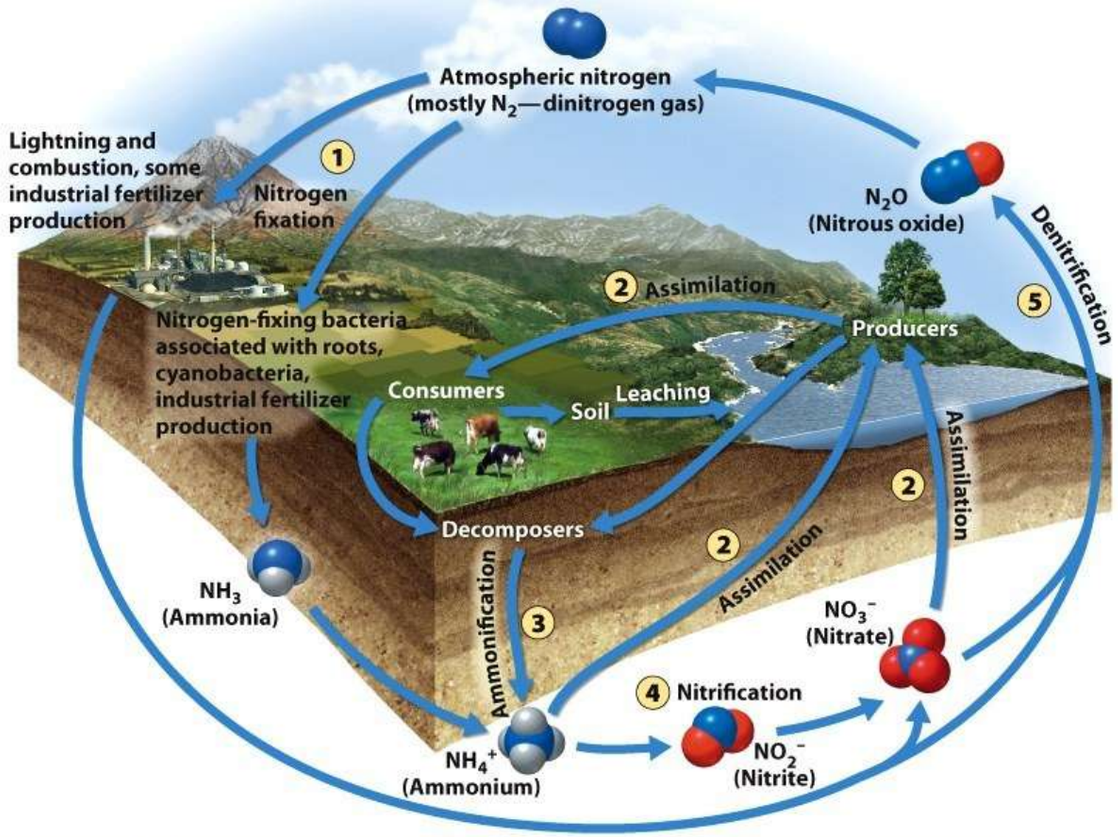
Draw a food web using the following organisms: Grey Whale, phytoplankton, Sea Weed, algae, snail, Sea Otter, Shark

Draw an energy Pyramid using the above organisms, label each trophic level.

Does this Ecosystem have Biological Diversity? Why or Why not?

http://library.thinkquest.org/11353/ecosystems.htm

The Nitrogen 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).
				

PROCESS	PRODUCT
Fix – Nitrogen Fixation	**A**mmonia
Nitrification	**N**itrates
Assimilation	**P**roteins
Ammonification	**A**mmonia
Denitrification	**N**itrogen

Figure 3.12
Environmental Science

The Phosphorus Cycle

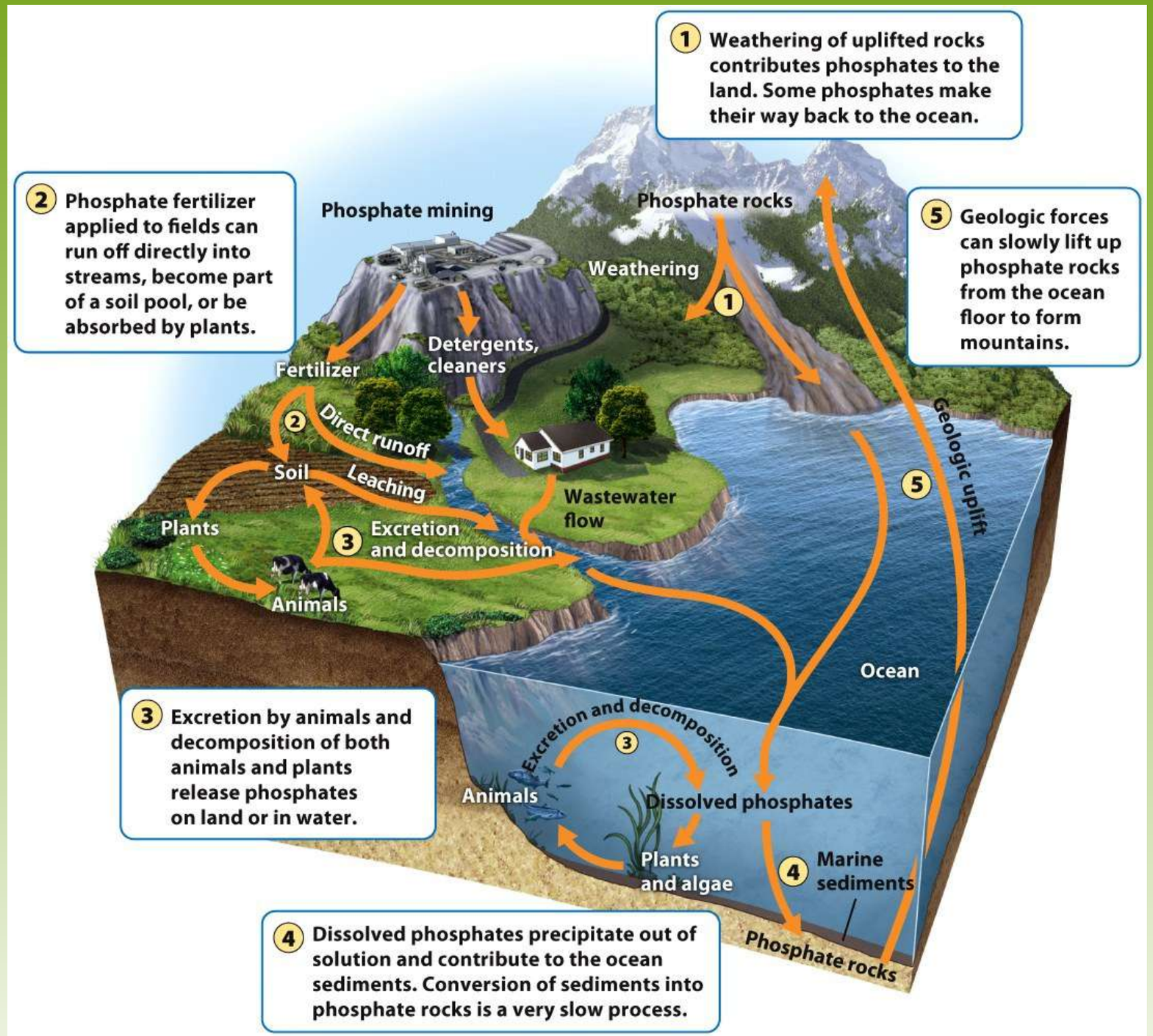


Figure 3.13
Environmental Science

No atmospheric form of Phosphorus

Ecosystems respond to disturbance

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

- Natural and anthropogenic disturbances.

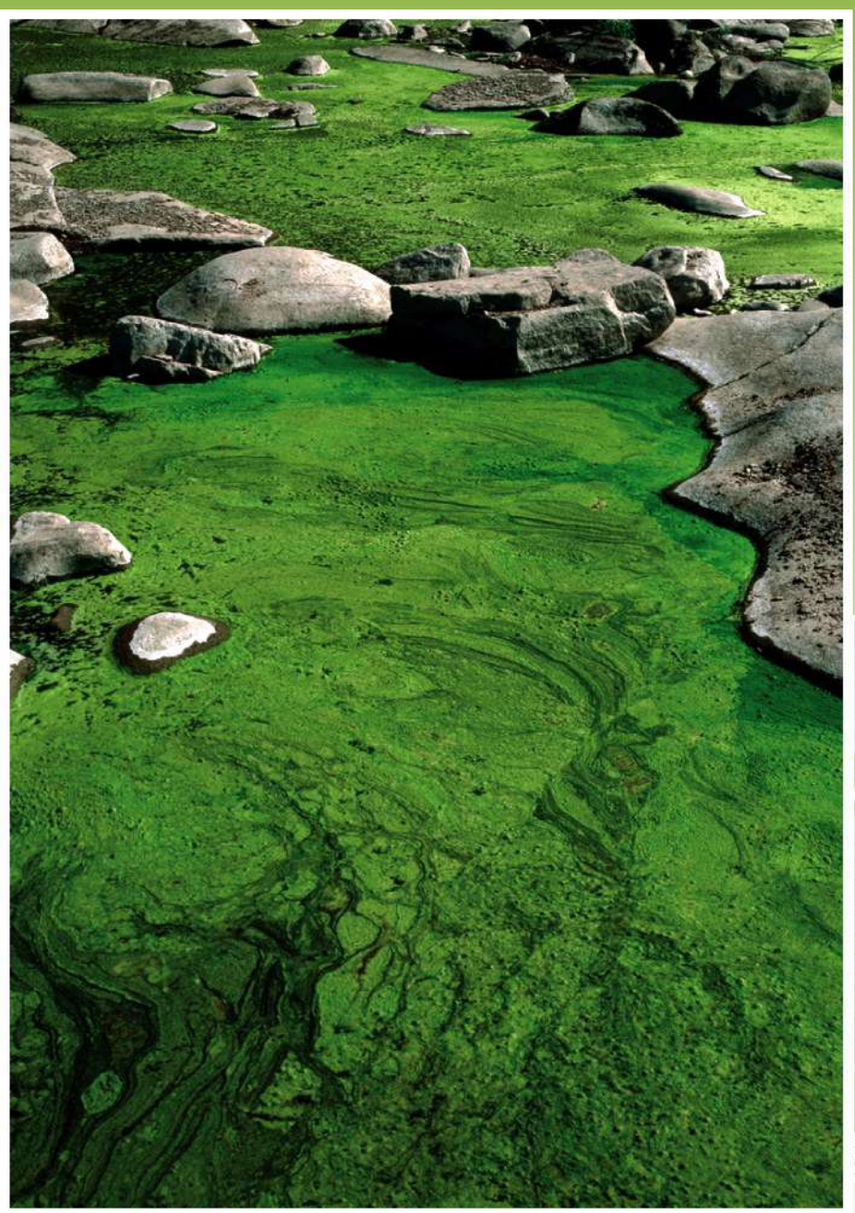


Figure 3.14
Environmental Science

Algal Bloom – excess phosphorus enters waterways, increases Algal growth, eventually they die because they consume all the nutrients, increasing decomposition, this decreases the O_2 content that triggers a die off of fish and shell fish, resulting in decreased biodiversity in the ecosystem.

Before hurricane KatrinaAfter hurricane Katrina

Figure 3.15a
Environmental Science

Figure 3.15b
Environmental Science

Watershed Studies

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

•What watershed are you familiar with?
•How does that Watershed impact you?

Figure 3.16
Environmental Science

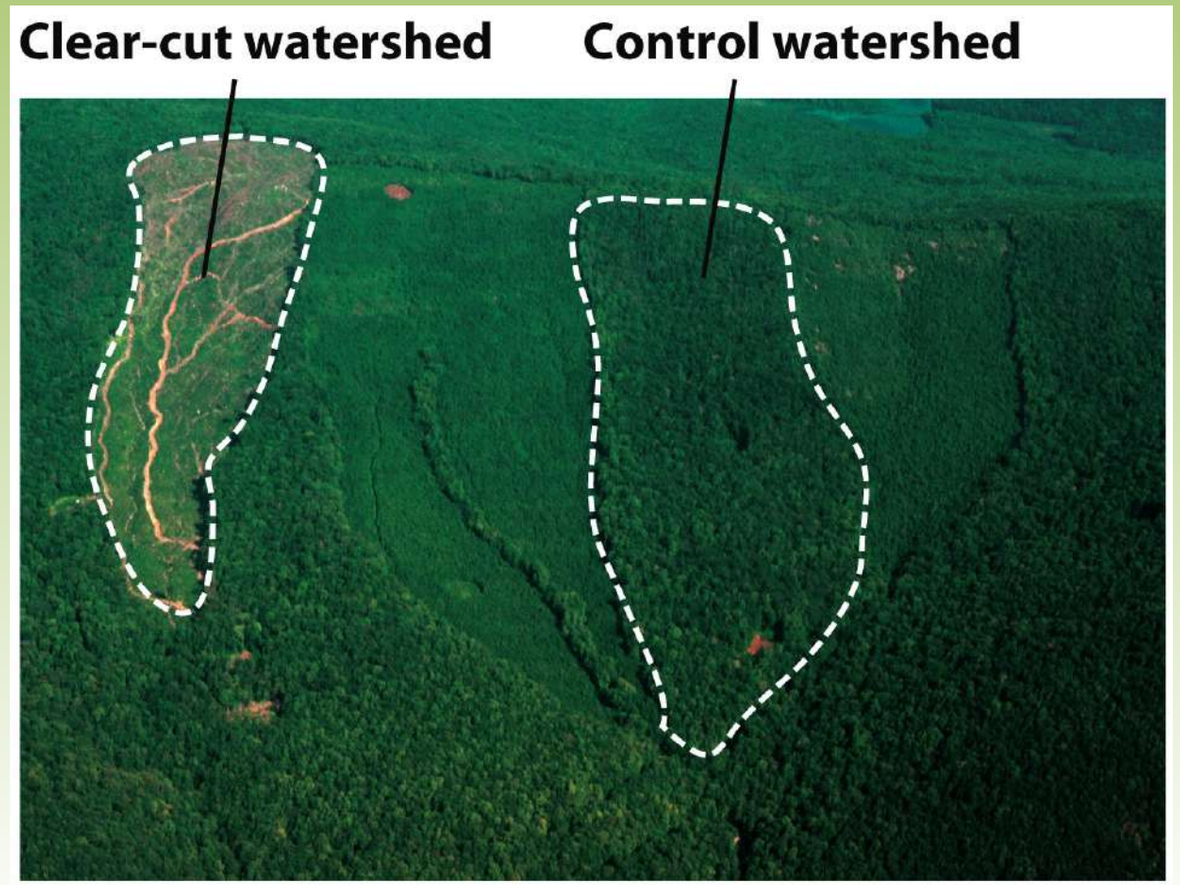


Figure 3.17
Environmental Science

Disturbance at a Watershed

How is it important for trees to retain nutrients in the soil?

What are the results to the Ecosystem when clear-cutting happens?

Resistance versus Resilience

- Resistance- A measure of how much a disturbance can affect its flows of energy and matter.

- Resilience- The rate at which an ecosystem returns to its original state after a disturbance.

- Restoration ecology- A new scientific discipline that is interested in restoring damaged ecosystems.

Figure 3.18a
Environmental Science

Wetland restoration
Original Wetland was destroyed due to drainage.
New Wetland created by using heavy machinery.

Figure 3.18b
Environmental Science

The Intermediate Disturbance Hypothesis

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

Disturbance affects Biodiversity

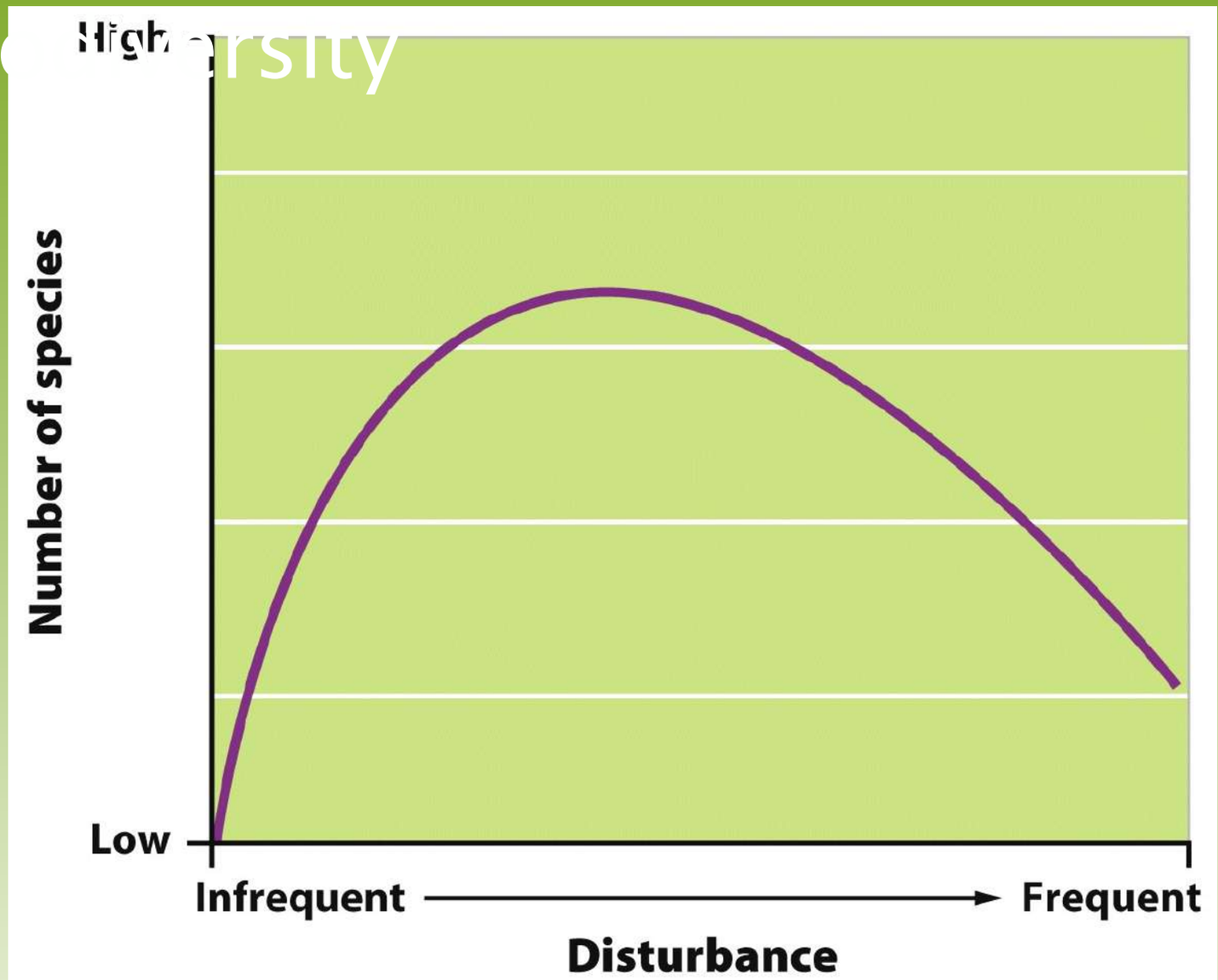


Figure 3.19
Environmental Science

Ecosystems Provide Valuable Services

Can you name some?

What are some intrinsic values of species?

Figure 3.22
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- Pollinators
- Species Diversity
- Resilience

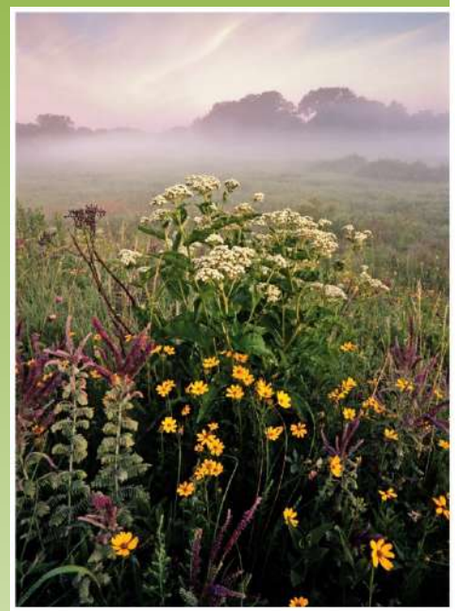

Figure 3.23
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Pacific Yew
Contains a chemical that has anticancer properties.

Figure 3.20
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Figure 3.21
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Tropical Rainforests play a major role in Carbon sequestration – absorbing CO_2

Grand Teton National Park

Figure 3.24
Environmental Science

Instrumental Values of Ecosystems

- **Provisions**- Goods that humans can use directly.

- **Regulating services-** The service provided by natural systems that helps regulate environmental conditions.

- **Support systems-** The support services that natural ecosystems provide such as pollination, natural filters and pest control.

- **Resilience-** Resilience of an ecosystem ensures that it will continue to provide benefits to humans. This greatly depends on species diversity.

- **Cultural services-** Ecosystems provide cultural or aesthetic benefits to many people.

How can we lower our Carbon footprint?

Figure 3.25
Environmental Science

- Making Golf Courses more Sustainable
- Increase biodiversity of plant species.
- Drought tolerant species
- More legumes so fertilizer is not used as much to decrease runoff and eutrophication of waterways.

Making a Data table & Graph with Excel p. 37NB

- What do you notice about the sequence of the data points?

- What are the layers called?

- How do you know?

Nitrogen Cycle Game

- Write on page 37 the steps you individually took through the Nitrogen cycle.
- Who visited the most organisms?'Who completed the most cycles?
- Who completed the longest cycle?
- Who completed the shorted cycle?
- Who spends the longest time in the atmosphere?
- AXES Paragraph: Are nitrogen atoms ever created? Ever Destroyed? Ever changed into other kinds of atoms? Ever changed into other compounds? Why? Or Why not?
- Discuss the following processes: Nitrogen Fixation,

Working Toward Sustainability
p. 80 ESBK
p. 52 NB

- What are some inherent problems of maintaining a golf course?

- Discuss a solution that several groups developed to make Golf Greens “Greener”.