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- From the Chapter menu screen click on any lesson to go directly to that lesson’s presentation.
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End Of Slide

Chapter menu | Resources

Resources

Chapter Presentation

Image and Activity Bank

Transparencies

Standardized Test Prep

Table of Contents

End Of Slide

Objectives

- **List** two examples of ecological succession.
- **Explain** how a pioneer species contributes to ecological succession.
- **Explain** what happens during old-field succession.
- **Describe** how lichens contribute to primary succession.

End Of Slide

Life Depends on the Sun

- Energy from the sun enters an ecosystem when plants use sunlight to make sugar molecules.
- This happens through a process called photosynthesis.

Life Depends on the Sun

- **Photosynthesis** is the process by which plants, algae, and some bacteria use sunlight, carbon dioxide, and water to produce carbohydrates and oxygen.

End Of Slide

From Producers to Consumers

- Because plants make their own food, they are called *producers*.
- A **producer** is an organism that can make organic molecules from inorganic molecules.
- Producers are also called autotrophs, or self-feeders.

End Of Slide

From Producers to Consumers

- Organisms that get their energy by eating other organisms are called *consumers.*
- A **consumer** is an organism that eats other organisms or organic matter instead of producing its own nutrients or obtaining nutrients from inorganic sources.
- Consumers are also called heterotrophs, or other-feeders.

End Of Slide

From Producers to Consumers

- Some producers get their energy directly from the sun by absorbing it through their leaves.
- Consumers get their energy indirectly by eating producers or other consumers.

End Of Slide

An Exception to the Rule

- Deep-ocean communities of worms, clams, crabs, mussels, and barnacles, exist in total darkness on the ocean floor, where photosynthesis cannot occur.
- The producers in this environment are bacteria that use hydrogen sulfide present in the water.
- Other underwater organisms eat the bacteria or the organisms that eat the bacteria.

End Of Slide

What Eats What?

- Organisms can be classified by what they eat.

- Types of Consumers:
  - Herbivores
  - Carnivores
  - Omnivores
  - Decomposers

End Of Slide

Burning the Fuel

- An organism obtains energy from the food it eats.
- This food must be broken down within its body.
- The process of breaking down food to yield energy is called **cellular respiration**.

End Of Slide

Burning the Fuel

- **Cellular Respiration** is the process by which cells produce energy from carbohydrates; atmospheric oxygen combines with glucose to form water and carbon dioxide.

- Cellular respiration occurs inside the cells of most organisms.

Burning the Fuel

- During cellular respiration, cells absorb oxygen and use it to release energy from food.
- Through cellular respiration, cells use glucose (sugar) and oxygen to produce carbon dioxide, water, and energy.

End Of Slide

Burning the Fuel

- Part of the energy obtained through cellular respiration is used to carry out daily activities.
- Excess energy is stored as fat or sugar.

Energy Transfer

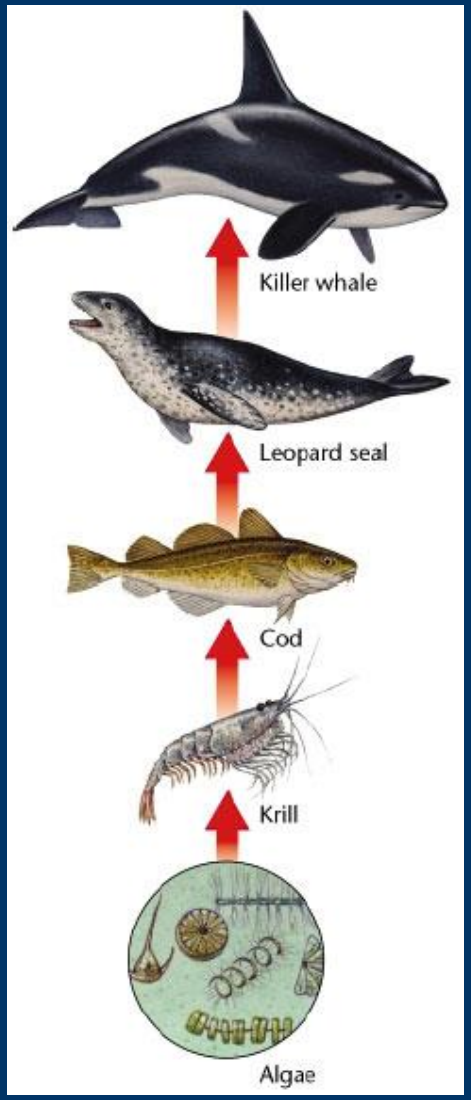
- Each time an organism eats another organism, an energy transfer occurs.
- This transfer of energy can be traced by studying food chains, food webs, and trophic levels.

End Of Slide

Food Chains

- A **food chain** is a sequence in which energy is transferred from one organism to the next as each organism eats another organism.

Food Chains

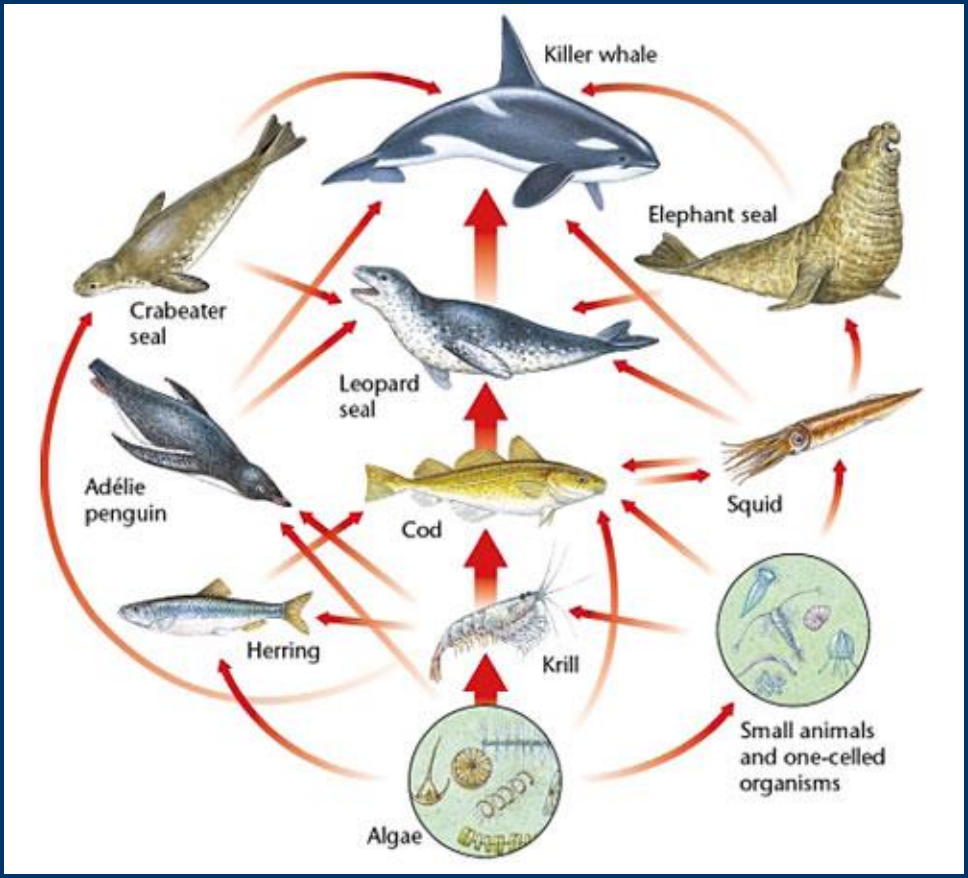


Food Webs

- Ecosystems, however, almost always contain more than one food chain.
- A **food web** shows many feeding relationships that are possible in an ecosystem.

End Of Slide

Food Webs



Trophic Levels

- Each step in the transfer of energy through a food chain or food web is known as a trophic level.
- A **trophic level** is one of the steps in a food chain or food pyramid; examples include producers and primary, secondary, and tertiary consumers.

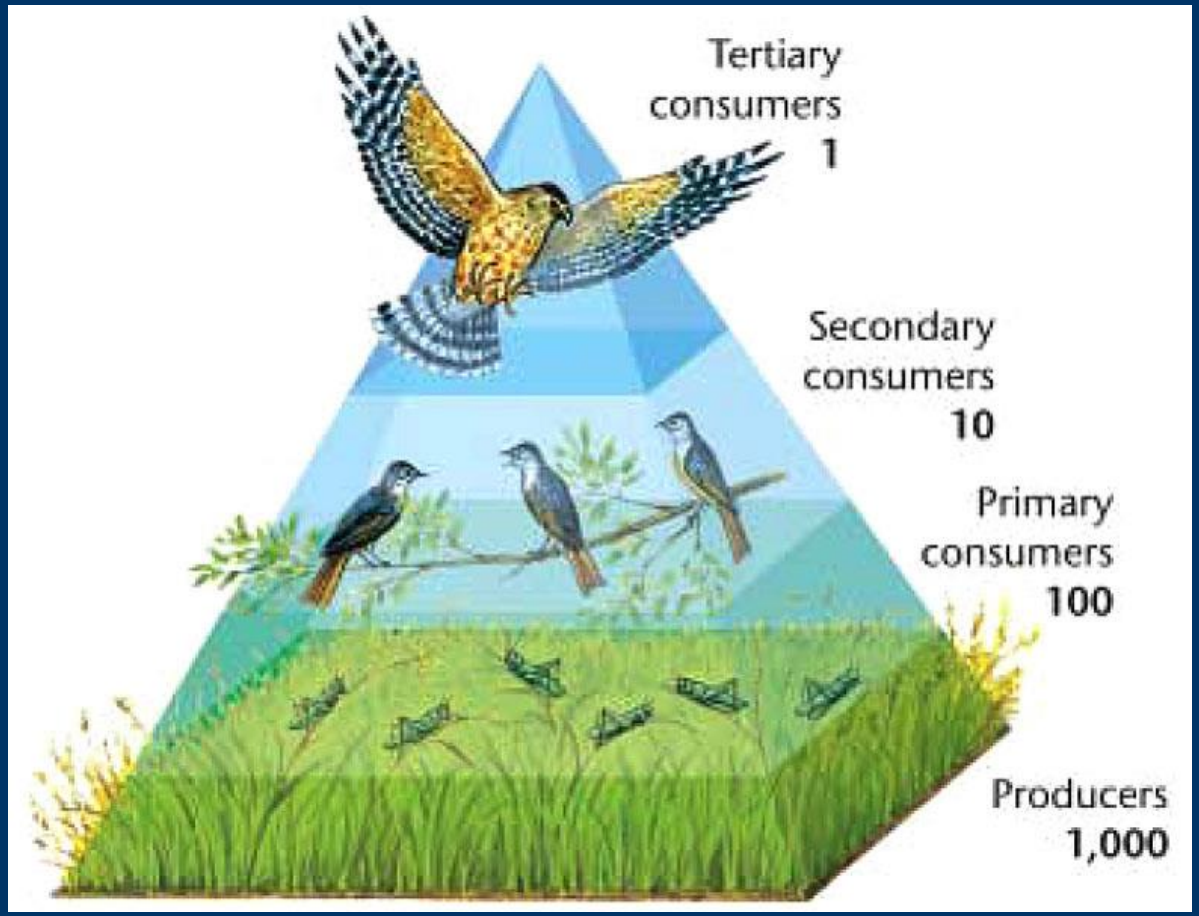
End Of Slide
Chapter menu
Resources

Trophic Levels

- Each time energy is transferred, some of the energy is lost as heat.
- Therefore, less energy is available to organisms at higher trophic levels.
- One way to visualize this is with an energy pyramid.

End Of Slide

Trophic Levels



Trophic Levels

- Each layer of the pyramid represents one trophic level.
- Producers form the base of the energy pyramid, and therefore contain the most energy.
- The pyramid becomes smaller toward the top, where less energy is available.

End Of Slide

Energy Loss Affects Ecosystems

- Decreasing amounts of energy at each trophic level affects the organization of an ecosystem.
  - Energy loss affects the number of organisms at each level.
  - Energy loss limits the number of trophic levels in an ecosystem.

End Of Slide

Objectives

- **List** the three stages of the carbon cycle.
- **Describe** where fossil fuels are located.
- **Identify** one way that humans are affecting the carbon cycle.
- **List** the tree stages of the nitrogen cycle.
- **Describe** the role that nitrogen-fixing bacteria play in the nitrogen cycle.
- **Explain** how the excess use of fertilizer can affect the nitrogen and phosphorus cycles.

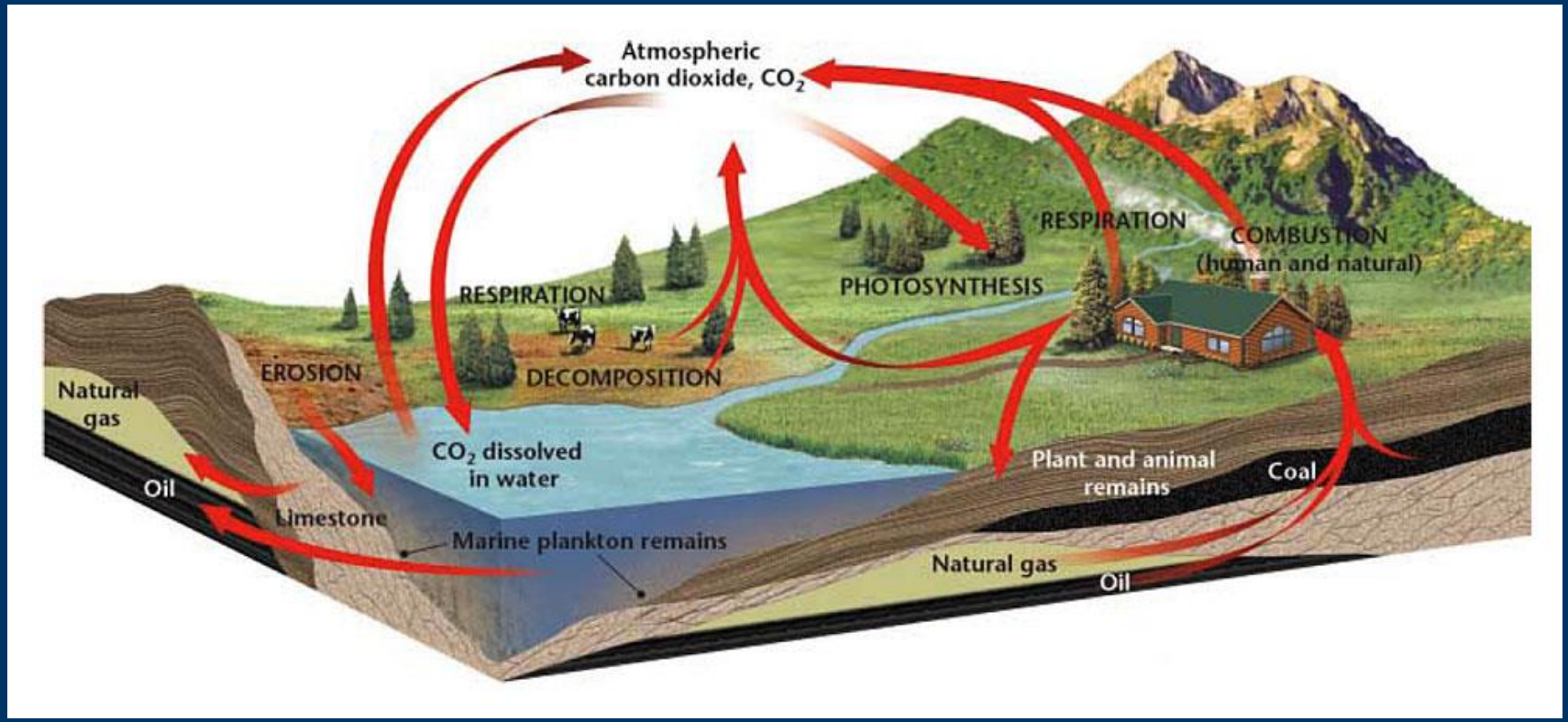
End Of Slide

The Carbon Cycle

- The **carbon cycle** is the movement of carbon from the nonliving environment into living things and back
- Carbon is the essential component of proteins, fats, and carbohydrates, which make up all organisms.

End Of Slide

The Carbon Cycle



The Carbon Cycle

- Carbon exists in air, water, and living organisms.
  - Producers convert carbon dioxide in the atmosphere into carbohydrates during photosynthesis.
  - Consumers obtain carbon from the carbohydrates in the producers they eat.

End Of Slide

The Carbon Cycle

- During cellular respiration, some of the carbon is released back into the atmosphere as carbon dioxide.
- Some carbon is stored in limestone, forming one of the largest “carbon sinks” on Earth.

End Of Slide

The Carbon Cycle

- Carbon stored in the bodies of organisms as fat, oils, or other molecules, may be released into the soil or air when the organisms dies.
- These molecules may form deposits of coal, oil, or natural gas, which are known as fossil fuels.
- Fossil fuels store carbon left over from bodies of organisms that dies millions of years ago.

End Of Slide

How Humans Affect the Carbon Cycle

- Humans burn fossil fuels, releasing carbon into the atmosphere.
- The carbon returns to the atmosphere as carbon dioxide.

End Of Slide

How Humans Affect the Carbon Cycle

- Increased levels of carbon dioxide may contribute to global warming.
- Global warming is an increase in the temperature of the Earth.

End Of Slide

The Nitrogen Cycle

- The **nitrogen cycle** is the process in which nitrogen circulates among the air, soil, water, plants, and animals in an ecosystem.
- All organisms need nitrogen to build proteins, which are used to build new cells.
- Nitrogen makes up 78 percent of the gases in the atmosphere.

End Of Slide

The Nitrogen Cycle

- Nitrogen must be altered, or fixed, before organisms can use it.
- Only a few species of bacteria can fix atmospheric nitrogen into chemical compounds that can be used by other organisms.
- These bacteria are known as “nitrogen-fixing” bacteria.

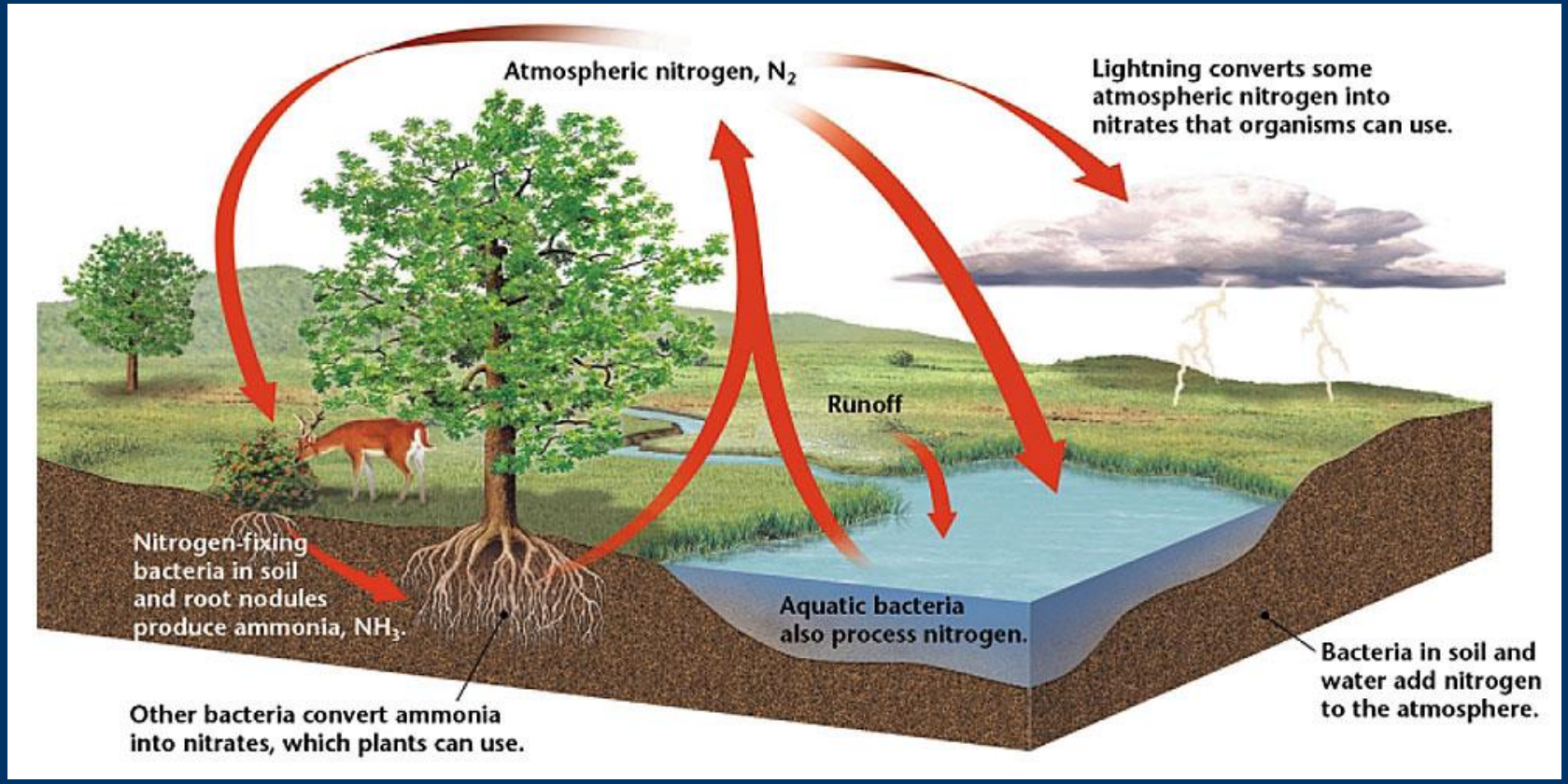
End Of Slide
Chapter menu
Resources

The Nitrogen Cycle

- **Nitrogen-fixing bacteria** are bacteria that convert atmospheric nitrogen into ammonia.
- These bacteria live within the roots of plants called legumes, which include beans, peas, and clover.
- The bacteria use sugar provided by the legumes to produce nitrogen containing compounds such as nitrates.
- Excess nitrogen fixed by the bacteria is released into the soil.

End Of Slide

The Nitrogen Cycle



Decomposers and the Nitrogen Cycle

- Nitrogen stored within the bodies of living things is returned to the nitrogen cycle once those organisms die.
- Decomposers break down decaying plants and animals, as well as plant and animal wastes.
- After decomposers return nitrogen to the soil, bacteria transform a small amount of the nitrogen into nitrogen gas, which then returns to the atmosphere to complete the nitrogen cycle.

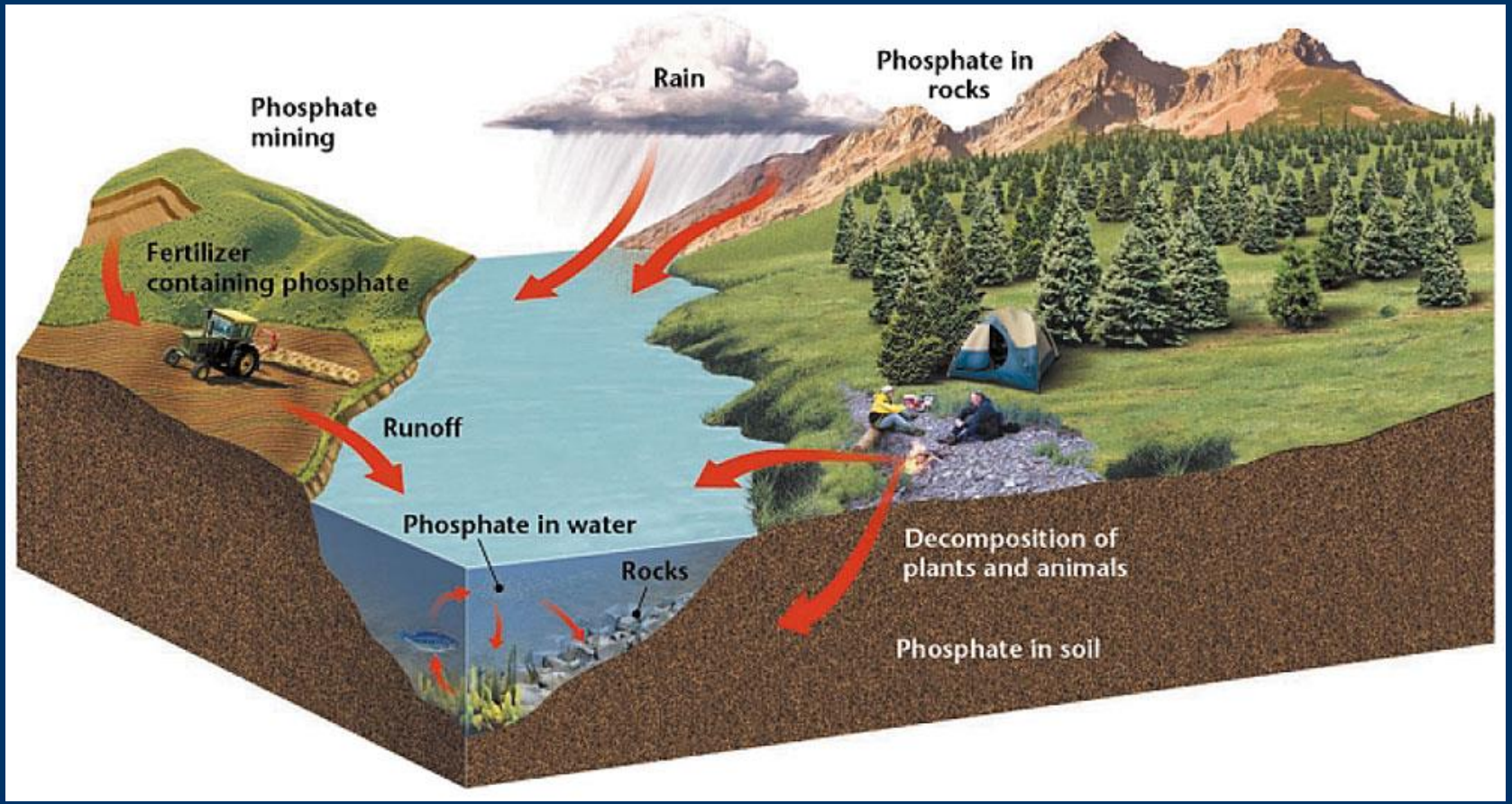
End Of Slide

The Phosphorus Cycle

- Phosphorus is an element that is part of many molecules that make up the cells of living organisms.
- Plants get the phosphorus they need from soil and water, while animals get their phosphorus by eating plants or other animals that have eaten plants.
- The **phosphorus cycle** is the cyclic movement of phosphorus in different chemical forms from the environment to organisms and then back to the environment.

End Of Slide

The Phosphorus Cycle



The Phosphorus Cycle

- Phosphorus may enter soil and water when rocks erode. Small amounts of phosphorus dissolve as phosphate, which moves into the soil.
- Plants absorb phosphates in the soil through their roots.
- Some phosphorus washes off the land and ends up in the ocean.
- Because many phosphate salts are not soluble in water, they sink to the bottom and accumulate as sediment.

End Of Slide

Fertilizers and the Nitrogen and Phosphorus Cycles

- Fertilizers, which people use to stimulate and maximize plant growth, contain both nitrogen and phosphorus.
- Excessive amounts of fertilizer can enter terrestrial and aquatic ecosystems through runoff.
- Excess nitrogen and phosphorus can cause rapid growth of algae.
- Excess algae can deplete an aquatic ecosystem of important nutrients such as oxygen, on which fish and other aquatic organisms depend.

End Of Slide
Chapter menu
Resources

Acid Precipitation

- When fuel is burned, large amounts of nitric oxide is release into the atmosphere.
- In the air, nitric oxide can combine with oxygen and water vapor to form nitric acid.
- Dissolved in rain or snow, the nitric acid falls as acid precipitation.

End Of Slide

Objectives

- **List** two examples of ecological succession.
- **Explain** how a pioneer species contributes to ecological succession.
- **Explain** what happens during old-field succession.
- **Describe** how lichens contribute to primary succession.

End Of Slide

Ecological Succession

- Ecosystems are constantly changing.
- **Ecological succession** is a gradual process of change and replacement of the types of species in a community.
- Each new community that arises often makes it harder for the previous community to survive.

End Of Slide

Ecological Succession

- **Primary succession** is a type of succession that occurs on a surface where no ecosystem existed before. It begins in an area that previously did not support life.

- Primary succession can occur on rocks, cliffs, or sand dunes.

Ecological Succession

- **Secondary succession** occurs on a surface where an ecosystem has previously existed. It is the process by which one community replaces another community that has been partially or totally destroyed.

- Secondary succession can occur in ecosystems that have been disturbed or disrupted by humans, animals, or by natural process such as storms, floods, earthquakes, or volcanic eruptions.

End Of Slide

Ecological Succession

- A **pioneer species** is a species that colonizes an uninhabited area and that starts an ecological cycle in which many other species become established.
- Over time, a pioneer species will make the new area habitable for other species.
- A **climax community** is the final, stable community in equilibrium with the environment.
- Even though a climax community may change in small ways, this type of community may remain the same through time if it is not disturbed.

End Of Slide

Ecological Succession

- Natural fires caused by lightning are a necessary part of secondary succession in some communities.
- Minor forest fires remove accumulations of brush and deadwood that would otherwise contribute to major fires that burn out of control.
- Some animal species also depend on occasional fires because the feed on the vegetation that sprouts after a fire has cleared the land.

End Of Slide

Ecological Succession

- Old-field succession is a type of secondary succession that occurs when farmland is abandoned.
- When a farmer stops cultivating a field, grasses and weeds quickly grow and cover the abandoned land.
- Over time, taller plants, such as perennial grasses, shrubs, and trees take over the area.

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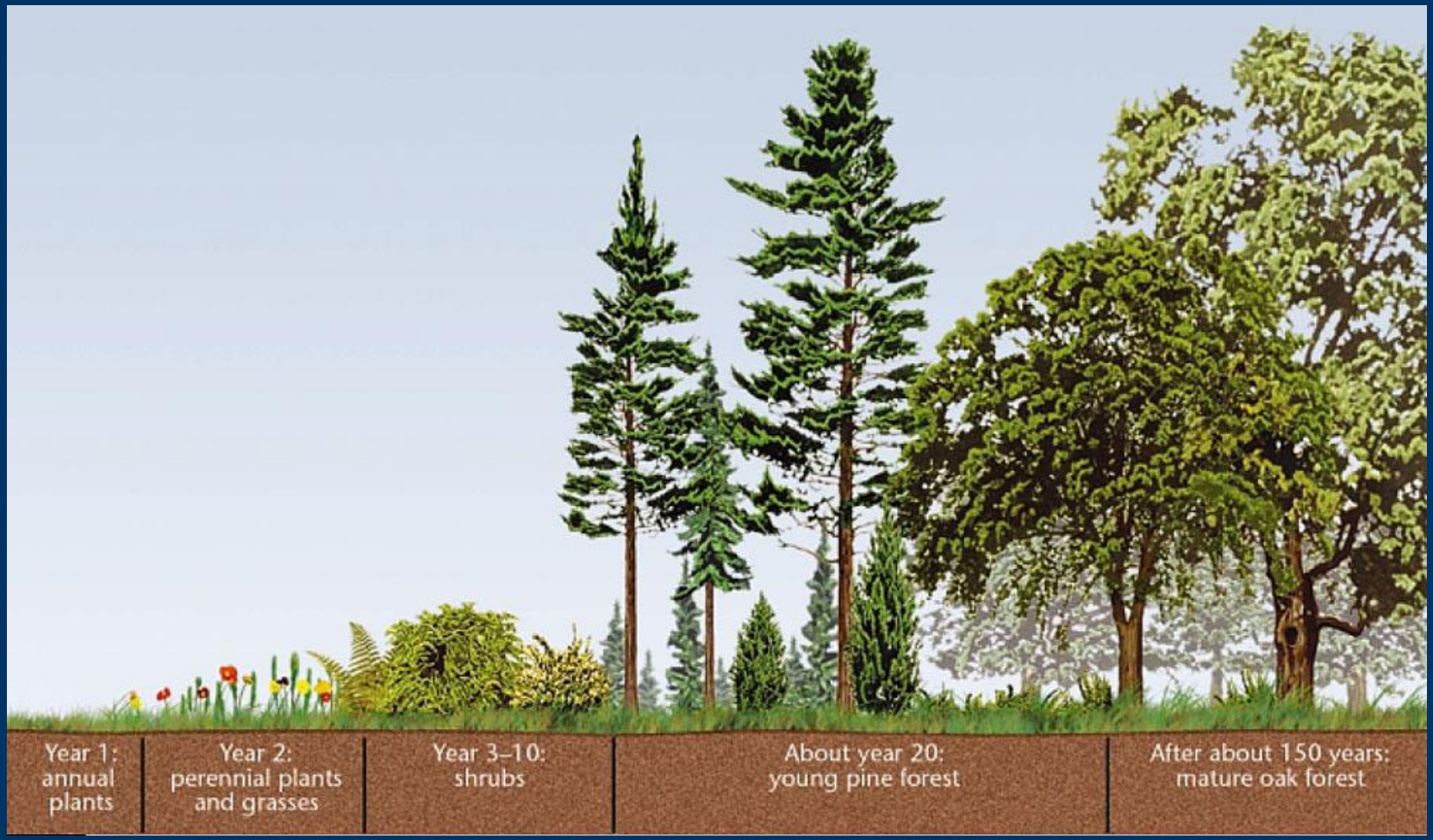
Ecological Succession



Ecological Succession

- Primary succession can occur
  - on new islands created by volcanic eruptions
  - in areas exposed when a glacier retreats
  - any other surface that has not previously supported life

- Primary succession is much slower than secondary succession. This is because it begins where there is no soil.

End Of Slide
Chapter menu
Resources

Ecological Succession

- The first pioneer species to colonize bare rock will probably be bacteria and lichens, which can live without soil.
- The growth of lichens breaks down the rock, which with the action of water, begins to form soil.

Bellringer

Section: Energy Flow in Ecosystems

List three plants or animals and the animals that eat them. Also list any plants you know of that eat animals. Be sure to think about animals and plants on different continents.

Write your response in your ***EcoLog***.

Section: The Cycling of Materials

List three products that you recycle. Where do the products come from? Where will the products go after they are recycled?

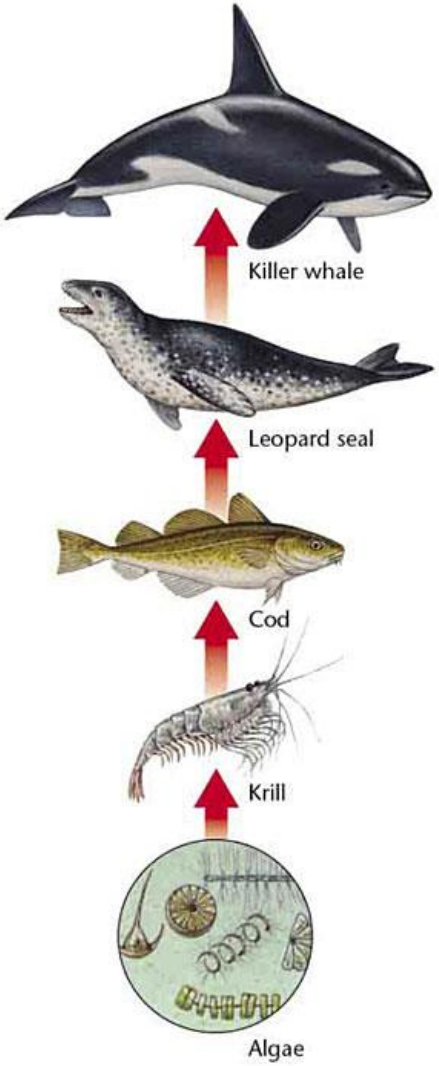
Write your responses in your ***EcoLog***.

Section: How Ecosystems Change

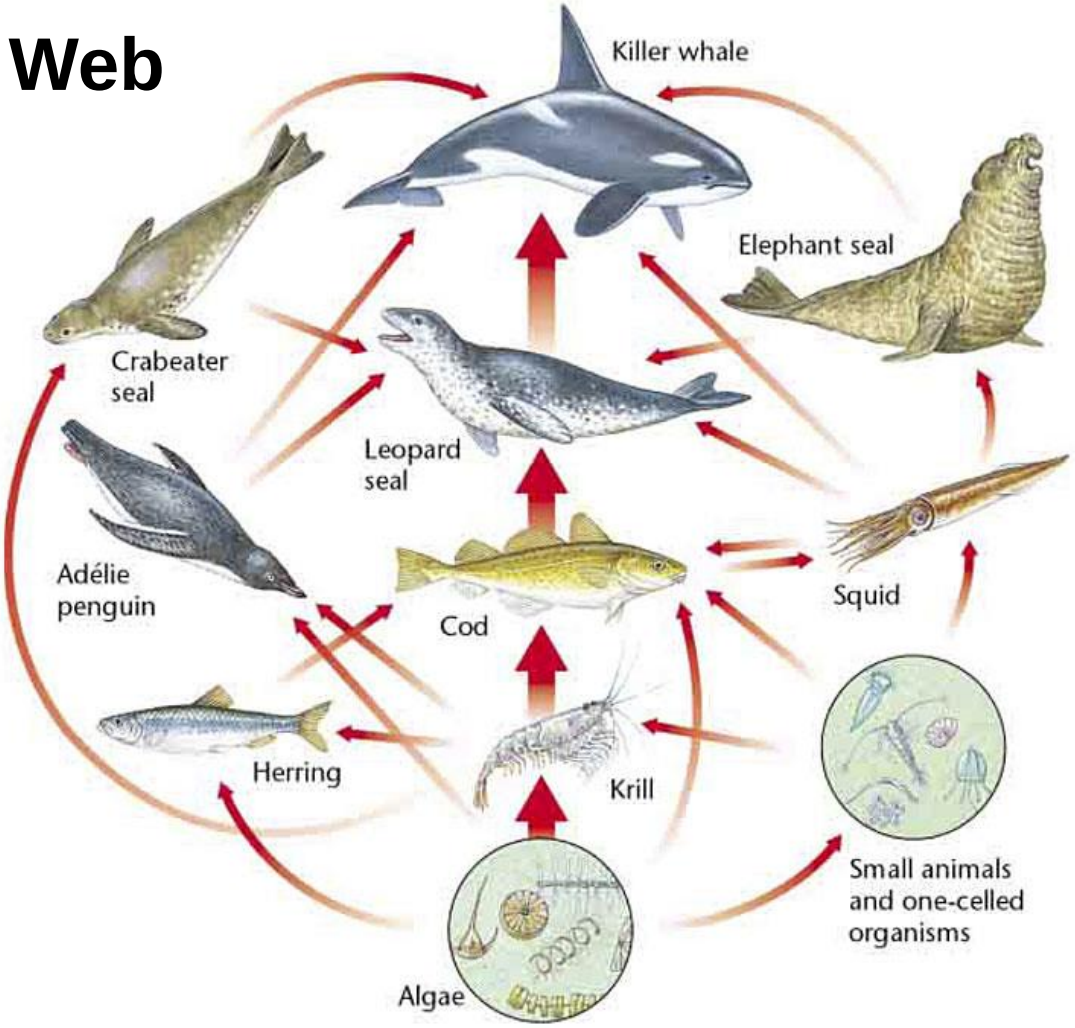
Are your school grounds undergoing ecological succession? What clues would you look for to answer this question?

Write your responses in your ***EcoLog***.

A Food Chain



A Food Web



Bellringer

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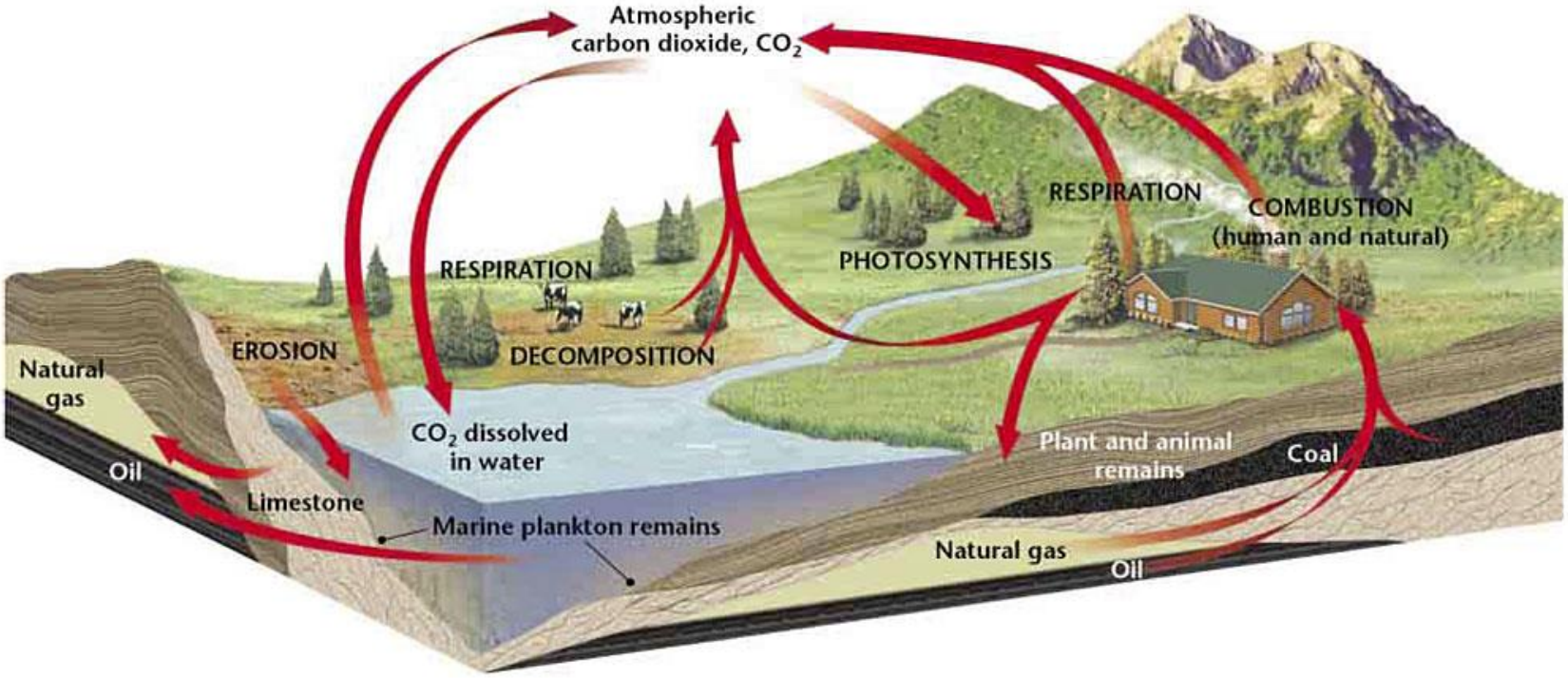
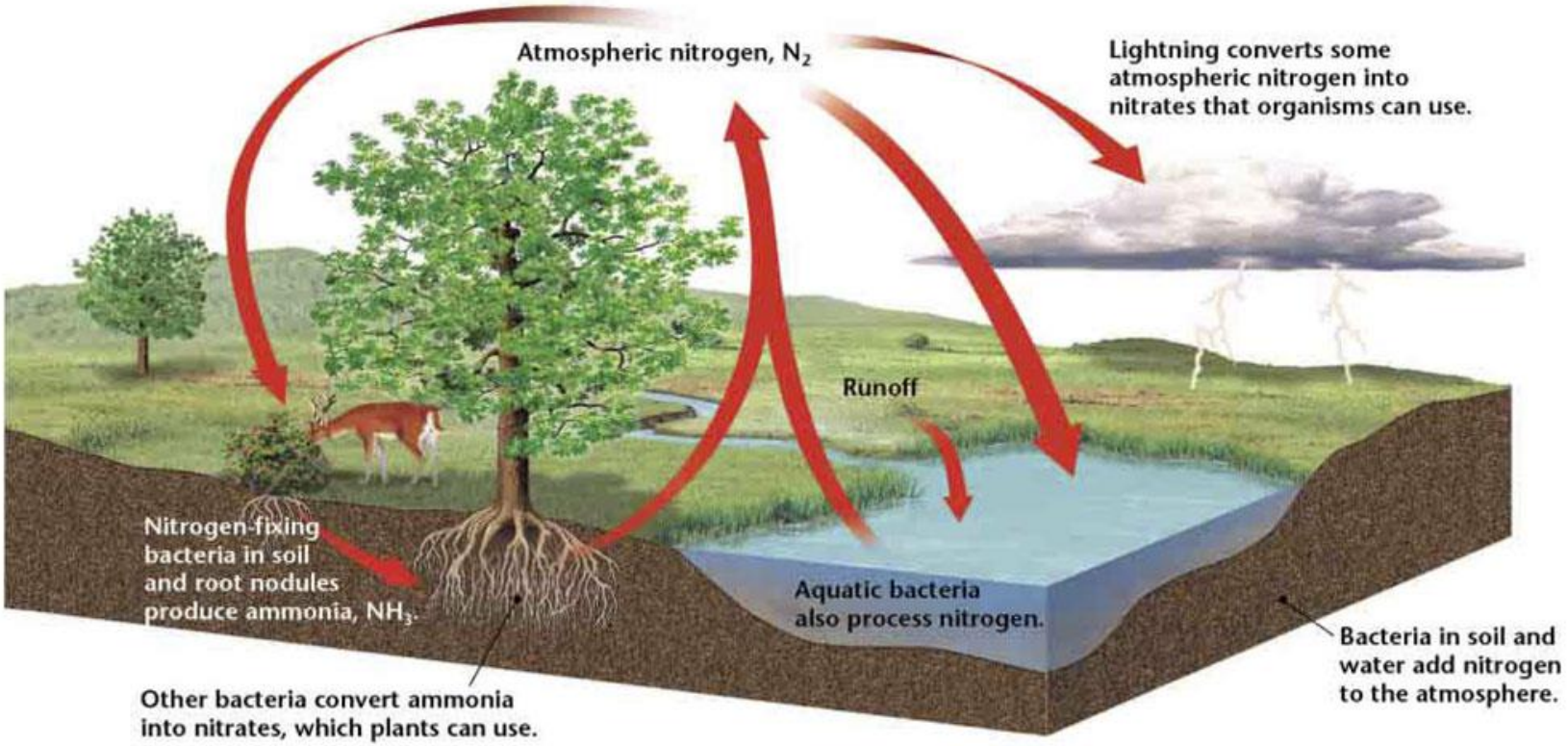
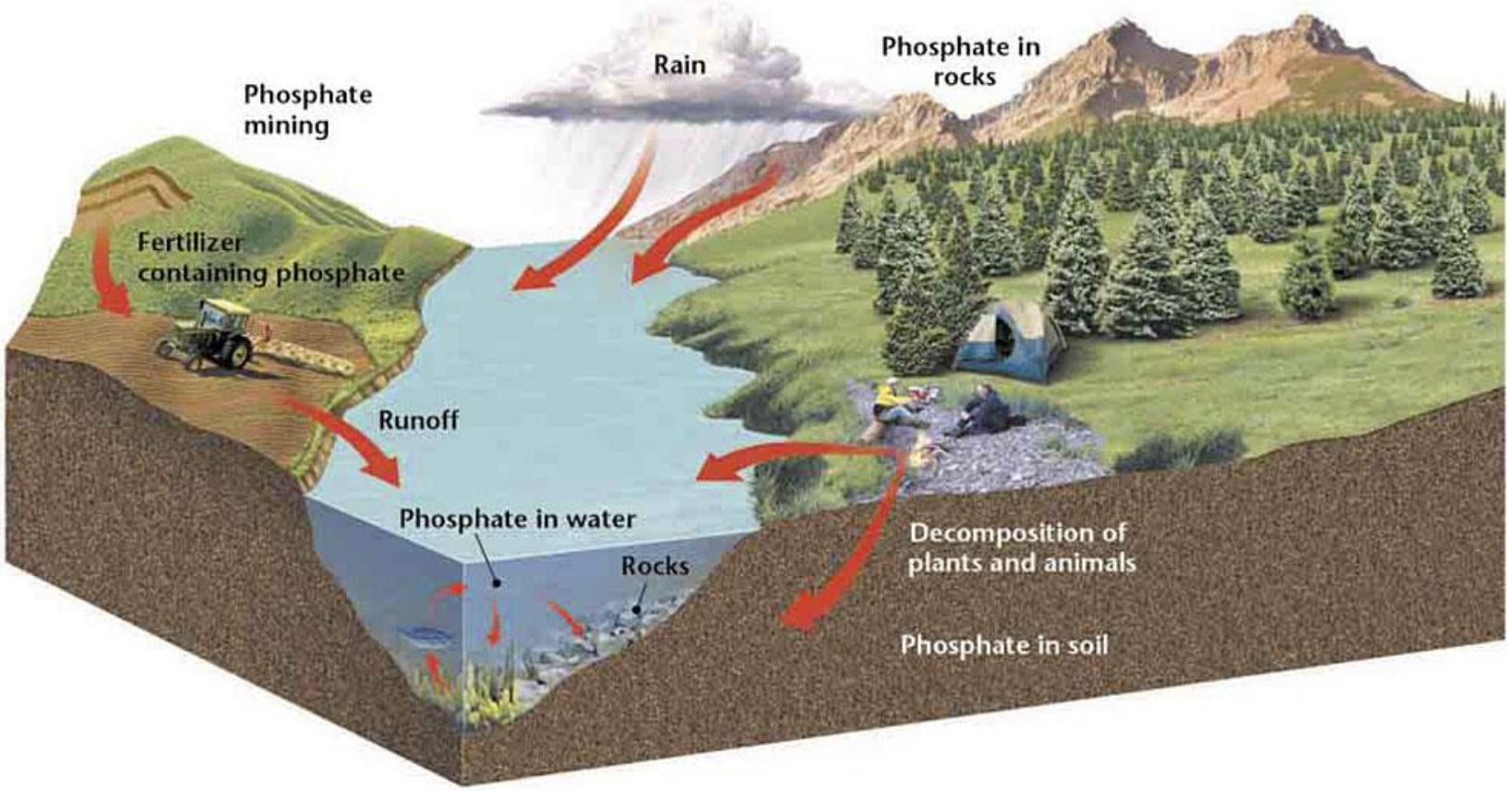
The Carbon Cycle



The Nitrogen Cycle



The Phosphorus Cycle



Bellringer

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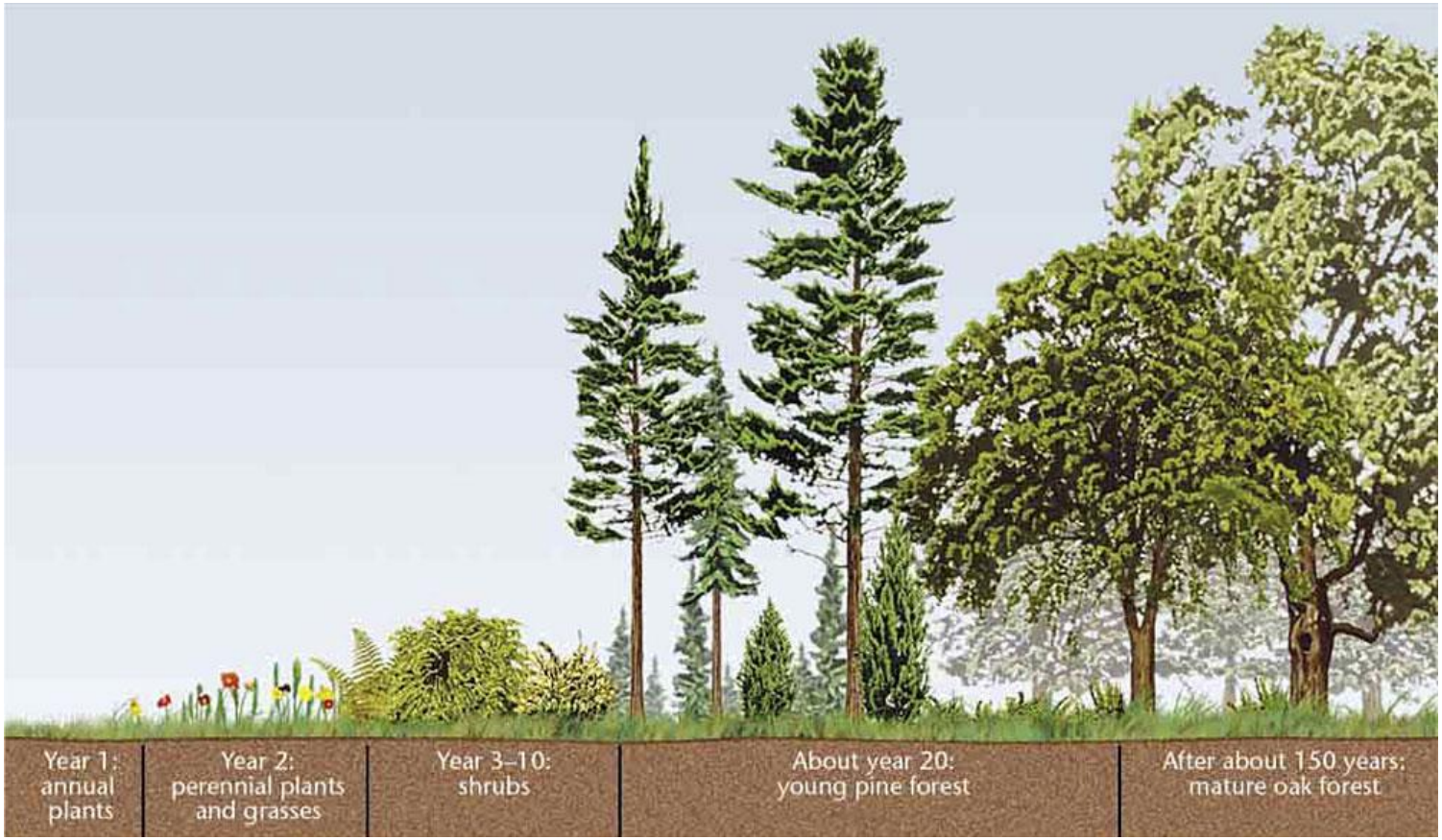
Secondary Succession; Old-Field Succession



Multiple Choice

1. How does energy move through most ecosystems on Earth?

A. From the sun to consumers to producers

B. From the sun to producers to consumers to decomposers

C. From the sun to decomposers to producers to consumers

D. From the sun to consumers to producers back to consumers

Multiple Choice

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A. From the sun to consumers to producers

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D. From the sun to consumers to producers back to consumers

Multiple Choice, *continued*

2. Which of the following statements indicates an understanding of the importance of energy to life on Earth?

F. Many organisms on Earth require energy for their life processes.

G. All organisms on Earth require energy for their life processes.

H. Energy is required for the most important life processes on Earth.

I. The most important organisms on Earth require energy for their life processes.

Multiple Choice, *continued*

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G. All organisms on Earth require energy for their life processes.
H. Energy is required for the most important life processes on Earth.
I. The most important organisms on Earth require energy for their life processes.

Multiple Choice, *continued*

3. What role do bacteria play during the nitrogen cycle?

A. Bacteria store nitrogen in wastes.
B. Bacteria convert nitrogen into water.
C. Bacteria turn nitrogen into phosphates.
D. Bacteria transform nitrogen into molecules.

Multiple Choice, *continued*

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C. Bacteria turn nitrogen into phosphates.
D. Bacteria transform nitrogen into molecules.

Multiple Choice, *continued*

4. What is the process that breaks down food to yield energy called?

F. cellular digestion
G. cellular respiration
H. decomposition
I. photosynthesis

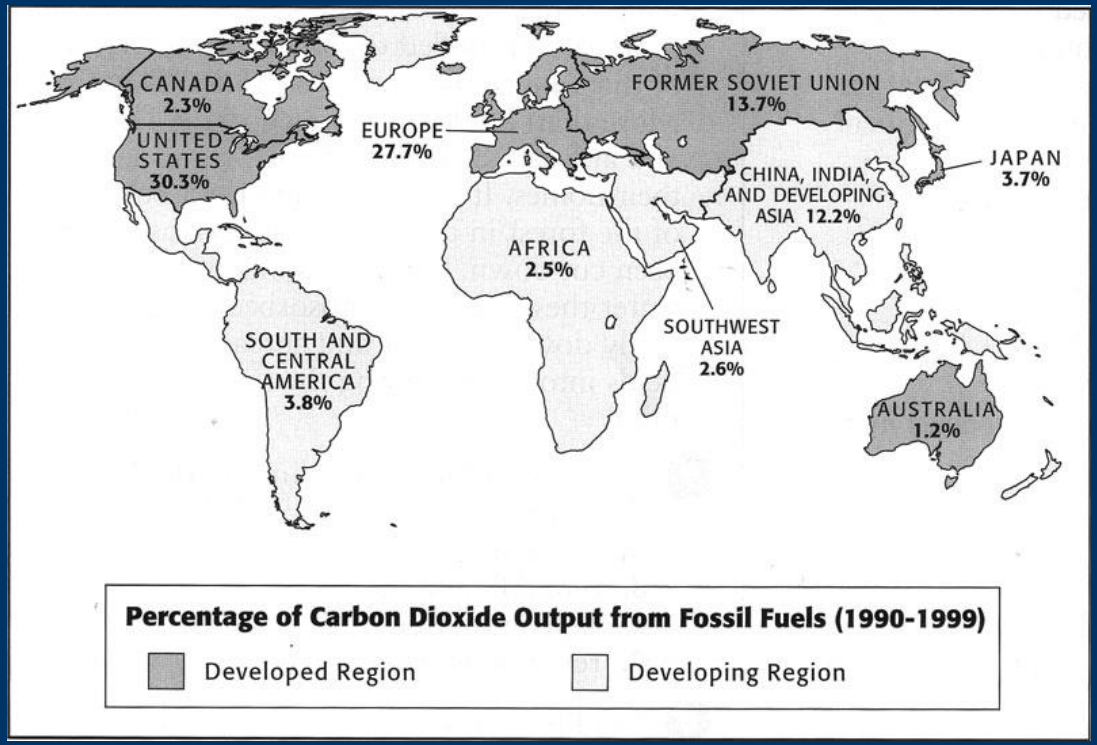
Multiple Choice, *continued*

4. What is the process that breaks down food to yield energy called?

F. cellular digestion
G. cellular respiration
H. decomposition
I. photosynthesis

Multiple Choice, *continued*

Use this map to answer questions 5 and 6.



Multiple Choice, *continued*

5. What continent has the lowest percentage of carbon dioxide output?

A. Asia
B. Australia
C. Europe
D. North America

Multiple Choice, *continued*

5. What continent has the lowest percentage of carbon dioxide output?

A. Asia
B. Australia
C. Europe
D. North America

Multiple Choice, *continued*

6. What regions are responsible for the highest percentage of carbon dioxide output?

F. developed regions in the western hemisphere
G. developed regions in the eastern hemisphere
H. developing regions in the western hemisphere
I. developing regions in the eastern hemisphere

Multiple Choice, *continued*

6. What regions are responsible for the highest percentage of carbon dioxide output?

F. developed regions in the western hemisphere

G. developed regions in the eastern hemisphere

H. developing regions in the western hemisphere

I. developing regions in the eastern hemisphere

Multiple Choice, *continued*

7. Which of the following shows an effect on the carbon cycle of the increased burning of fossil fuels?

A. More carbonates remain in fossil fuels.
B. More carbon dioxide is absorbed by organisms.
C. More carbon dioxide is absorbed by the atmosphere.
D. More carbohydrates remain buried deep in the ground.

Multiple Choice, *continued*

7. Which of the following shows an effect on the carbon cycle of the increased burning of fossil fuels?

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C. More carbon dioxide is absorbed by the atmosphere.
D. More carbohydrates remain buried deep in the ground.

Image and Activity Bank

Image and Activity Bank

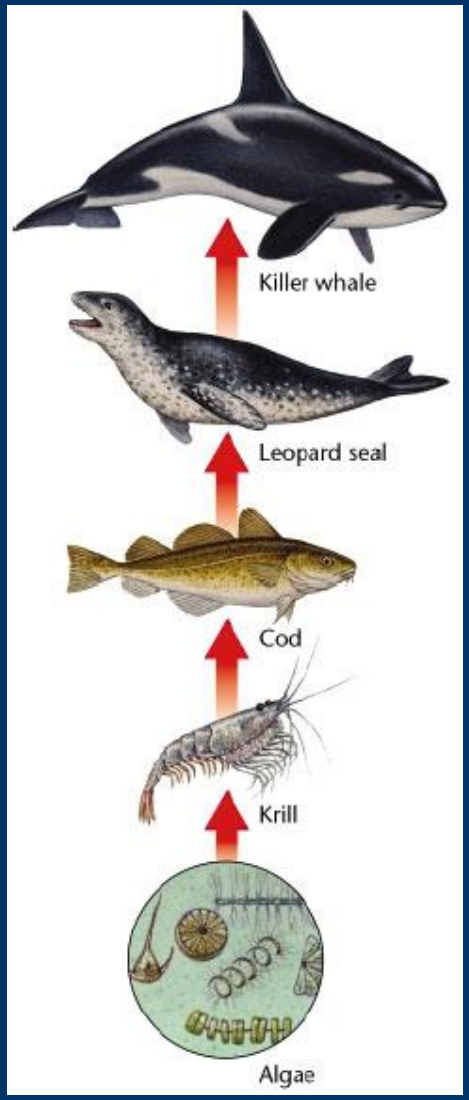
What Eats What in an Ecosystem

	Energy source	Examples
Producer	makes its own food through photosynthesis or chemical sources	grasses, ferns, cactuses, flowering plants, trees, algae, and some bacteria
Consumer	gets energy by eating producers or other consumers	mice, starfish, elephants, turtles, humans, and ants

Types of Consumers in an Ecosystem

	Energy source	Examples
Herbivore	producers	cows, sheep, deer, and grasshoppers
Carnivore	other consumers	lions, hawks, snakes, spiders, sharks, alligators, and whales
Omnivore	both producers and consumers	bears, pigs, gorillas, rats, raccoons, cockroaches, some insects, and humans
Decomposer	breaks down dead organisms in an ecosystem and returns nutrients to soil, water, and air	fungi and bacteria

Image and Activity Bank



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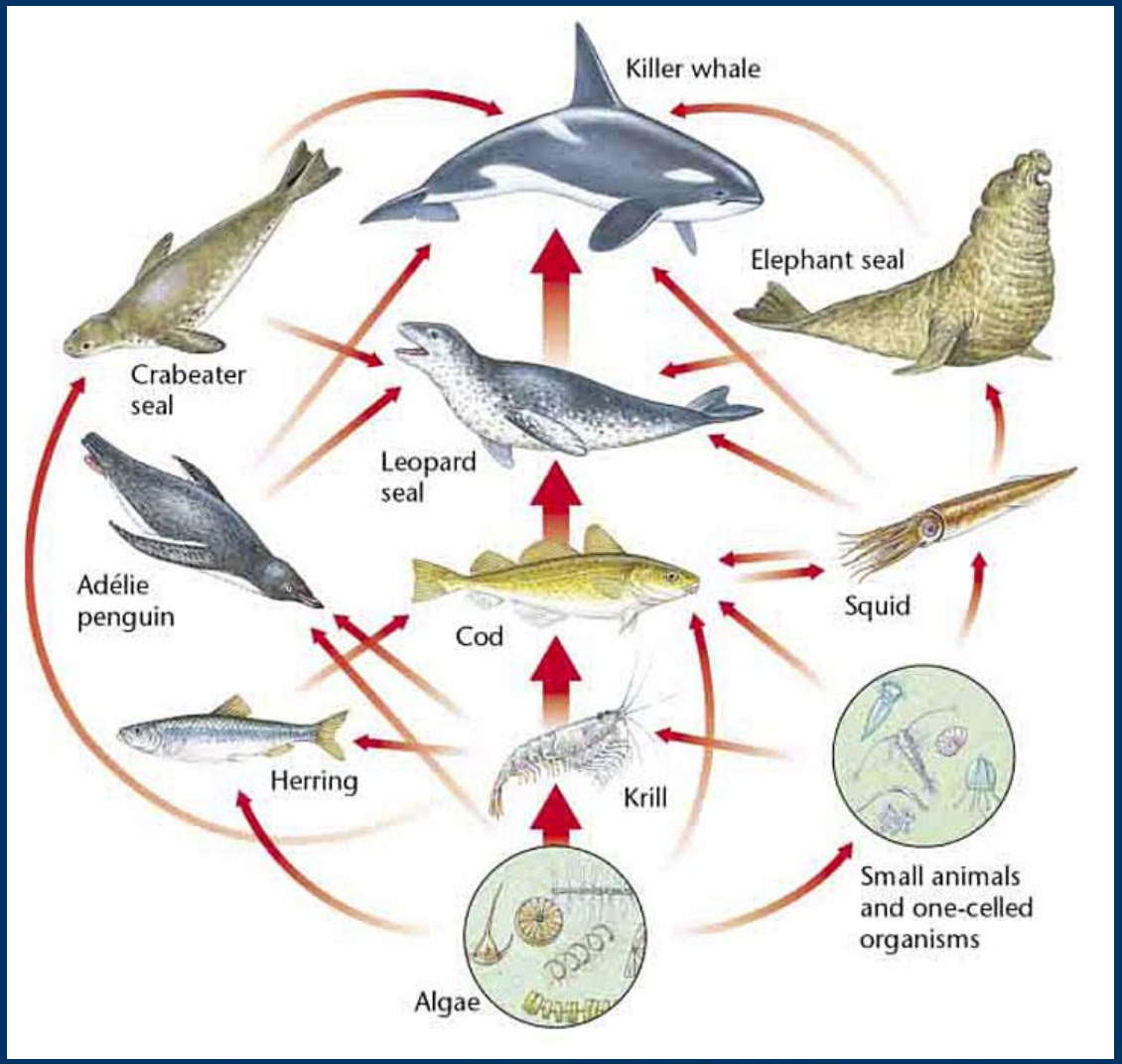

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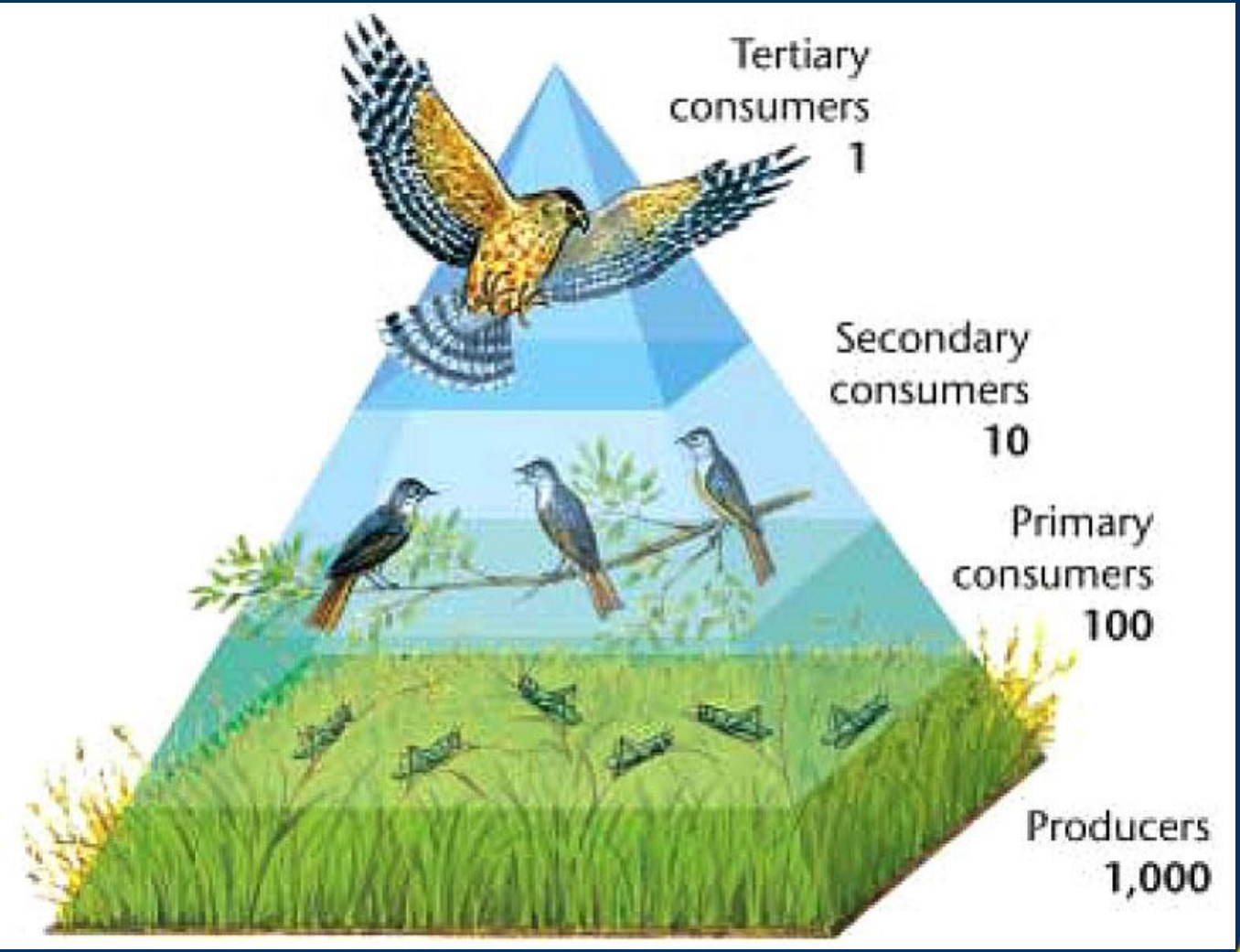

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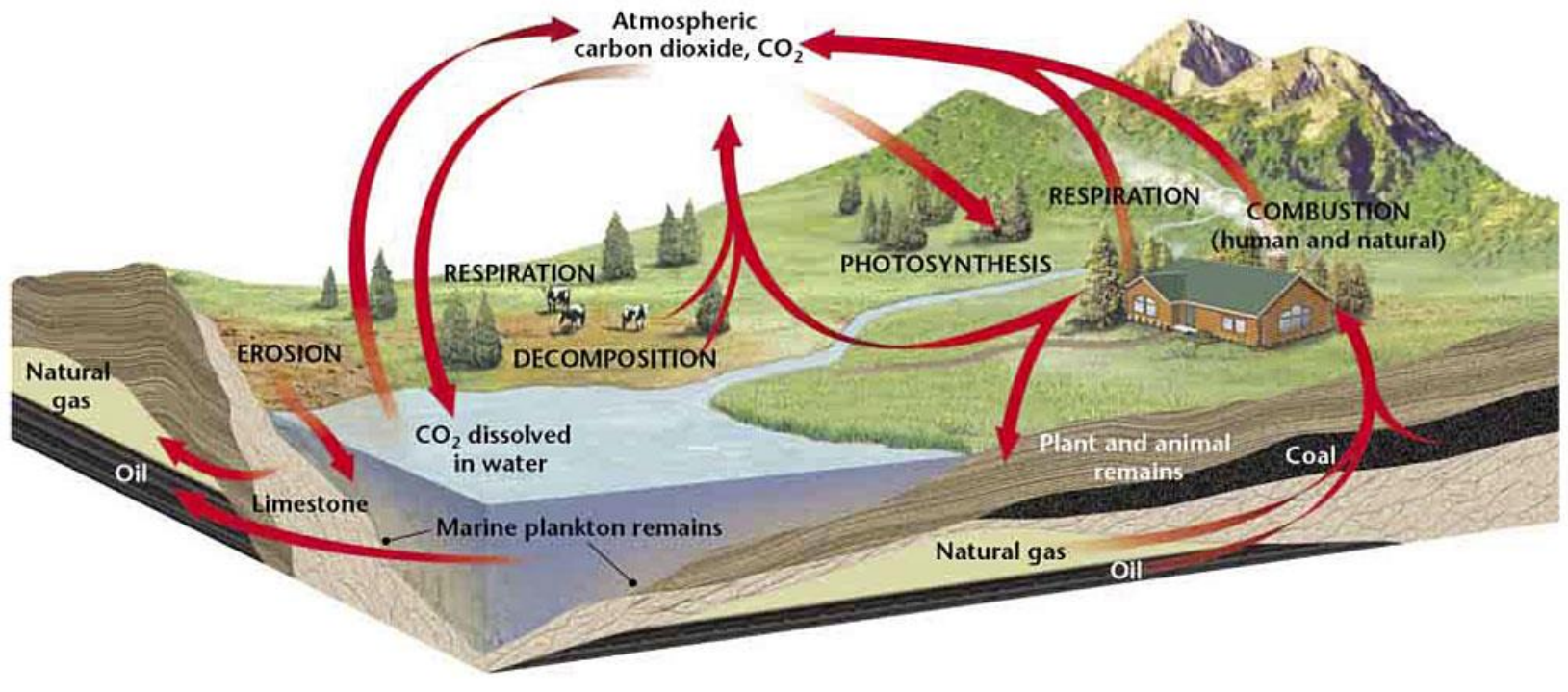

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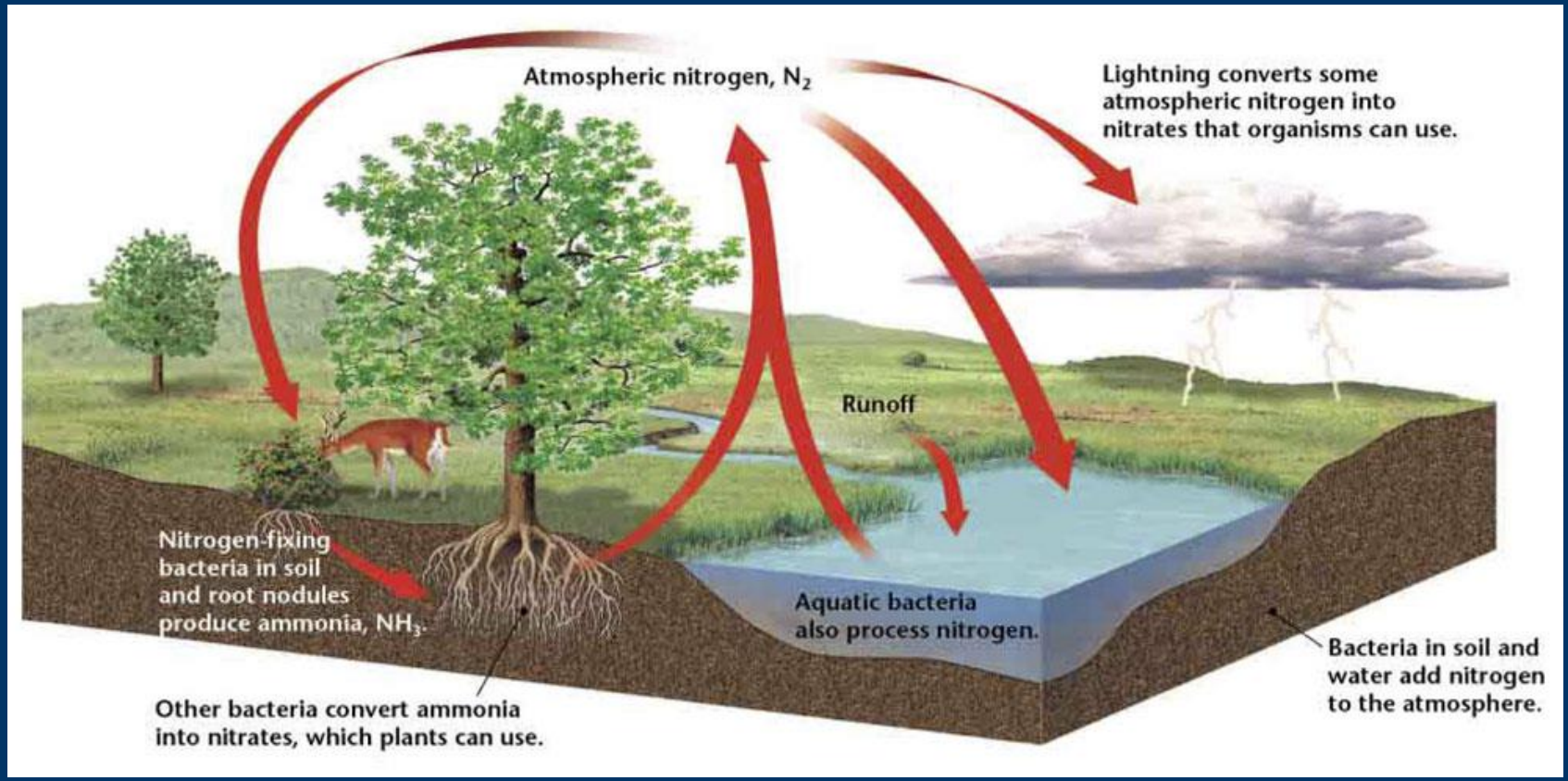

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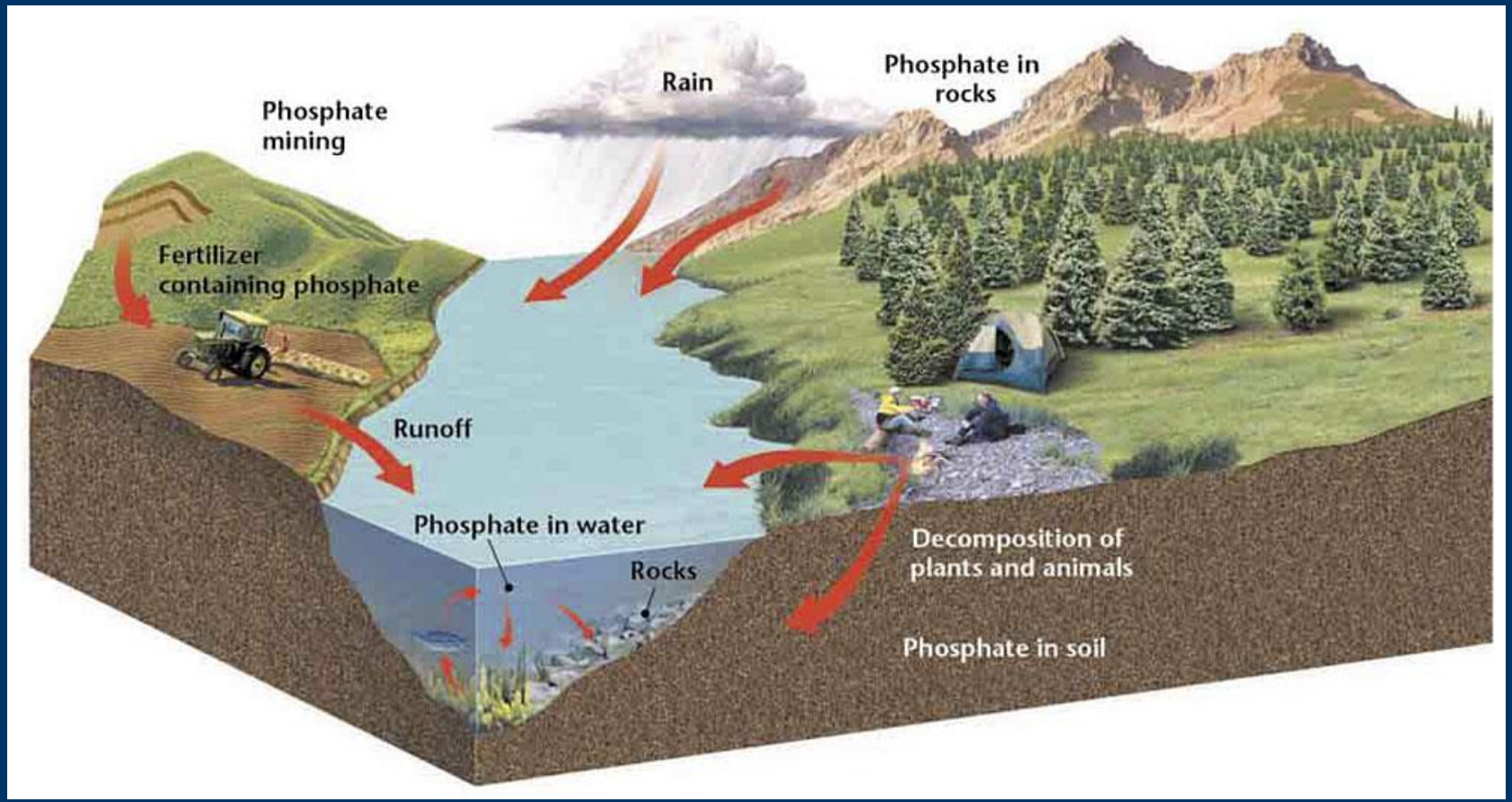

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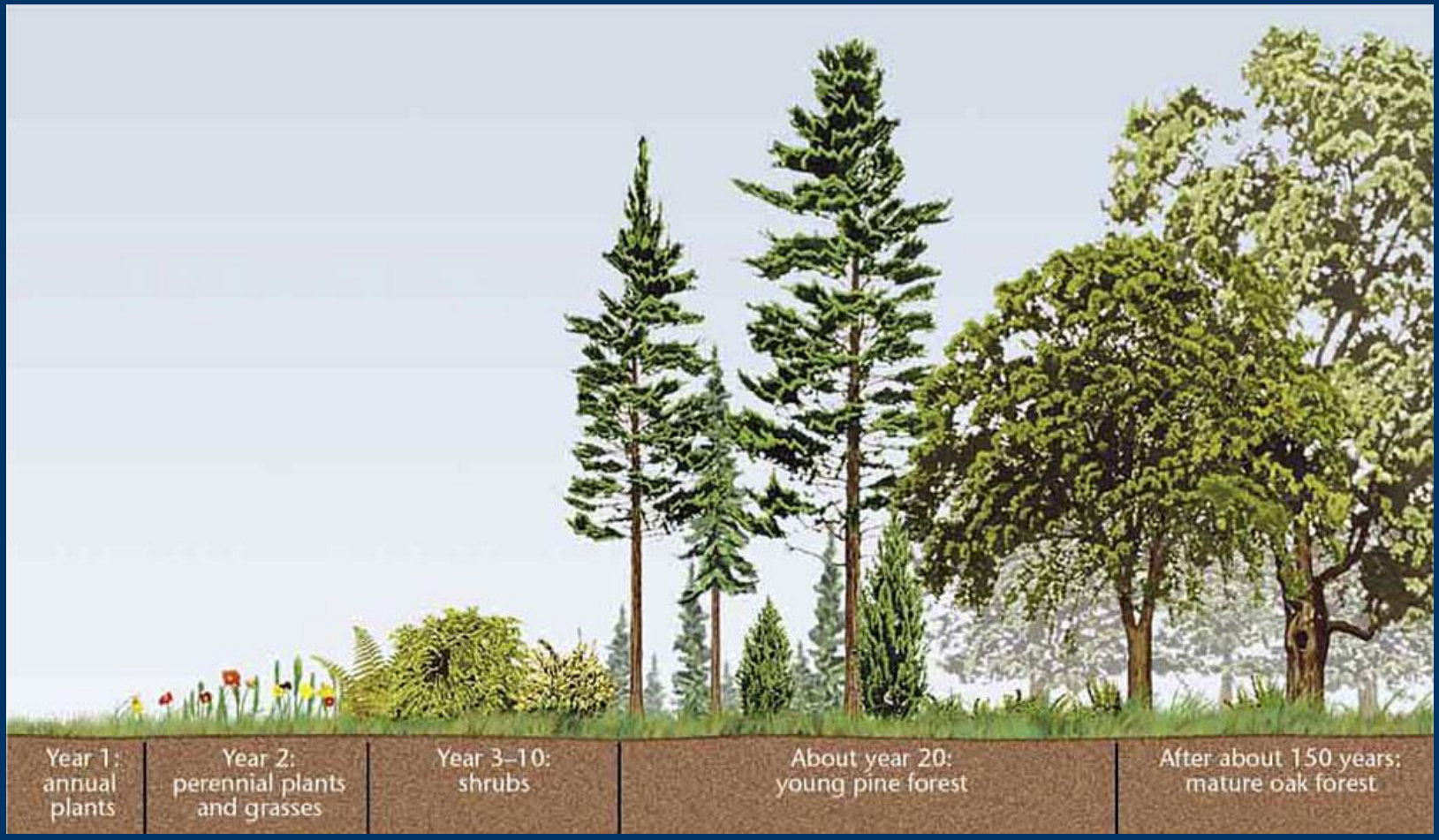
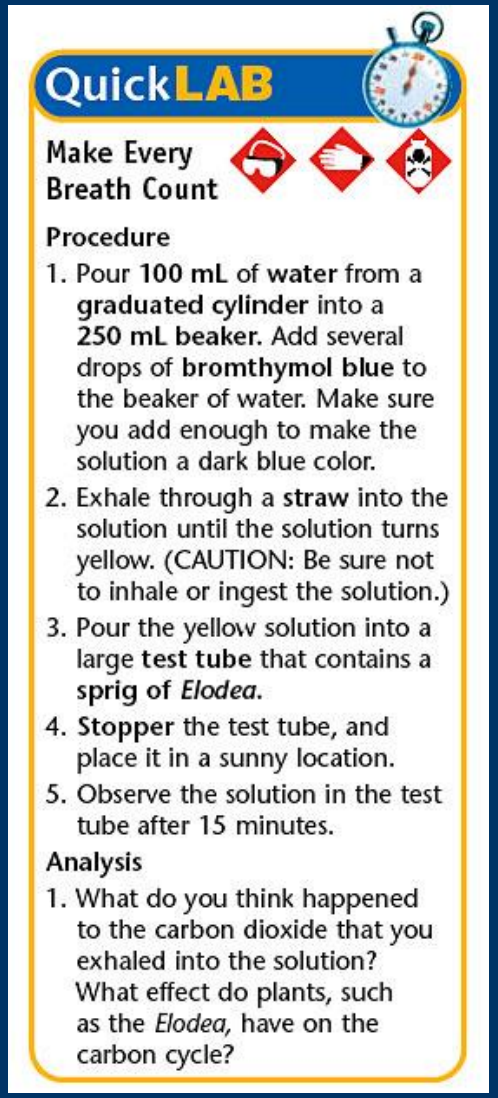


Image and Activity Bank

MATH PRACTICE

A Meal Fit for a Grizzly Bear Grizzly bears are omnivores that can eat up to 15 percent of their body weight per day when eating salmon and up to 33 percent of their body weight when eating fruits and other vegetation. How many pounds of salmon can a 200 lb grizzly bear eat in one day? How many pounds of fruits and other vegetation can the same bear eat in one day?

Image and Activity Bank



QuickLAB

Make Every Breath Count

Procedure

1. Pour **100 mL** of **water** from a **graduated cylinder** into a **250 mL beaker.** Add several drops of **bromthymol blue** to the beaker of water. Make sure you add enough to make the solution a dark blue color.
2. Exhale through a **straw** into the solution until the solution turns yellow. (CAUTION: Be sure not to inhale or ingest the solution.)
3. Pour the yellow solution into a large **test tube** that contains a **sprig of** *Elodea*.
4. **Stopper** the test tube, and place it in a sunny location.
5. Observe the solution in the test tube after 15 minutes.

Analysis

1. What do you think happened to the carbon dioxide that you exhaled into the solution? What effect do plants, such as the *Elodea*, have on the carbon cycle?

Image and Activity Bank