

Chapter 5
How Ecosystems Work
Section 1: Energy Flow in Ecosystems

DAY 1

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 result of photosynthesis is a **carbohydrate (sugar molecules)**.
- Gives you energy to do daily activities.



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**.



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**.



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.



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.



What Eats What?

- Organisms can be classified by what they eat.
- Types of Consumers:
 - Herbivores – **eat only plants**
 - Carnivores – **eat only animals**
 - Omnivores – **eat both plants and animals**
 - Decomposers – **eat dead organic matter**



What Eats What?

- Consumers that eat producers to get energy are what we call **primary consumers**.
- In other words they are **herbivores**.
- Most of the energy will be used up by the consumer (herbivore).
- A consumer that eats another consumer is called a **secondary consumer**.



What Eats What?

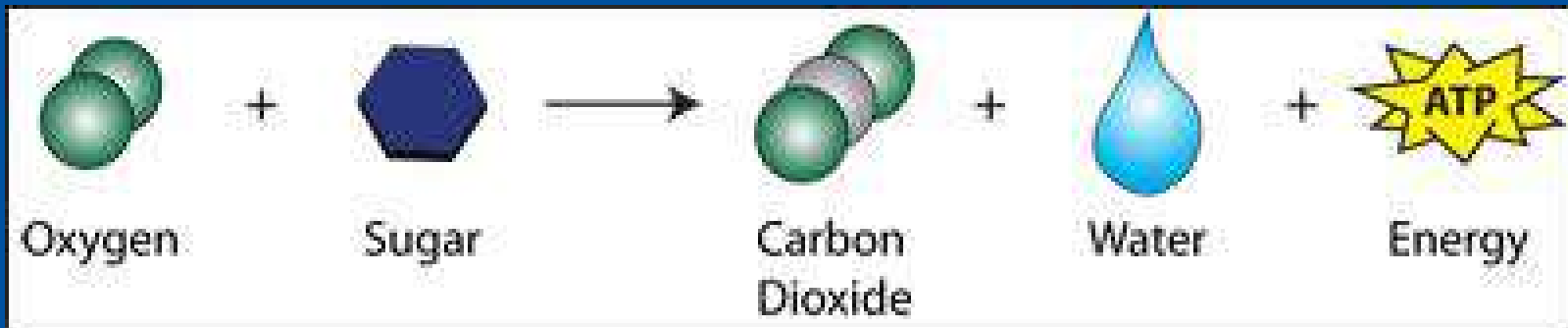
What Eats What In an Ecosystem		
	Energy source	Examples
Producer	makes its own food through photosynthesis or chemical sources	grasses, ferns, cactuses, flowering plants, trees, algae, and some bacteria
Consumer	gets energy by eating producers or other consumers	mice, starfish, elephants, turtles, humans,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

Something to help you remember!

Energy Roles Song

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**.



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.



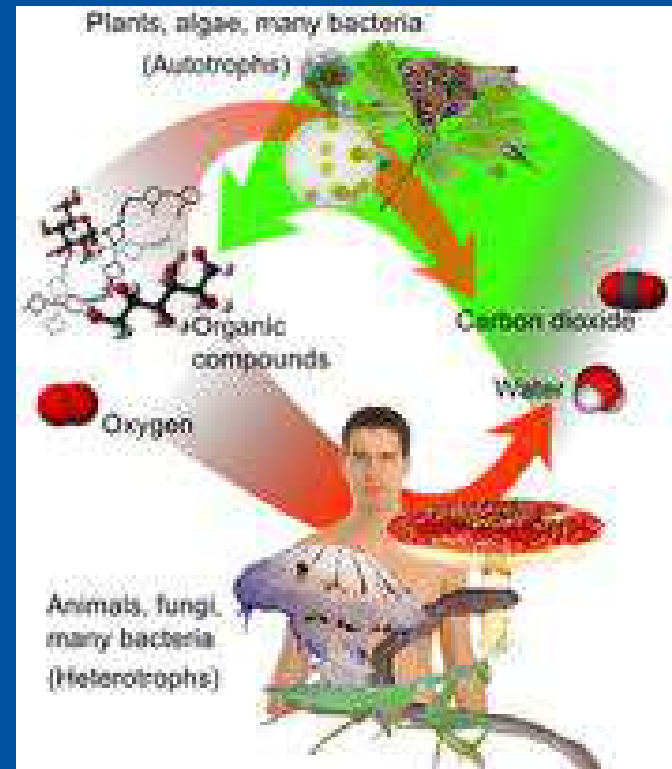
Burning the Fuel

- 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.



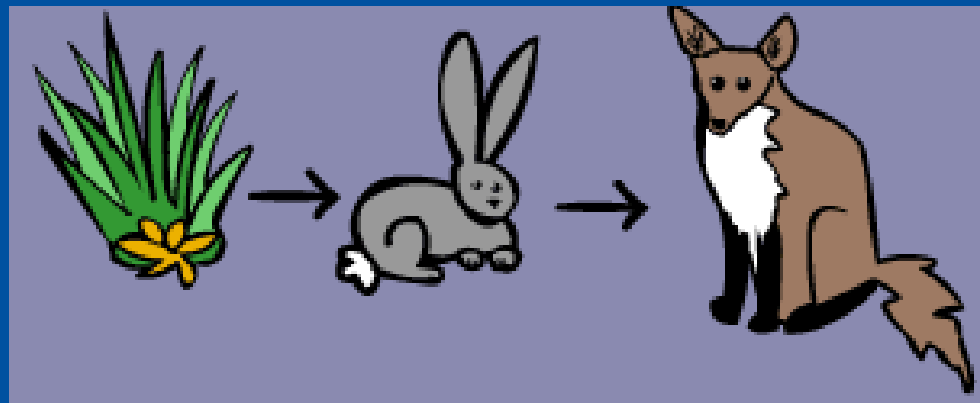
Burning the Fuel

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



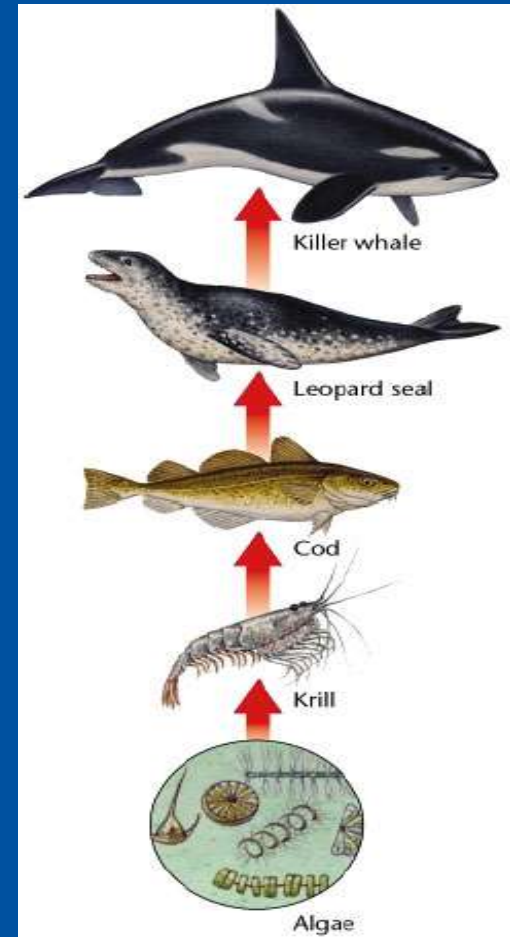
Energy Transfer

- 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**.



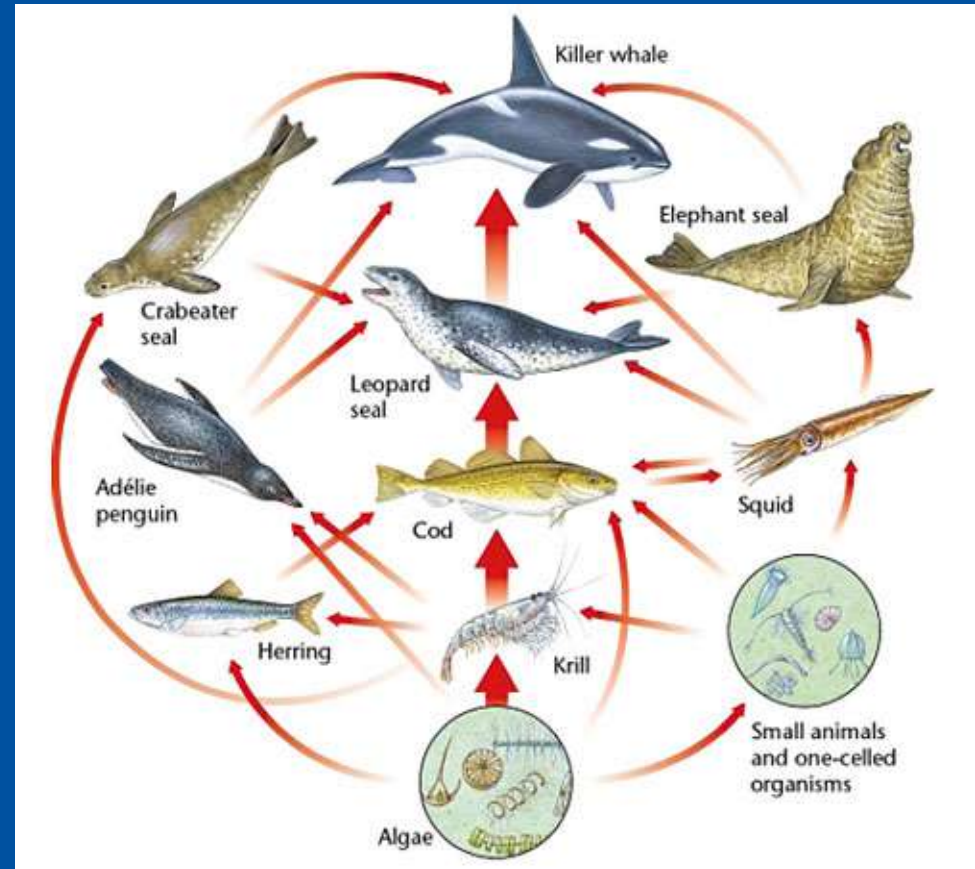
Food Chains

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



Food Webs

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



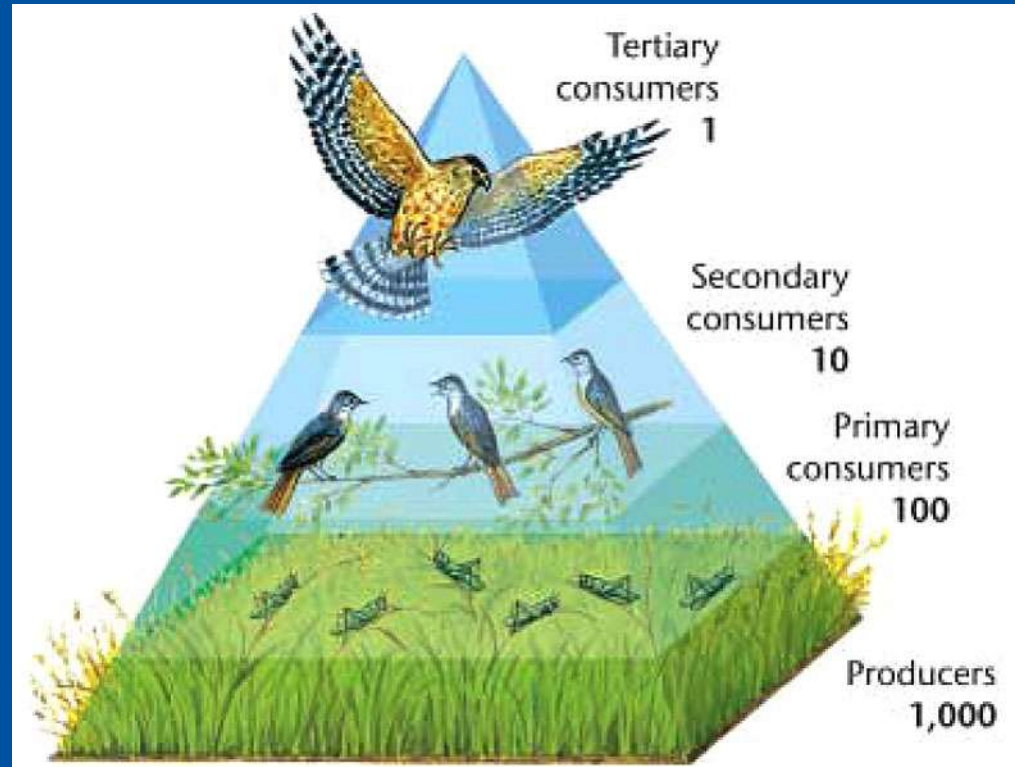
Trophic Levels

- 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.



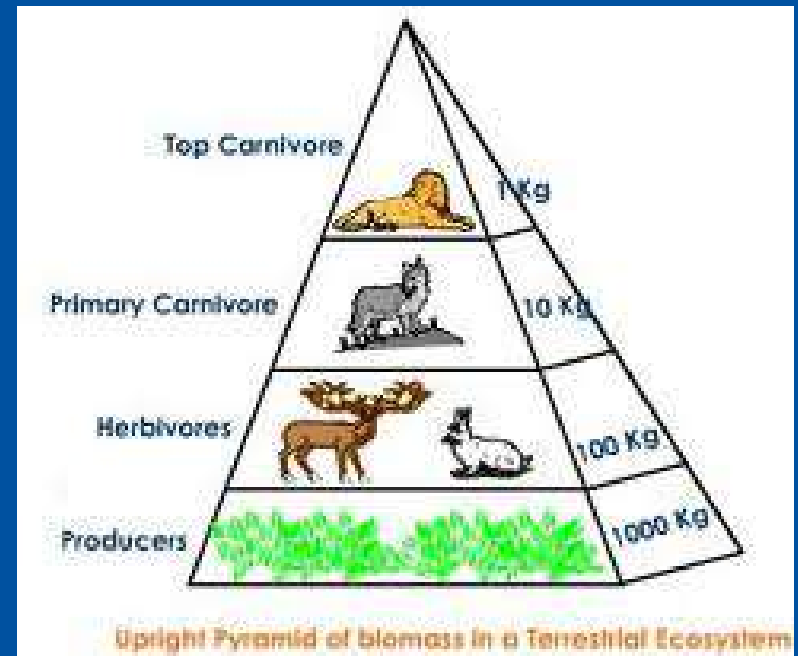
Trophic Levels

- 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**.



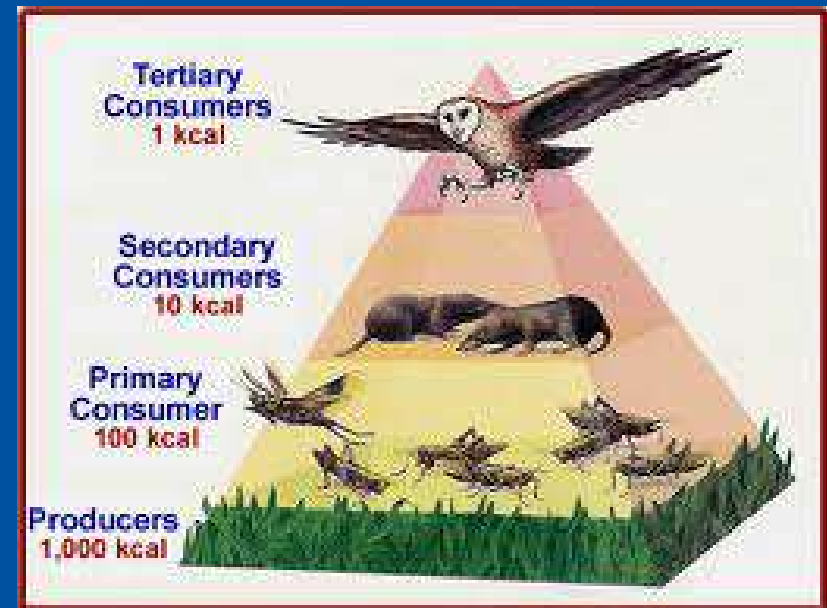
Trophic Levels

- 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.



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.



Ticket Out the Door

1. What is the end result of photosynthesis?
2. List the four types of consumers. Give a definition for each of the types of consumers.
3. What is the difference between a primary consumer and a secondary consumer?
4. What is cellular respiration?
5. What is the difference between a food chain and food web?

Chapter 5
How Ecosystems Work
Section 2: Cycling of Materials

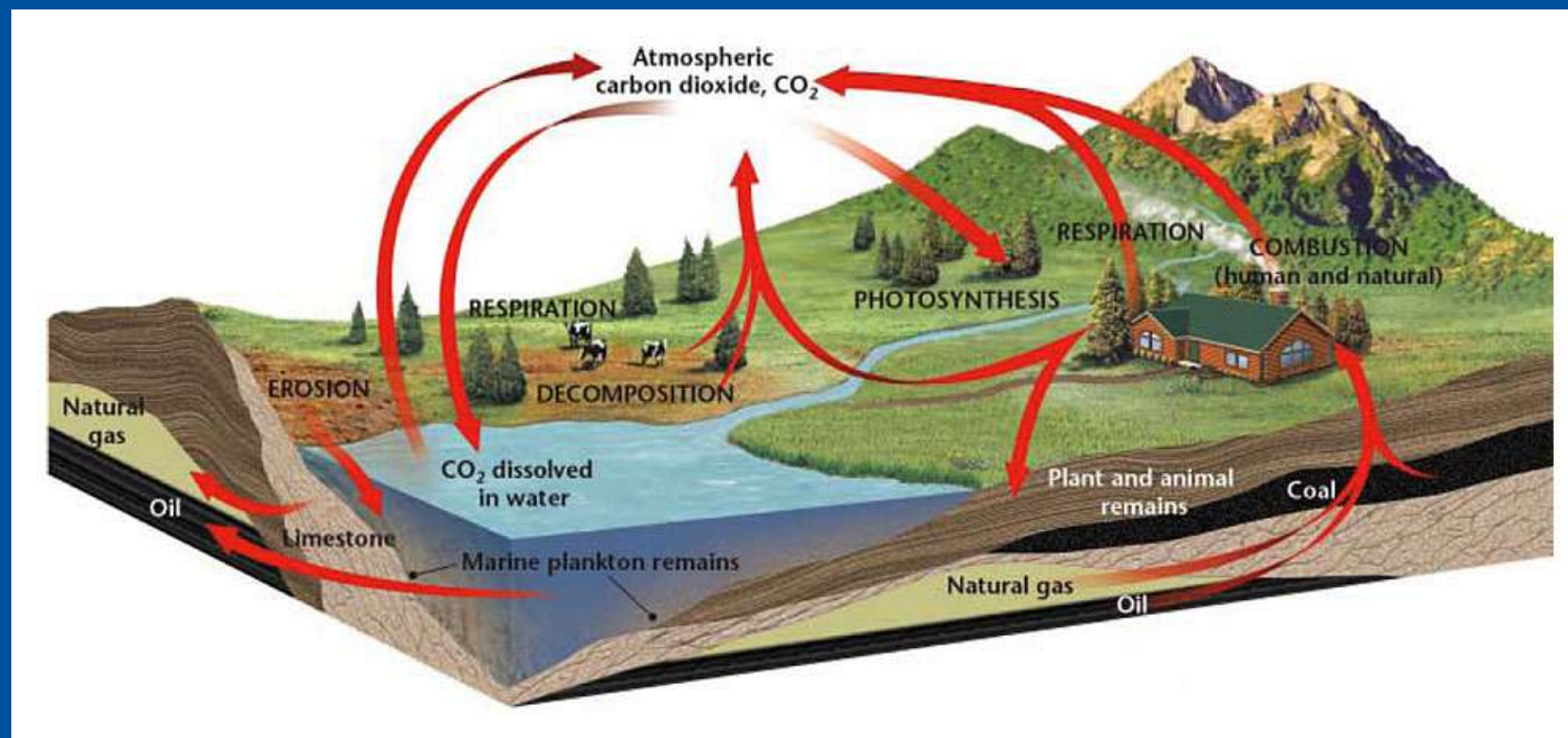
DAY 1

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.

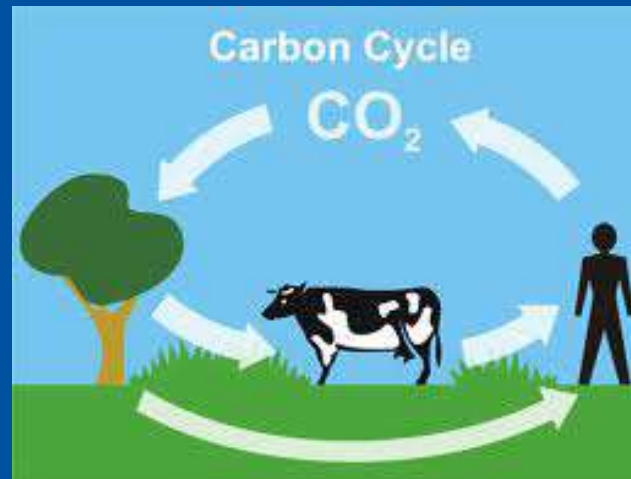


The Carbon Cycle



The Carbon Cycle

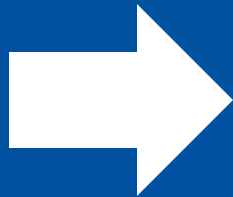
- Carbon exists in **air, water, and living organisms**.
- Producers convert **carbon dioxide** in the atmosphere into carbohydrates during photosynthesis.
- Consumers obtain carbon from the carbohydrates in the producers they eat.



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.

BRAZIL



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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.

How Humans Affect the Carbon Cycle

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



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.

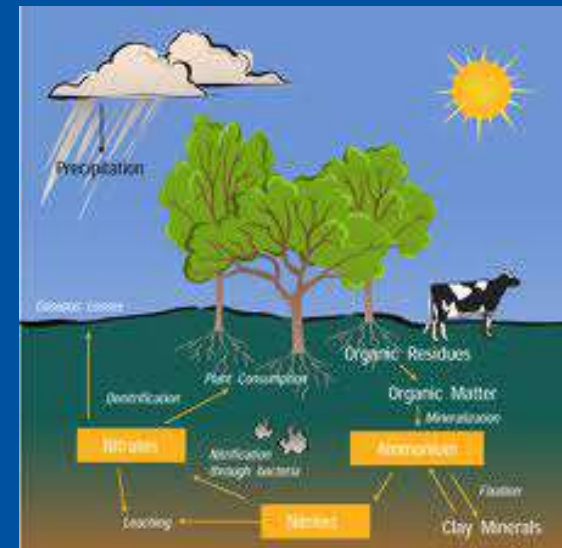


Norton the Nucleus Explains the Carbon Cycle

Carbon Cycle Explained

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.



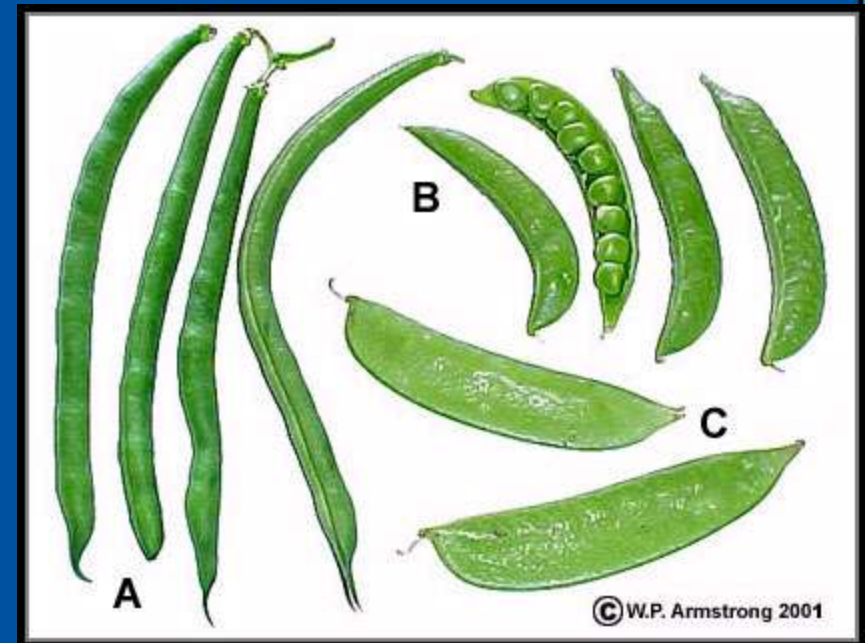
The Nitrogen Cycle

- 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.

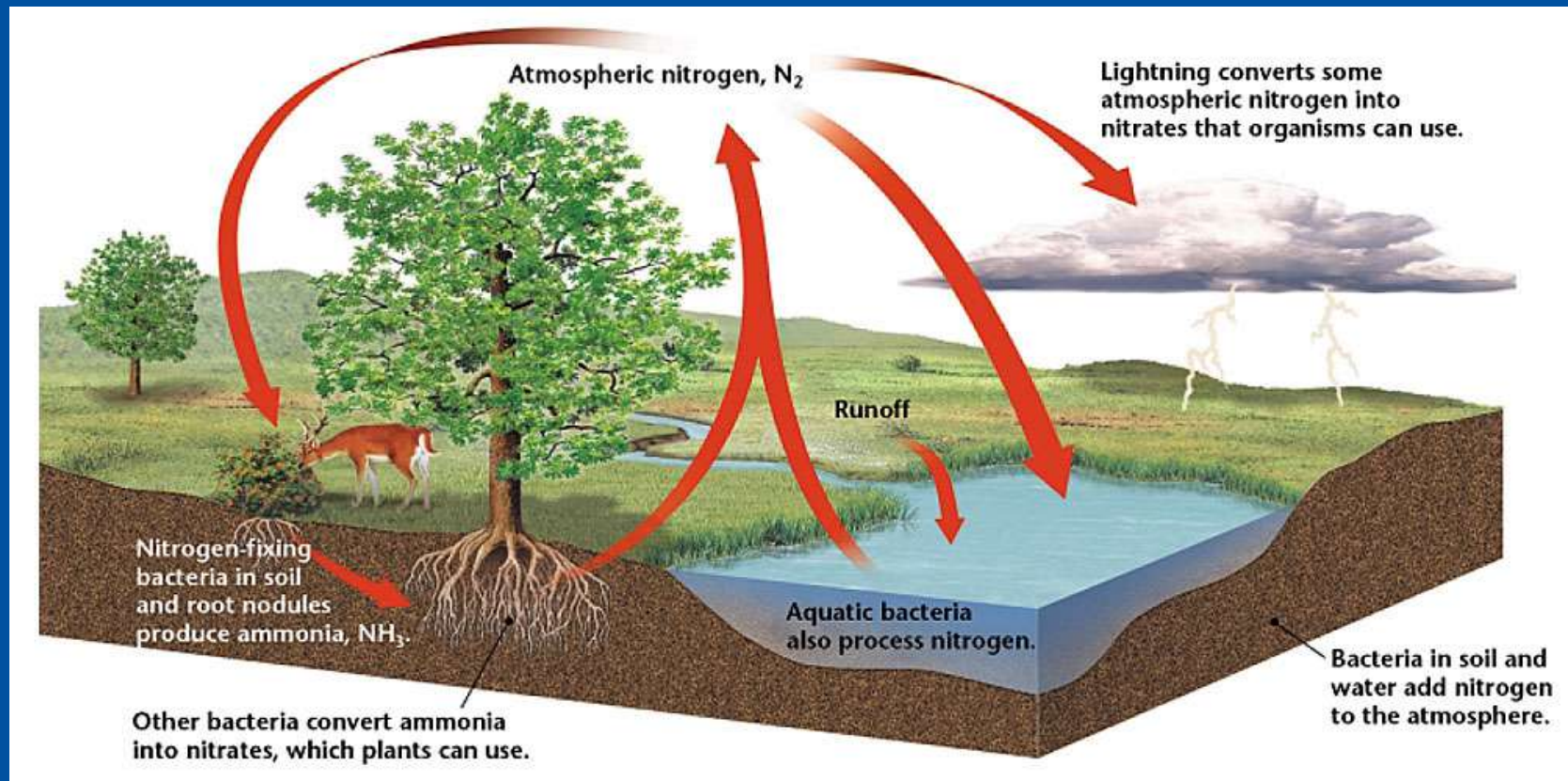


The Nitrogen Cycle

- **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.



The Nitrogen Cycle



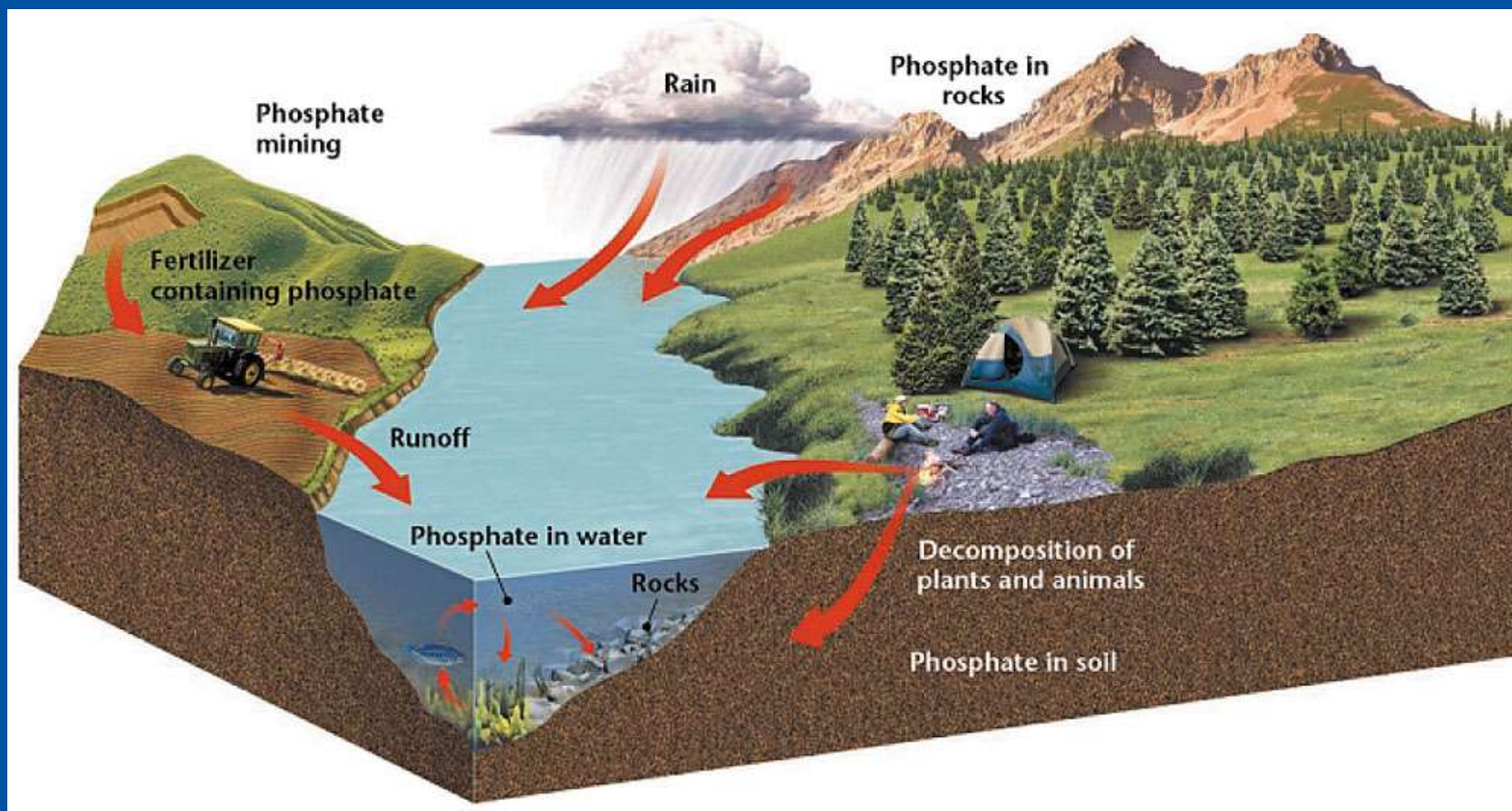
Decomposers and the Nitrogen Cycle

- 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.

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.

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**.

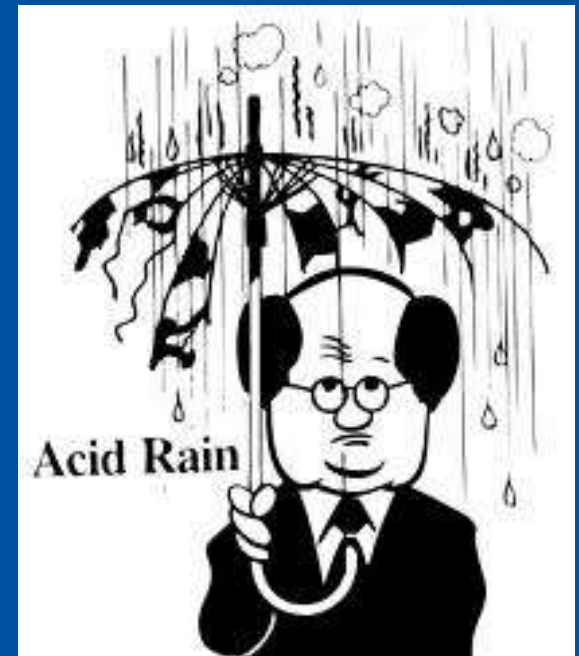
Fertilizers and the Nitrogen and Phosphorus Cycles

- **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, algal bloom**.
- Excess algae can deplete an aquatic ecosystem of important nutrients such as **oxygen**, on which fish and other aquatic organisms depend.



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**.



Acid Rain Explained via YouTube!

Acid Rain Explained

Ticket Out the Door

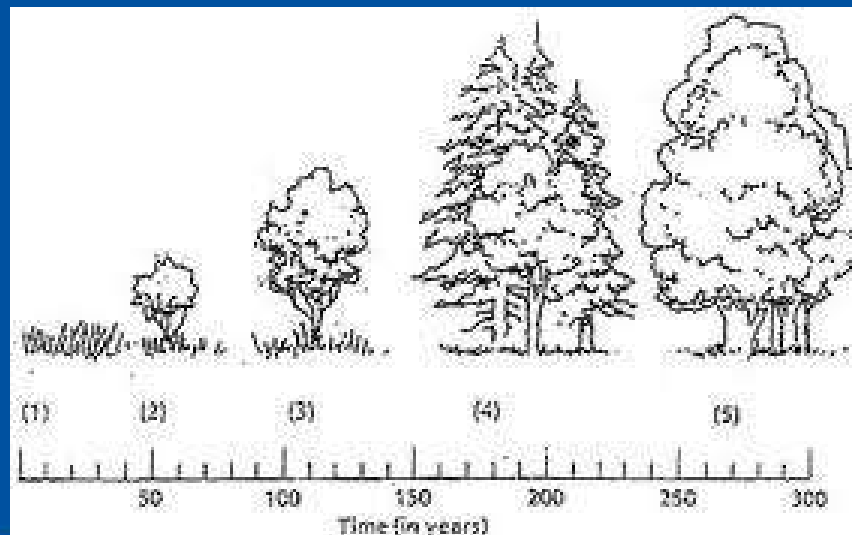
1. What is carbon the essential component of?
2. How do humans affect the carbon cycle?
3. What process occurs by having increased carbon dioxide levels?
4. Why do organisms need nitrogen?
5. What percent of nitrogen do we find in the atmosphere?
6. What is acid precipitation?

Chapter 5
How Ecosystems Work
Section 3: How Ecosystems Change

DAY ONE

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.



Ecological Succession

Ecological Succession Video

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.

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.

Climax Community

Climax Community

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 they feed on the vegetation that sprouts after a fire has cleared the land.

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.

Ecological Succession

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Ecological Succession

- **Primary succession** can occur on new islands created by **volcanic eruptions**.
- Primary succession is much slower than secondary succession. This is because it begins where there is no soil.

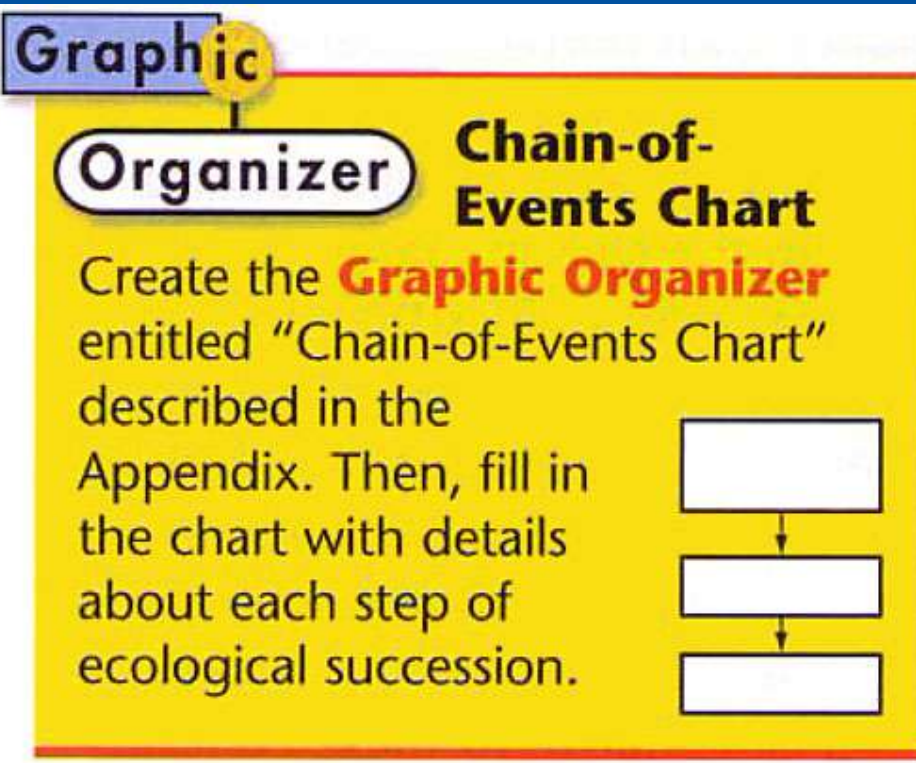


Ecological Succession

- 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.



Graphic Organizer



Graphic Organizer **Chain-of-Events Chart**

Create the **Graphic Organizer** entitled "Chain-of-Events Chart" described in the Appendix. Then, fill in the chart with details about each step of ecological succession.

```
graph TD; A[ ] --> B[ ]; B --> C[ ]
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The graphic organizer is a yellow rectangular box with a red border. It contains the title "Graphic Organizer" in a purple box and "Chain-of-Events Chart" in bold black text. Below the title, there is a paragraph of text and a diagram consisting of three white rectangular boxes arranged vertically, connected by downward-pointing arrows.