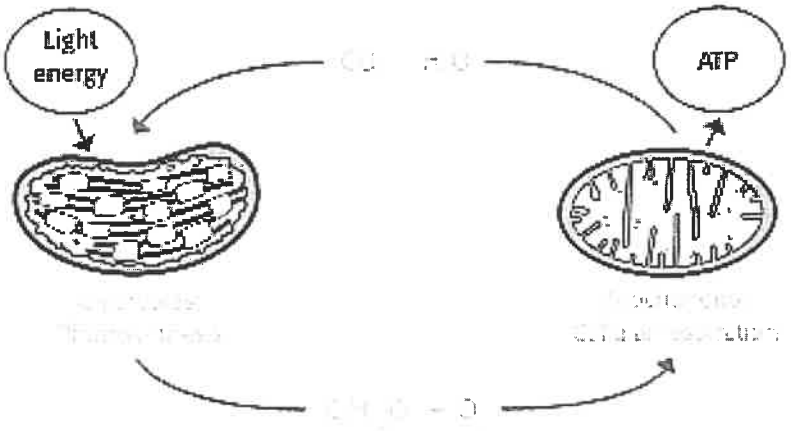
1. Read the passage and annotate.
2. Answer the question in complete sentences.

Photosynthesis and Respiration

How do organisms get the energy they need to power life's processes?



The end products of **photosynthesis** are the raw materials of **cellular respiration**.

During **photosynthesis**, green plants and algae trap the energy in sunlight and use it to make food. In their cells, organelles called chloroplasts contain the green pigment **chlorophyll**, which absorbs solar energy. This energy is used to combine carbon dioxide (CO_2) from the air and water (H_2O) from the soil to form sugar ($C_6H_{12}O_6$) and oxygen (O_2). Some of the trapped energy from the sun is stored in the bonds of the sugar molecules as chemical energy. The plant uses sugar, a **carbohydrate**, for food.

From the chloroplasts, the sugar moves to the mitochondria. There, **cellular respiration** occurs. In this process, sugar is broken down and combined with oxygen from the air. Carbon dioxide and water form, and energy is released. The energy is transferred to **ATP**, a molecule that supplies energy to cells.

Unlike plants, animals cannot trap light energy and produce their own food. That's because their cells have no chloroplasts and no chlorophyll. Instead, animals take in food. When the carbohydrates in food are digested, sugar forms. The sugar is then broken down to release energy. Cellular respiration occurs in the mitochondria of animal cells just as it occurs in the mitochondria of plant cells.

The energy source for all life processes is the sun. **Producers** trap solar energy during photosynthesis. **Consumers** eat either producers or other consumers that eat producers. Thus, animals also depend on the sun for energy.

Show What You Know

How are the cellular activities of plants and animals alike? How are they different?

_____

_____

_____

1. Read each passage, annotate, and complete guided questions
2. Color each illustration. Use the key to help you!

Chapter 11-9: The Water Cycle

Water is the most abundant substance in living things. The human body, for example, is composed of about 70% water, and jellyfish are 95% water. Water participates in many important biochemical mechanisms, including photosynthesis, digestion, and cellular respiration. It is also the habitat for many species of plants, animals, and microorganisms, and it participates in the cycling of all of the materials used by living things. Water is distributed through the biosphere in a cycle known as the water, or hydrologic cycle. In this plate, we will examine some aspects of that cycle.

In this plate, we show the biosphere and several arrows that show the movement of water through it. Our primary emphasis will be on the arrows; and you should color them in darker colors than the other aspects of the biosphere.

We begin by looking at the atmosphere, which includes the clouds. When water vapor cools, it condenses and falls to Earth as rain. For instance, look at the arrow labeled (A), or precipitation over land; gravity draws the water back to Earth in the form of rain, sleet, and snow. Precipitation also occurs over oceans (B).

We have begun our discussion of the water cycle by showing how water reaches the Earth. We will now see how it is stored in living things before it is returned to the atmosphere. Continue your reading as you color the diagram, including its arrows.

The living things on Earth are represented, in our diagram, by the trees. Water is absorbed by the roots of the trees and used in photosynthesis, but it is also lost from their leaves through the process of transpiration (C). Water also returns to the atmosphere through evaporation from the soil and from numerous other sources. In general, the amount of precipitation received by an area helps determine what types of plants will grow there. The nature of the vegetation, in turn, determines the types of animals that inhabit a region.

Water from the land enters the ocean through seepage from the ground (D); it percolates from the surface down to the water table. This water-saturated zone of soil and rock is called an aquifer, and water seeps from the aquifer to the ocean.

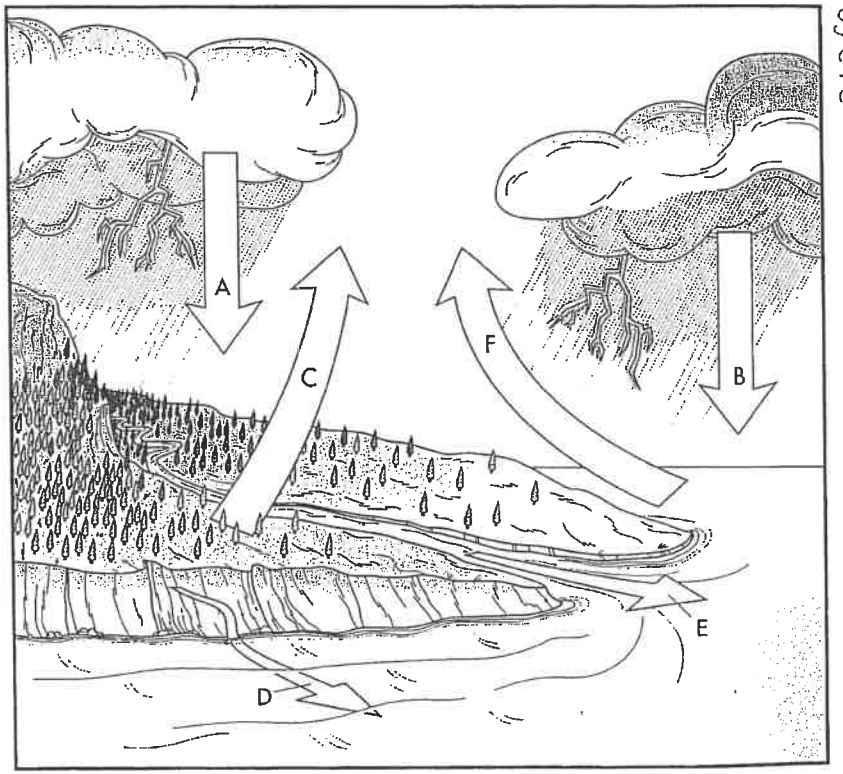
Water also reaches the ocean as runoff from the surface (E). Runoff from the surface includes flow from rivers as well as melting snowfields and glaciers.

Now that we have described how water reaches the oceans, we will explore how it returns to the atmosphere, completing the hydrologic cycle. Continue reading below as you complete your coloring.

The major reservoirs of water on Earth are the oceans. Oceans cover about three-quarters of Earth's surface and contain about 97% of its water. Solar radiation causes water's evaporation from the ocean (F). Over 80% of the evaporated water in the hydrologic cycle enters the atmosphere in this way, and about 52% of this falls back into the oceans in the form of rain. The remainder remains in the atmosphere as clouds, ice crystals, and water vapor and then precipitates over land. On a global scale, the quantity of ocean water that evaporates each year is equivalent to a layer that's 120 cm deep and covers the entire surface of the ocean.

Water Cycle

1. Name three important needs for water?
2. How is water distributed throughout the biosphere?
3. What is transpiration?
4. What is an aquifer?
5. Name two ways water travels from the land to enter the ocean.
6. What does runoff include?



The Water Cycle

- ○ Precipitation Over Land.....A
- ○ Precipitation Over Ocean.....B
- ○ Transpiration C
- ○ Seepage From Ground ....D
- ○ Runoff From Surface ....E
- ○ Evaporation from Ocean .....F

1. Read each passage, annotate, and complete the guided questions.
2. Color each illustration. Use the Key to help you!

CHAPTER ELEVEN

Chapter 11-10: The Carbon Cycle

Energy flows from the sun into the biosphere, but nutrients do not enter the biosphere from an outside source. Essentially, the same pool of nutrients has circulated for the billions of years that the Earth has been in existence. Some nutrients, called macronutrients, are used by organisms in large quantities, while others, micronutrients, are used only in trace quantities. Macronutrients include carbon, hydrogen, oxygen, nitrogen, and phosphorus; micronutrients include iodine, iron, zinc, and some others.

Both macronutrients and micronutrients are recycled; they are passed back and forth between living and nonliving components of the ecosystem in processes that we call biogeochemical cycles. This plate and the ones that follow trace the pathways of several elements through biogeochemical cycles.

The prime focus of this plate is on the arrows that show how carbon travels among components of the biosphere. You should use darker colors for the arrows.

Material substances are incorporated into organic compounds by primary producers. Primary producers are then consumed by secondary consumers, and decomposers are ultimately responsible for releasing the material back into the nonliving environment.

We will begin our study of the carbon cycle with the **atmosphere (A)**, which is Earth's major reservoir of carbon, in the form of carbon dioxide. Carbon enters the biotic (living) part of the ecosystem through **photosynthesis (B)**. We suggest a green color for the arrow. Plants of the **forest (C)** take the carbon in carbon dioxide and fix it in organic compounds such as glucose, starch, cellulose, and other carbohydrates. **Respiration in plants (D)** returns carbon dioxide to the atmosphere; an arrow shows this process.

We have seen how carbon enters the cycle of living things through photosynthesis, and we will now see how it passes through various life forms. Continue your reading below as you color.

Plants are primary producers. In the course of **plant consumption (E)**, carbon passes into primary consumers, animals. When **animal consumption (F)** occurs, or when the primary consumer is eaten, carbon passes to a secondary consumer, represented by the lion in the plate. **Respiration (G)** takes place in cells of the primary and secondary consumers, and carbon is released back into the environment as carbon dioxide.

When the primary and secondary consumers die, their organic matter enters the soil through the process of **decay (H)**. It is broken down by the decomposers, or **detritus feeders (I)**, which are small animals and microorganisms that subsist on decaying matter such as fallen leaves, dead bodies, and animal waste. Earthworms, mites, centipedes, insects, and crustaceans are detritus feeders. Thus, **respiration in detritus feeders (J)** also returns carbon to the atmosphere.

We have seen how carbon cycles through various living things on Earth. We will now turn to a storage process for carbon in the soil. Continue your reading below as you complete the plate.

Throughout history, much carbon has been converted to fossil fuel (K). High pressure and temperature transform carbon-containing organic matter into coal, oil, and natural gas. **Fossil fuel processing (L)** follows. There are many uses for fossil fuels (M). Some power plants generate electricity using fossil fuels, and automobiles are powered by gasoline. The **products of the combustion (N)** of fossil fuels include carbon dioxide and other carbon compounds that enter the atmosphere. Carbon also enters the environment from the burning of wood and plants that occurs during **forest fires (O)**.

A final aspect of the carbon cycle that we will examine is **exchange with oceans (P)**. Some carbon dioxide from the air dissolves in oceans and combines with calcium to form calcium carbonate, which is incorporated into the shells of mollusks and other creatures. When these shells decay, they transform into limestone, which, over time, dissolves as it is exposed to water. Carbon is released from the limestone and may return to the atmosphere.

The Carbon Cycle

1. Where is most of the Earth's Carbon located and in what form?

2. How does carbon enter the living (biotic) part of the ecosystem?

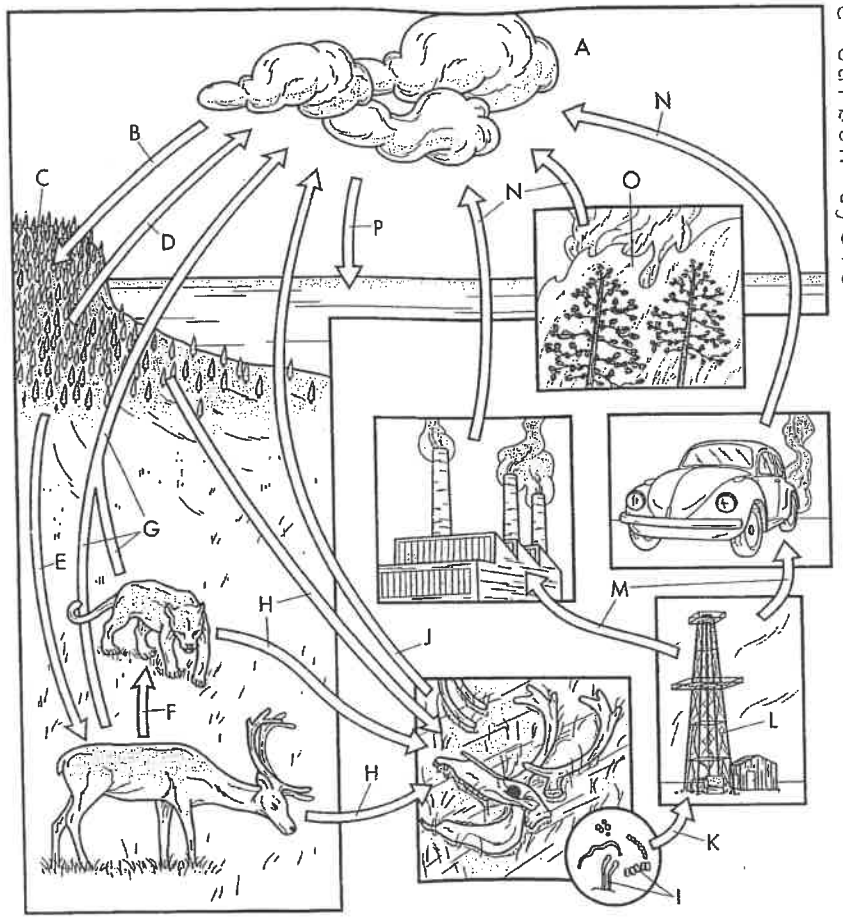
3. How are plants a part of the carbon cycle?

4. How is carbon dioxide returned to the atmosphere?

5. What happens when consumers die?

6. What is a fossil fuel?

7. How does carbon get into the ocean?



The Carbon Cycle

- Atmosphere .....A
- Photosynthesis .....B
- Forest C
- Respiration in Plants..D
- Plant Consumption.....E
- Animal Consumption ....F
- Respiration in Animals.....G
- Decay.....H
- Detritus Feeders I
- Respiration in Detritus Feeders.....J
- Conversion to Fossil Fuel .....K
- Fossil Fuel Processing L
- Uses for Fossil Fuel ..M
- Products of Combustion .....N
- Forest Fire.....O
- Exchange with Oceans ..P

1. Read each passage, annotate, and complete the guided questions.
2. Color each illustration. Use the key to help you!

Chapter 11-11: The Nitrogen Cycle

An important process in ecosystems is the recycling of nitrogen through its living (biotic) and nonliving (abiotic) components. The living components, or biota, of the ecosystem participate in the nitrogen cycle in a number of ways, as you will see in this plate.

If you look closely at the plate, you will notice that we show the various ways in which nitrogen cycles through nature. As you color the plate, the arrows should be emphasized.

Approximately 78% of the air is composed of diatomic nitrogen. Nitrogen is essential to life because it is a key component of amino acids and nucleic acids. Even ATP, the basic energy currency of living things, contains nitrogen.

Neither plants nor animals can obtain nitrogen directly from the atmosphere (A). Instead, they must depend on a process called nitrogen fixation (B). Key players in nitrogen fixation are legumes (C) and the symbiotic bacteria that are associated with their root nodules. Legumes include clover, peas, alfalfa, and soybeans. The bacteria associated with their root nodules are nitrogen-fixing bacteria (D). These bacteria convert nitrogen in the soil to ammonia (NH_3), which can be taken up by some plants. The bacteria and the plant are in a symbiotic relationship. Cyanobacteria are also nitrogen-fixing bacteria; they are prominent in aquatic ecosystems.

We have seen how nitrogen is brought into the biotic component of the ecosystem via nitrogen-fixing bacteria. We will now focus on how nitrogen is cycled through the living aspects of the ecosystem.

Nitrogen is fixed into the soil through the actions of free-living bacteria and, as we mentioned above, through bacteria that's associated with root nodules of legumes. Both of these methods of fixing nitrogen lead to its incorporation into ammonia (NH_3) in the process known as ammonification (E). The soil is a major reservoir for ammonia and other nitrogen-containing compounds. After nitrogen has been fixed, other bacteria convert it into nitrate, in a process called nitrification (F). In the first step of nitrification, *Nitrosomonas* (G) convert ammonia to nitrite (NO_2), and in the second step, nitrite is converted to nitrate (NO_3), by *Nitrobacter* (H). The nitrate (NO_3) is then consumed by plants (I), as the diagram shows.

But not all plants consume nitrate; as we mentioned before, some plants are able to use the ammonia from the soil. In both cases, nitrogen enters the primary producers in the biotic community. The plants may then be consumed by animals (J). Herbivores are the primary consumers, and the nitrogen of the plants is used for the synthesis of key organic compounds such as amino acids, proteins, and nucleic acids.

We have seen how nitrogen is fixed in the soil and eventually utilized by plants and then animals. We will now complete the cycle of nitrogen by showing how it returns to the atmosphere. Continue your reading as you color the final aspects of the plate.

The final aspect of the nitrogen cycle is the process of denitrification (K). This process is performed by a variety of microscopic bacteria, fungi, and other organisms. Nitrates in the soil are broken down by these organisms, and nitrogen is released into the atmosphere (A). This completes the nitrogen cycle.

The Nitrogen Cycle

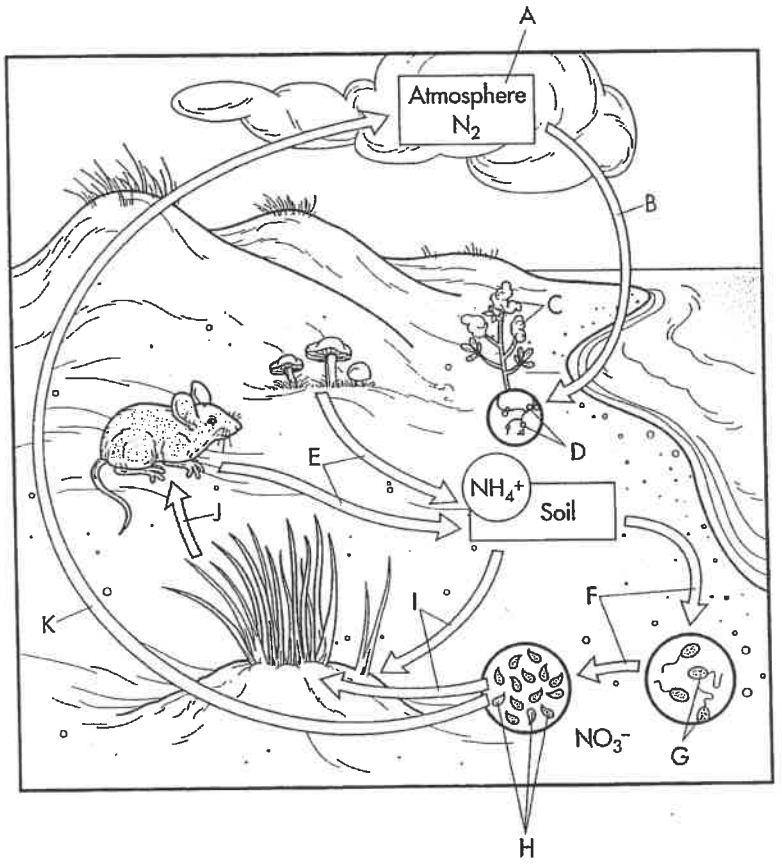
1. What percentage of the air is Nitrogen?

2. Why is nitrogen essential for life?

3. How do plants and animals get nitrogen if not from the atmosphere?

4. What are nitrogen fixing bacteria?

5. Why do herbivores need nitrogen?



The Nitrogen Cycle

○ Atmosphere .....A	○ Ammonification .....E	○ Consumption by Plants I
○ Nitrogen Fixation.....B	○ Nitrification.....F	○ Consumption by Animals.....J
○ Legume Plant C	○ *Nitrosomonas* .....G	○ Denitrification.....K
○ Nitrogen-Fixing Bacteria .....D	○ *Nitrobacter*.....H	