

## Answers to Questions for Comprehension

### Student Textbook page 36

**Q1.** Water has partial positive charges and partial negative charges. These partial charges attract oppositely charged ions. The partial positive charges of water's hydrogen atoms, for example, attract the negatively charged phosphate ions.

### Student Textbook page 37

- Q2. (a)** It takes considerable energy to break the many hydrogen bonds between water molecules in a volume of water. As a result, water does not change from a liquid to a gas until about 100 °C. Similarly, water freezes at 0 °C. Over this wide temperature range, water remains a liquid and therefore able to dissolve and transport nutrients.
- (b)** Due to hydrogen bonding, water is most dense at 4 °C. In spring, water from melting ice on the lake surface warms to 4 °C and sinks, displacing cooler water. Similarly, as winter approaches and the warm lake water cools towards 4 °C, it becomes denser and sinks, displacing warmer water. As water sinks and rises, it cycles nutrients with it.
- (c)** Adhesion—hydrogen bonding between water molecules and molecules of other substances—causes water to cling to the inside surface of a plant's xylem. As water evaporates from a plant's leaves, more water is drawn up through the xylem because of cohesion—the attraction of water molecules to each other due to hydrogen bonding.

## **Answers to Questions for Comprehension**

### **Student Textbook page 39**

- Q3.** Metabolic water is the water produced by cellular respiration.
- Q4.** Organisms gain water by eating, drinking, and absorbing water (animals through skin, plants through roots), and as a waste product of metabolism.
- Q5.** Organisms lose water via evaporation, including breathing and sweating in animals and transpiration in plants. Animals also lose water in feces and urine.

## Answers to Questions for Comprehension

### Student Textbook page 44

- Q8. (a)** Plants take up carbon dioxide from the air and use it to create carbon compounds through photosynthesis. During forest fires or when plant matter decomposes, carbon is released to the atmosphere.
- (b)** Animals consume carbon-rich organisms and release carbon dioxide as an end product of cellular respiration. Decomposition of animal matter also releases carbon into the biosphere.

## Answers to Questions for Comprehension

### Student Textbook page 43

- Q6.** A nutrient reservoir is a component of the biosphere in which nutrients temporarily accumulate. Examples include soil, water, and organisms.
- Q7.** When organic matter accumulates, it can move out of the rapid cycling of nutrients and become part of the slow cycling of nutrients through fossilization and the formation of sediments, and as such, becomes unavailable to living organisms. Weathering, erosion, and burning fossil fuels can release accumulated substances back into the rapid cycling of nutrients.

## Answers to Questions for Comprehension

### Student Textbook page 46

- Q9.** Earth's major carbon sinks are the oceans, forests, petroleum deposits, and limestone rock.
- Q10. (a)** Deforestation reduces photosynthesis by reducing the number of producers, and thereby reducing the amount of carbon dioxide that is removed from the atmosphere by these organisms. Students may also mention that when biomass, such as brush and branches, is left to decompose on the ground after deforestation or is burnt after harvesting, carbon dioxide is also released into the atmosphere. If the trees that are harvested are burnt, this carbon will also be released into the atmosphere.
- (b)** Burning fossil fuels takes carbon out of slow cycling as it quickly releases carbon dioxide into the atmosphere.
- (c)** Frequently, agriculture relies on deforestation, and as a result, atmospheric carbon dioxide will increase as photosynthesis decreases (trees remove a great deal more carbon dioxide from the air than agricultural crops).

## Answers to Questions for Comprehension

### Student Textbook page 48

- Q11.** Small amounts of acid deposition are natural, and return sulfur from the atmosphere to the oceans and soil where organisms can use it. Large amounts of acid deposition, however, damage plants, acidify lakes, kill fish and other aquatic organisms, and leach nutrients from the soil. Some students may also mention that nitrogen can play a role in acid deposition as well.
- Q12.** Bacteria convert sulfur from one form to another. Sulfate reducers convert sulfate to sulfide and elemental sulfur, while sulfur oxidizers convert sulfide to elemental sulfur and sulfate.

## Answers to Questions for Comprehension

### Student Textbook page 49

**Q13.** Plants can use ammonium or nitrate.

**Q14.**  $\text{N}_2(\text{g}) \rightarrow \text{NH}_4^+ \rightarrow \text{NO}_2^- \rightarrow \text{NO}_3^-$   
nitrogen gas  $\rightarrow$  ammonium, nitrite  $\rightarrow$  nitrate

### Student Textbook page 50

**Q15.** Organisms need phosphorus to make ATP, DNA, and teeth and bones.

**Q16.** Phosphorus is found in organisms, soil, water, and rock (through gradual weathering). It is mainly transported through water and does not cycle through the atmosphere.

**Q17.** Increased amounts of phosphorous in aquatic environments can result in algal blooms. Algal overgrowth may block sunlight, resulting in the death of aquatic plants. Decomposition of the resulting organic matter reduces oxygen levels in the water, and as a result, many aquatic life forms may die.

## **Answers to Questions for Comprehension**

**Student Textbook page 55**

- Q18.** Increased amounts of sunlight allows for more photosynthesis, and thus more productivity, as long as sufficient water is available. Too much ultraviolet radiation, however, can inhibit photosynthesis and limit the growth of plants.
- Q19.** Other than nutrients, the two major factors that limit productivity are sunlight and water.