Q4. Producers and consumers are linked though the processes of photosynthesis and cellular respiration: The products of cellular respiration are reactants in photosynthesis, and the products of photosynthesis are the reactants of cellular respiration. Specifically, producers, such as plants, algae, and some bacteria, use carbon dioxide, energy from the Sun, and water to make energy-rich organic molecules (glucose). This process also releases oxygen. Consumers eat producers or other consumers to gain the fuel required to carry out their life processes. Both producers and consumers use oxygen to release the energy in glucose via cellular respiration, and in the process release carbon dioxide and water.

Answers to Questions for Comprehension

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Q1. Cellular respiration is a process that releases the energy stored in carbohydrates and other energy-rich organic molecules. The chemical reactions involved in cellular respiration occur in most species, including species of plants and animals.

Q2. Photosynthesis is the process that producers, such as plants, algae, and some bacteria, use to chemically convert carbon from carbon dioxide into carbohydrates using light energy from the Sun.

Q3. Through photosynthesis, producers use the Sun's light energy to make energy-rich organic molecules. Through cellular respiration, producers, decomposers, and consumers release the energy stored in energy-rich organic molecules. The energy released by cellular respiration supports organisms' activities.

Answers to Questions for Comprehension

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Q5. Earth's land and ocean surfaces absorb 51% of the incoming radiant energy from the Sun.

Q6. The amount of energy from the Sun that reaches producers is a tiny fraction of the energy from the Sun that reaches Earth's atmosphere.

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Q7. Chemosynthesis and photosynthesis are both carried out by autotrophs. Chemosynthetic micro-organisms use energy stored in inorganic hydrogen sulfide molecules to make energy-rich organic molecules. These chemosynthetic micro-organisms obtain the building blocks for these organic molecules from carbon dioxide and water. Similarly, photosynthetic autotrophs use carbon dioxide and water to build organic molecules, but the energy they use to make these molecules is solar energy. Further, while oxygen is a product of photosynthesis, chemosynthesis produces sulphuric acid.

Q8. Herbivores are classified as primary consumers because they are the first (primary) eaters of plants and other producers.

Q9. Secondary consumers eat primary consumers. Secondary consumers include carnivores that eat mainly herbivores. Tertiary consumers eat secondary consumers. Tertiary consumers include carnivores that eat mainly other carnivores.

Q10. Decomposers do not directly capture energy from the Sun or from inorganic molecules; therefore, decomposers are not producers. Because decomposers consume organic matter and obtain energy from the energy-rich molecules within, they are heterotrophic organisms. As a result, producers are essential to all life on Earth, as they contribute useable energy to the biosphere via photosynthesis.

Answer to Question for Comprehension

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Q11. The first law of thermodynamics states that energy cannot be created or destroyed. Since organisms cannot create the energy they need, they must obtain energy from other sources: sunlight, inorganic chemicals, other organisms, and organic waste. The second law of thermodynamics states that with every energy conversion, there is less energy available to do useful work. Cellular respiration, for example, is not 100% efficient: Some of the energy stored in glucose is converted into heat that disperses into the environment.

Answers to Questions for Comprehension

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Q12. Organisms can be identified by how they obtain their food and what they eat: i.e., as producers, herbivores, carnivores, and decomposers. Organisms can also be identified as types of food-makers or food-consumers: i.e., as producers, primary consumers, secondary consumers, and tertiary consumers. Finally, organisms can be identified by their trophic level (feeding level) in an ecosystem. Organisms at higher trophic levels eat organisms at lower trophic levels.

Q13. A trophic level is a feeding level through which energy and matter are transferred in an ecosystem.

Q14. The first trophic level consists of producers. All other trophic levels consist of consumers. The second trophic level consists of primary consumers, the third trophic level consists of secondary consumers, and the fourth trophic level consists of tertiary consumers. Decomposers feed at all trophic levels.

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Q15. When an organism consumes a meal, only 5-20% of the chemical energy available in that meal is incorporated into the organism's body tissues. The rest is lost to the environment as heat produced during cellular respiration or passes out through waste products. The energy in waste and heat is not available to the next trophic level, thus only a small percentage of the original energy is transferred.

Q16. Since only about 5-20% of the energy available at one trophic level is transferred to the next trophic level, eventually there is not enough usable energy to pass on.

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Q17. A pyramid of numbers is upright when the organisms at higher trophic levels are fewer in number than the organisms at lower trophic levels. A pyramid of numbers is inverted when the organisms at higher trophic levels are greater in number than the organisms at lower trophic levels. For example, an inverted pyramid of numbers would be used to depict an ecosystem in which thousands of plant-eating insects live off one or two trees.

number of organisms found in each trophic level. Similarly, it differs from a pyramid of biomass, which depicts the relative dry mass, in grams per square metre, of organisms in each trophic level. Unlike a pyramid of numbers or a pyramid of biomass, a pyramid of energy is always upright, because there can never be more energy in a higher trophic level than in a lower trophic level.

Answer to Question for Comprehension

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Q18. A pyramid of energy depicts the total amount of energy that is transferred through each trophic level. This differs from a pyramid of numbers, which depicts the total