Part A—Multiple Choice

1. Which of the following is an autotroph?
   1. lizard
   2. cactus
   3. shark
   4. antelope

2. In heterotrophs, energy for the life processes comes from the chemical energy stored in the bonds of
   1. water molecules
   2. organic compounds
   3. oxygen molecules
   4. inorganic compounds

3. During photosynthesis,
   1. animals use sunlight to convert the starch in plants into food
   2. animals use the oxygen released by plants to make carbon dioxide
   3. plants use the energy of sunlight to convert carbon dioxide and water into glucose and oxygen
   4. plants use the energy of sunlight to convert glucose and oxygen into carbon dioxide and water

4. The equation below represents an important biological process. This process is carried out within a cell's
   \[ \text{carbon dioxide + water} \rightarrow \text{glucose + water + oxygen} \]
   1. mitochondria
   2. cell membranes
   3. ribosomes
   4. chloroplasts

5. The source of energy for photosynthesis is
   1. oxygen
   2. sunlight
   3. carbon dioxide
   4. glucose

6. To occur, photosynthesis requires the presence of the green substance
   1. tree sap
   2. glucose
   3. chlorophyll
   4. copper

7. The approximate mass of a field of corn plants at the end of its growth period was 3 tons per hectare. Most of this mass was produced from
   1. water and organic compounds absorbed from the soil
   2. minerals and organic materials absorbed from the soil
   3. minerals from the soil and oxygen from the air
   4. water from the soil and carbon dioxide from the air

8. The diagram below represents part of the life process that occurs inside a leaf chloroplast. If the process were to be interrupted by a chemical at point X, there would be an immediate effect on the release of which substance?

![Diagram of photosynthesis]

   1. chlorophyll
   2. carbon dioxide
   3. nitrogen
   4. oxygen

9. The food produced by plants during photosynthesis is used
   1. by the plants themselves only
   2. by animals that eat them only
   3. by both the plants and the animals that eat them
   4. up at the end of the reaction

10. If stored energy were to be released too quickly, a cell would
    1. release too much heat
    2. produce ATP molecules
    3. become an autotroph
    4. become a heterotroph
Answer question 11 based on the following information and diagram.

The flow of energy through an ecosystem involves many energy transfers. The diagram below summarizes the transfer of energy that eventually powers muscle activity.

\[ \text{Sun} \rightarrow \text{Food} \rightarrow \text{ATP} \rightarrow \text{Muscle Activity} \]

11. The process of cellular respiration is represented by
   1. arrow A only
   2. arrow B only
   3. arrow C only
   4. arrows A, B, and C

12. How do humans and plants interact in terms of the two gases involved in photosynthesis?
   1. Humans take in the CO₂ released by plants and release O₂ to the plants.
   2. Humans take in the O₂ released by plants and release CO₂ to the plants.
   3. Plants and humans usually compete for the same O₂ available in the air.
   4. Plants and humans usually compete for the same CO₂ available in the air.

13. Cellular respiration occurs in
   1. autotrophs only
   2. heterotrophs only
   3. autotrophs and heterotrophs
   4. humans only

14. Eating a sweet potato provides energy for human metabolic processes. The original source of this energy is the energy
   1. in protein molecules stored within the potato
   2. that is made available by photosynthesis
   3. from starch molecules absorbed by the potato plant
   4. in vitamins and minerals found in the soil

15. In nature, during a 24-hour period, green plants continuously use
   1. carbon dioxide only
   2. oxygen only
   3. both carbon dioxide and oxygen
   4. neither carbon dioxide nor oxygen

16. Plant leaves contain openings known as stomates, which are opened and closed by specialized cells, allowing for gas exchange between the leaf and the outside environment. Which phrase best describes the net flow of gases involved in photosynthesis into and out of the stomates on a sunny day?
   1. carbon dioxide moves in, oxygen moves out
   2. oxygen moves in, nitrogen moves out
   3. carbon dioxide and oxygen move in, ozone moves out
   4. water and ozone move in, carbon dioxide moves out

Part B—Analysis and Open Ended

Answer question 17 based on the following information and graph.

As the depth of the ocean increases, the amount of light that penetrates to that depth decreases. At about 200 meters, there is almost no light present. The graph below illustrates the population size of four different species at different water depths.

17. Which species most likely performs photosynthesis?
   1. species A
   2. species B
   3. species C
   4. species D

18. Explain why plants are defined as autotrophs and why animals are defined as heterotrophs.

19. Why might the process of photosynthesis be considered a “bridge” between the living and nonliving parts of the world?
20. Briefly describe three ways in which the structures of a leaf enable the process of photosynthesis to occur. Your answer should include the following factors:

- light
- water
- gases

Base your answers to questions 21 and 22 on the summary equations of two processes shown below and on your knowledge of biology.

**Photosynthesis**

\[ \text{water + carbon dioxide} \rightarrow \text{glucose + oxygen + water} \]

**Respiration**

\[ \text{glucose + oxygen} \rightarrow \text{water + carbon dioxide} \]

21. Choose one of the processes shown above and identify the following:

a. the source of the energy in the process you chose; and
b. where the energy ends up at the end of that process.

22. State one reason why each of the following processes is important for living things:

a. respiration; and
b. photosynthesis.

Base your answers to questions 23 to 25 on the information and diagram below and on your knowledge of biology.

The diagram represents a system in a space station that includes a tank containing algae. An astronaut from a spaceship boards the space station.

23. Identify one process that is being controlled in the setup shown in the diagram.

24. State two changes in the chemical composition of the space station atmosphere as a result of the astronaut coming on board the station.

25. State two changes in the chemical composition of the space station atmosphere that would result from turning on more lights.

Base your answers to questions 26 and 27 on the information and diagram below.

The diagram represents a single-celled organism known as *Euglena*. This organism is able to carry out both photosynthesis and cellular respiration.

26. Choose one of the two processes that *Euglena* carries out. Write down the word for it; then use words or chemical symbols to summarize the reaction for the process you chose.

27. State one reason why the process you chose is essential for the survival of the *Euglena*.

28. Look at the chart on page 54 to answer this question. Which phrase would you choose to fill in the missing title?
1. Some Living Factors in the Environment
2. The Chemical Process of Photosynthesis
3. Factors That Affect the Rate of Photosynthesis
4. The Nonliving Things That Make Up a Plant

29. Look at the following diagrams (A and B) to answer this question. The energy change in diagram B is different from the energy change in diagram A because, in diagram B,

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--- ATP
   \|\ ATP
   \|\ ATP
   \|\ ATP
   \|\ ATP
   \|\ ATP
   \|\ ATP
   \|\ ATP
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--- Object burning
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1. the energy is released suddenly in one step
2. the energy is released in a series of steps
3. there is less stored energy at the beginning
4. there is less stored energy remaining at the end

Refer to the chemical equation below to answer questions 30 and 31.

\[
\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{CHLOROPHYLL}} \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2
\]

30. What important life process is described by this equation? What are the two vital products of this reaction?

31. Explain why “cellular respiration is basically the opposite” of the process shown in the equation. What are the two waste products of cellular respiration?
We walk on land. Even the very name Earth is used to mean land. But look at a world map and you will see a lot of blue space. In fact, more than 70 percent of Earth's surface is covered by water, mostly oceans. Unseen in these waters—drifting along with waves and currents—are countless numbers of tiny organisms. Photosynthetic bacteria, protists, and plants are included in these drifters. Some of these unicellular species are so small that if 12 million cells were lined up in a row, the line would be only about 1 centimeter long. In some places in the oceans, these microscopic organisms are so numerous that a cup of seawater may hold 24 million individuals of a single species, and that cup would contain other species as well!

These species are very small, but their importance to the overall life on the planet is huge. Tiny sea-dwelling organisms are the beginning food source for almost all living things in the oceans. It is easy for us land dwellers to understand that many animals eat plants to get food. We have seen cattle and sheep grazing on grasses in a pasture. The drifting cells in the ocean could be called the grass fields or pastures of the sea. Just like grass on land, the sea drifters capture energy from the sun and convert inorganic CO₂ and water into organic molecules, which become important foods for other organisms. On land, plants bloom with wild displays of colorful flowers in spring. The photosynthetic drifters in the pastures of the seas are said to “bloom” in the spring, too, as the water warms and nutrients from ocean depths are brought to the surface by currents. A great deal has been learned recently about the seasonal explosive growth of these photosynthetic cells in the ocean from photographs taken by orbiting satellites.

32. Explain why the drifting cells in the ocean can be called the grass fields or pastures of the sea.

33. Describe three ways in which microscopic drifting cells in the ocean are similar to plants on land.

34. How has modern technology improved our ability to study life in the ocean?