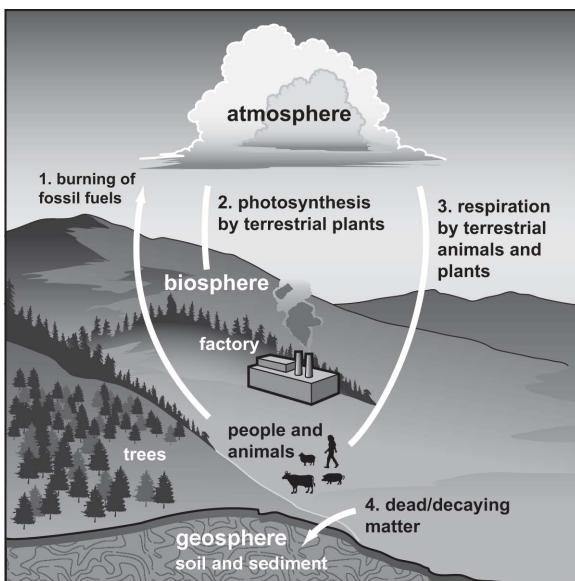


Unit Test: Matter and Energy in Living Systems

Read each question. Circle the letter of the correct answer.

1. Carbon dioxide from the atmosphere is dissolved in the seawater. Which process uses this dissolved carbon dioxide?
 - A. photosynthesis by oceanic fish
 - B. photosynthesis by phytoplankton
 - C. aerobic respiration by marine mammals
2. Brenda ran a race. During the race, she began to breathe heavily, and her muscles began to burn. Which statement explains why Brenda felt a burning?
 - A. The cells did not have enough oxygen.
 - B. The cells did not have enough glucose.
 - C. The cells had too much carbon dioxide.
3. Which statement explains the movement of energy through aerobic cellular respiration?
 - A. Heat energy is absorbed as chemical potential energy is transferred from oxygen molecules to ATP molecules.
 - B. Heat energy is released as chemical potential energy is transferred from oxygen molecules to ATP molecules.
 - C. Heat energy is released as chemical potential energy is transferred from glucose molecules to ATP molecules.
4. Alicia is making a model of photosynthesis and respiration. Which statement describes the role of glucose in Alicia's model?
 - A. Oxygen is an output for both respiration and for photosynthesis.
 - B. Glucose is an input for respiration and an output for photosynthesis.
 - C. Carbon dioxide is an input for respiration and an output for photosynthesis.
5. A certain water plant can live in either salt water or fresh water. The plants living in fresh water make 5 to 10 times as much glucose as those in salt water. Which statement best explains this difference?
 - A. The plants in fresh water have more oxygen.
 - B. The plants in salt water have less carbon dioxide.
 - C. The plants in fresh water have more chlorophyll.

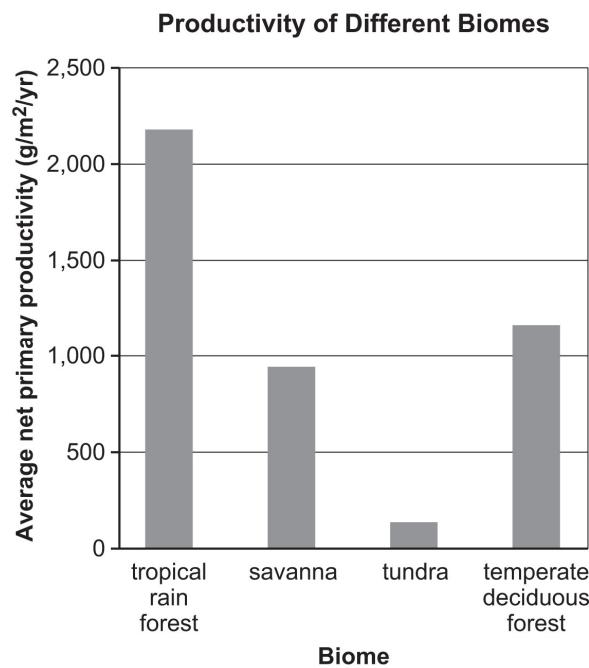
6. An incomplete carbon cycle is shown in the diagram.



Two arrows do not show direction. How should the arrows be changed to complete the diagram?

- A. Arrow 2 and 3 should both point up.
- B. Arrow 2 should point down, and arrow 3 should point up.
- C. Arrow 2 should point up, and arrow 3 should point down.

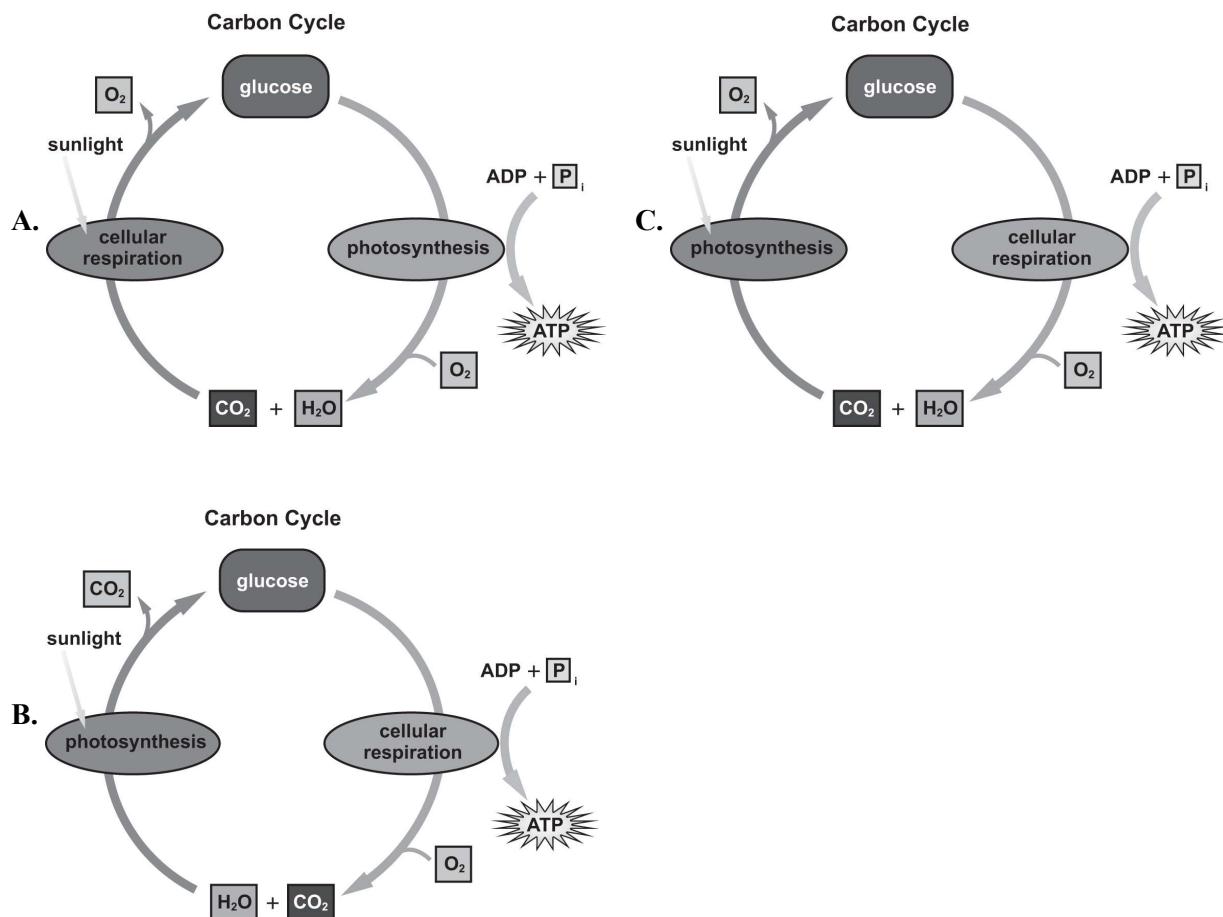
7. The primary productivity of an ecosystem is defined by the rate at which the producers can change inorganic substances into organic substances. The graph shows the primary productivity of four different biomes in grams per square meter per year ($\text{g/m}^2/\text{yr}$).



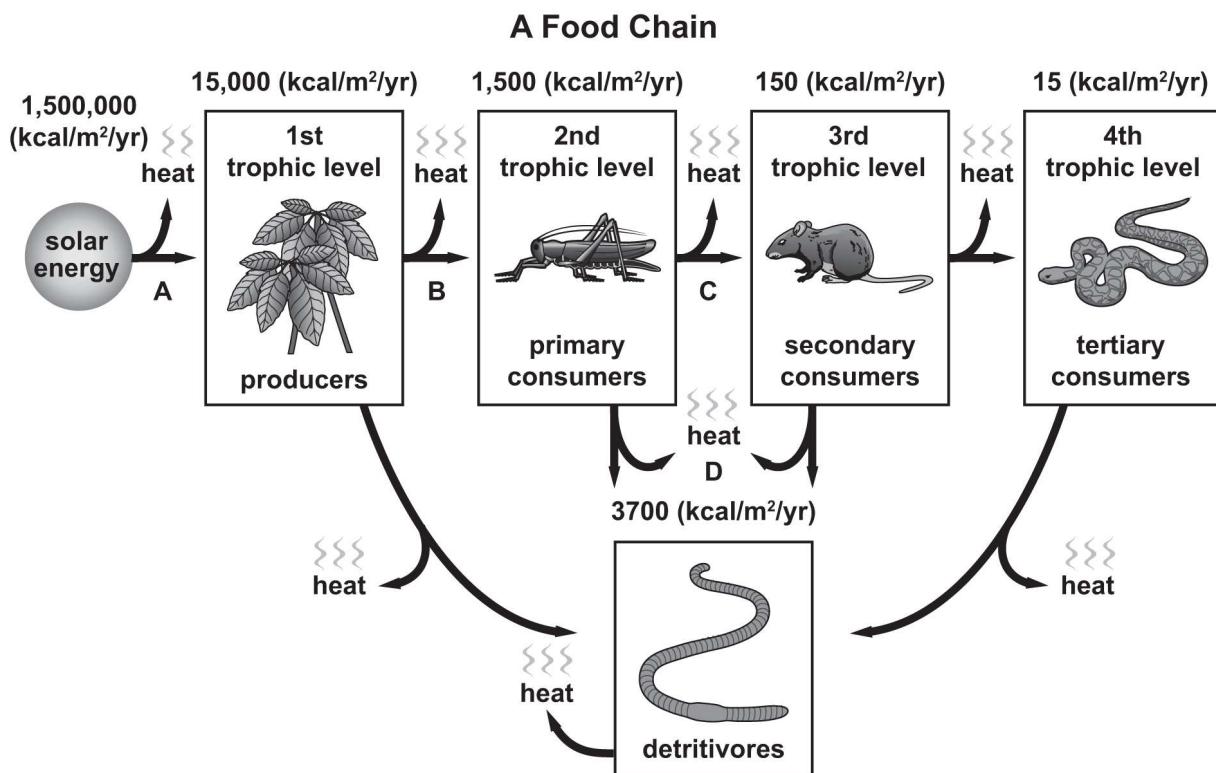
Which statement about the nitrogen cycle agrees with the data shown in the graph?

- A. More nitrogen is taken in in a tropical rainforest than in the savanna.
- B. More nitrogen is given off in the tundra than in a tropical rainforest.
- C. More nitrogen is taken in in the savanna than in a temperate deciduous forest.

8. Photosynthesis and cellular respiration transfer energy and cycle carbon through an ecosystem. Which diagram shows reactants and products in the carbon cycle?



9. The model shows the direction of movement of energy and matter through a food chain.



Which statement describes how energy and carbon move through a food chain?

- A. energy at lower trophic level = $0.1 \times$ energy at next trophic level
- B. energy at lower trophic level = $0.15 \times$ energy at next trophic level
- C. energy at lower trophic level = $10 \times$ energy at next trophic level

Read each question. Follow the instructions to answer the questions.

10. Write the letter of the words in the correct box to show whether it is an input or an output of glycolysis.
Some letters may be used more than once or not at all.

Input of glycolysis	Output of glycolysis

A. energy
B. oxygen
C. 6-carbon sugar

- 11.** A scientist is studying how certain human activities affect the phosphorous cycle. One of those activities is the use of fertilizer, which contains phosphorous. This phosphorous can end up in a watershed through the process of runoff. Write one letter in each blank to correctly complete the sentences.

Since phosphorous is a limiting factor in aquatic ecosystems, the direct result of excess phosphorous in the watershed is an increase in the amount of **1.** _____ in the habitat. When these organisms eventually die, decomposers break down the carbon-based molecules in their bodies through the process of **2.** _____. This process removes a large amount of the **3.** _____ from the water, which leads to the deaths of other aquatic organisms.

1. A. producers B. herbivores C. carnivores	2. D. decomposition E. photosynthesis	3. F. oxygen G. carbon dioxide
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- 12.** The area where the Mississippi River empties into the Gulf of Mexico contains little to no oxygen. This is caused by an excess of nutrients, including nitrogen, from various sources, such as agricultural runoff. Which activity could a farmer in this region do to help lower the amount of nitrogen added into the Mississippi River? Write each letter in the box beneath the correct heading.

Decreases nitrogen amounts	Increases nitrogen amounts	
		A. adding manure to the soil B. planting corn in a nitrogen-rich field C. adding commercial fertilizer to the soil

- 13.** Write one X for each activity to show whether the activity would add carbon to or remove carbon from the atmosphere.

Activity	Adds carbon to the atmosphere	Removes carbon from atmosphere
A. a factory burning fossil fuels		
B. a bush undergoing photosynthesis		
C. a caterpillar undergoing respiration		

- 14.** A student is making a model of the inputs and outputs of cell respiration. Write one letter in each blank to correctly complete the passage about changes in matter and energy during the process of cellular respiration.

The inputs of cellular respiration are glucose and 1. _____, and bonds in these molecules are broken.

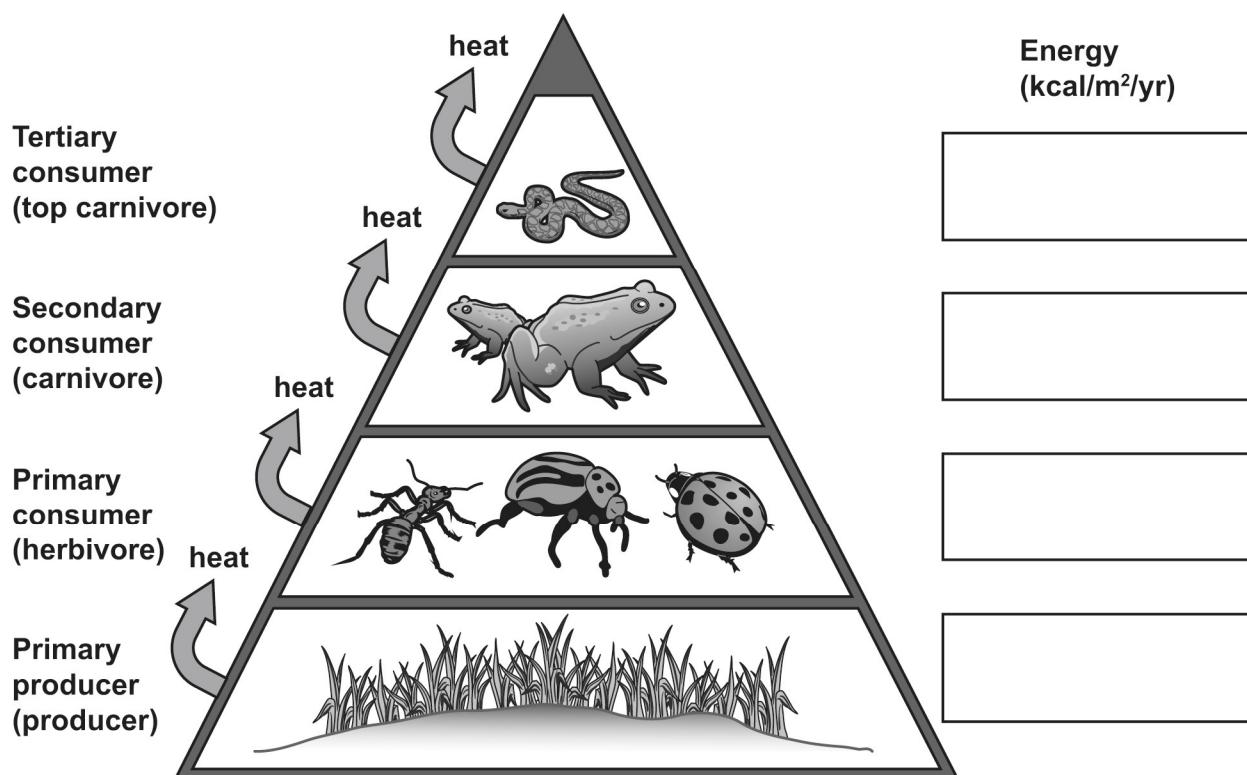
The outputs of cellular respiration are 2. _____ and water, and new bonds are formed in these molecules. The energy stored in one molecule of glucose leads to many molecules of 3. _____.

1. and 3.

- | | |
|-------------------|------------------|
| A. ATP | D oxygen |
| B oxygen | E glucose |
| C. carbon dioxide | F carbon dioxide |

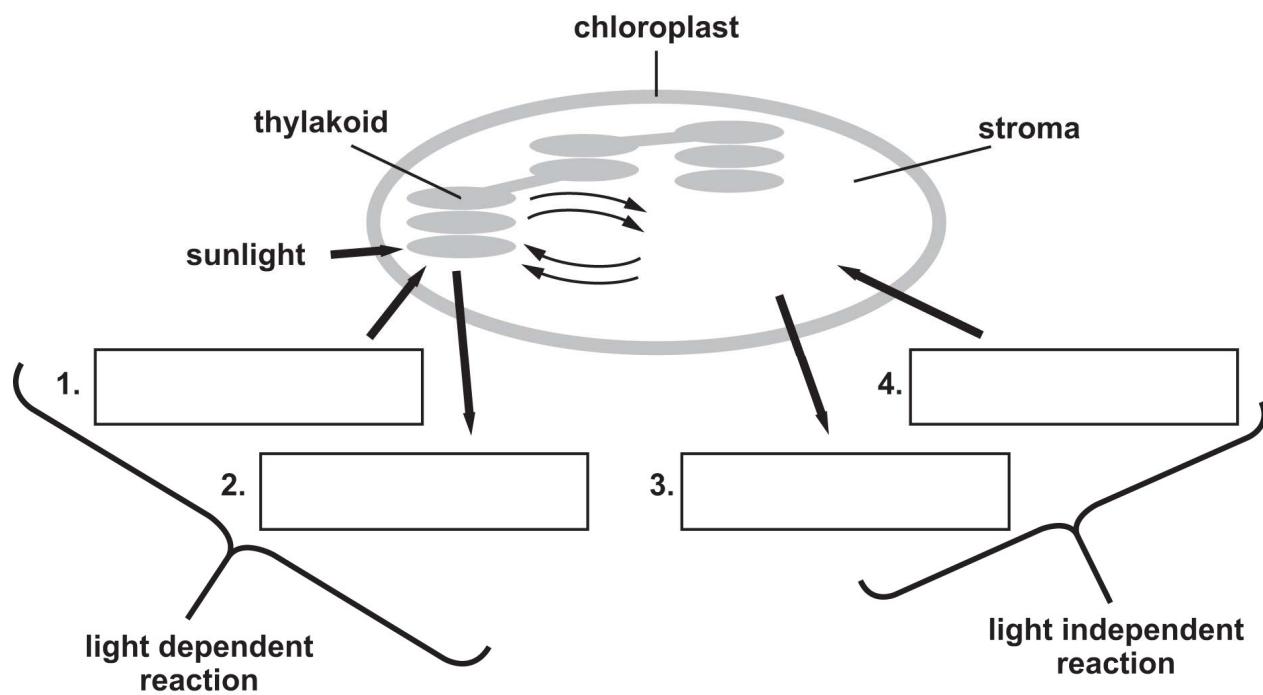
2.

- 15.** The energy pyramid model shows the movement of energy in an ecosystem. In this ecosystem, the primary consumers have available to them about 10,000 kilocalories per square meter per year ($\text{kcal}/\text{m}^2/\text{yr}$) from plants. About 10% of the energy at each trophic level is passed on to the next level. How much energy is available at each trophic level? Write the letter of the energy values in the correct boxes in the energy pyramid.



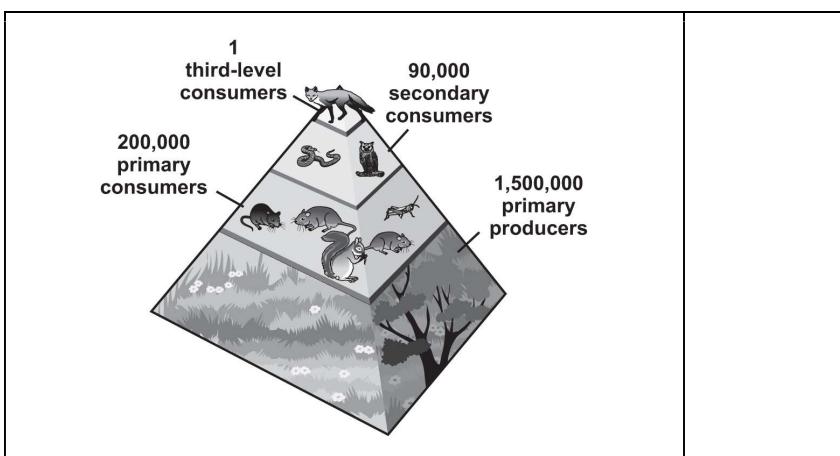
- | | |
|----------|------------|
| A. 100 | C. 10,000 |
| B. 1,000 | D. 100,000 |

16. The process of photosynthesis includes multiple steps. Write one letter in each box in the diagram to create a model of the process of photosynthesis.

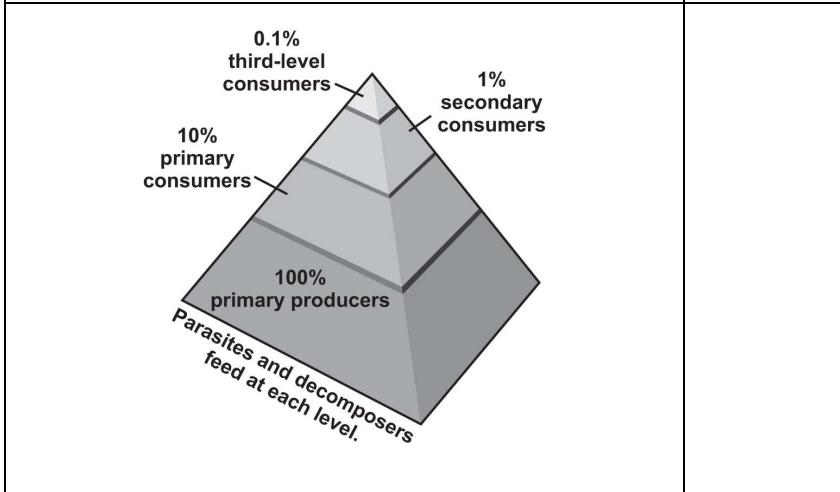
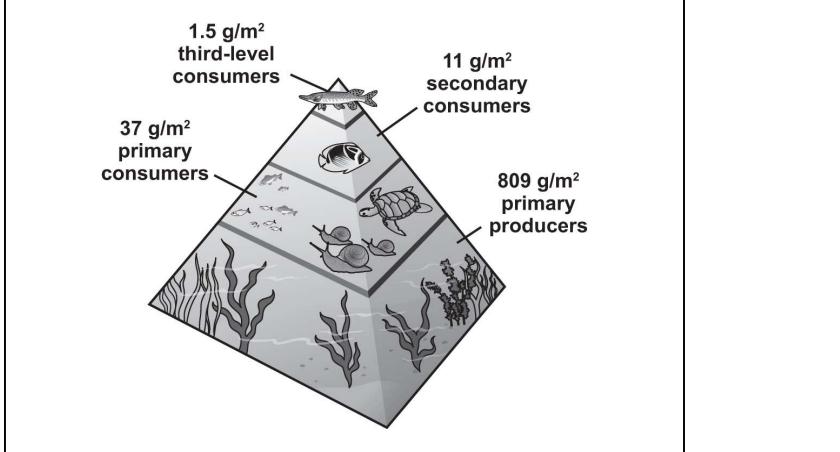


- | | |
|-------------------|----------|
| A. oxygen | C. water |
| B. carbon dioxide | D. sugar |

17. There are three major types of ecological pyramid models used for illustrating matter and energy transfer among organisms in an ecosystem. Write the letter of the terms to correctly label each type of ecological pyramid.



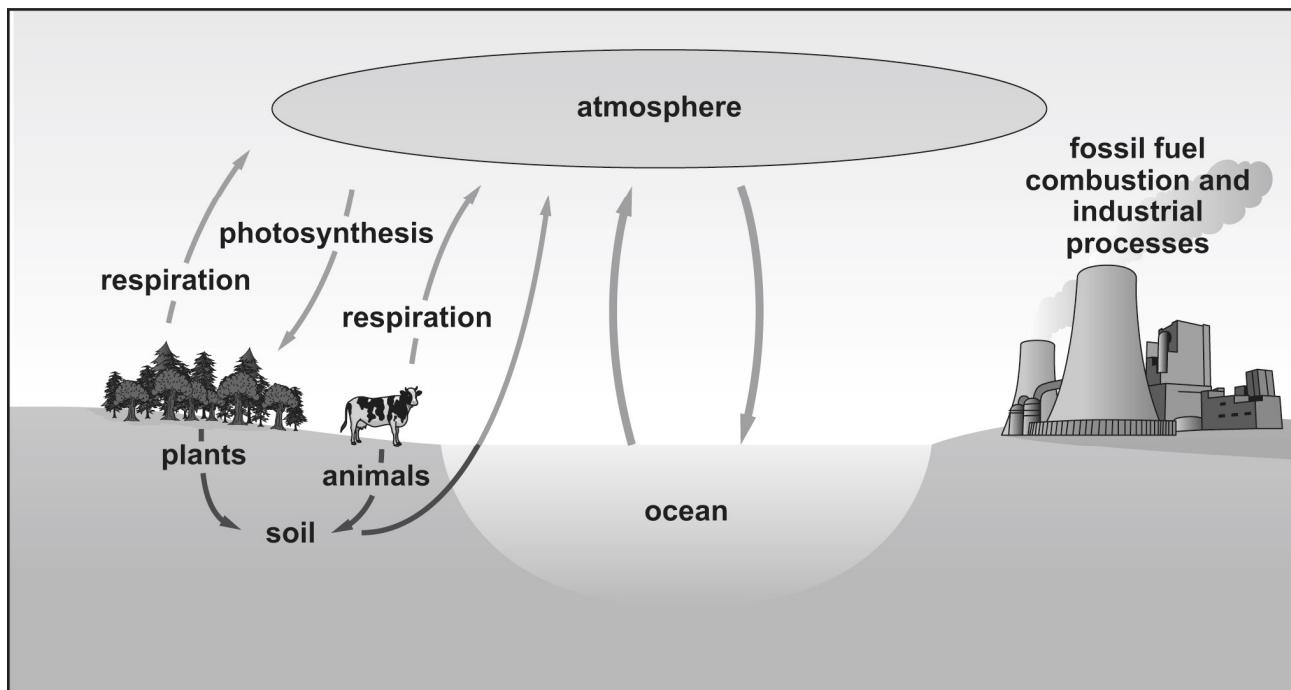
- A.** models energy transfer among trophic levels
- B.** compares the biomass at different trophic levels
- C.** shows how many organisms are present at each trophic level



Read each statement. Write your answer on the lines.

18. The model shows how carbon is cycled among Earth's biosphere, atmosphere, hydrosphere, and geosphere.

The Carbon Cycle



Climate predictions and forecasts depend on accurate carbon cycle models.

Describe the important role of producers in the cycling of carbon as represented in the model.

Explain why understanding the carbon cycle is useful in understanding climate change.

19. Hans Krebs researched the aerobic portion of respiration by adding certain four-carbon compounds to cells in his laboratory. He hypothesized that if they were a part of the process, adding them to cells would cause respiration to increase. Krebs's results are shown in the table.

Results of Compounds on Oxygen Consumption

Compound added	Oxygen consumed (μ mole)
none	650
fumarate	1,300
malate	1,350
succinate	1,500

Krebs concluded that the substances he added to the cells were a part of respiration.

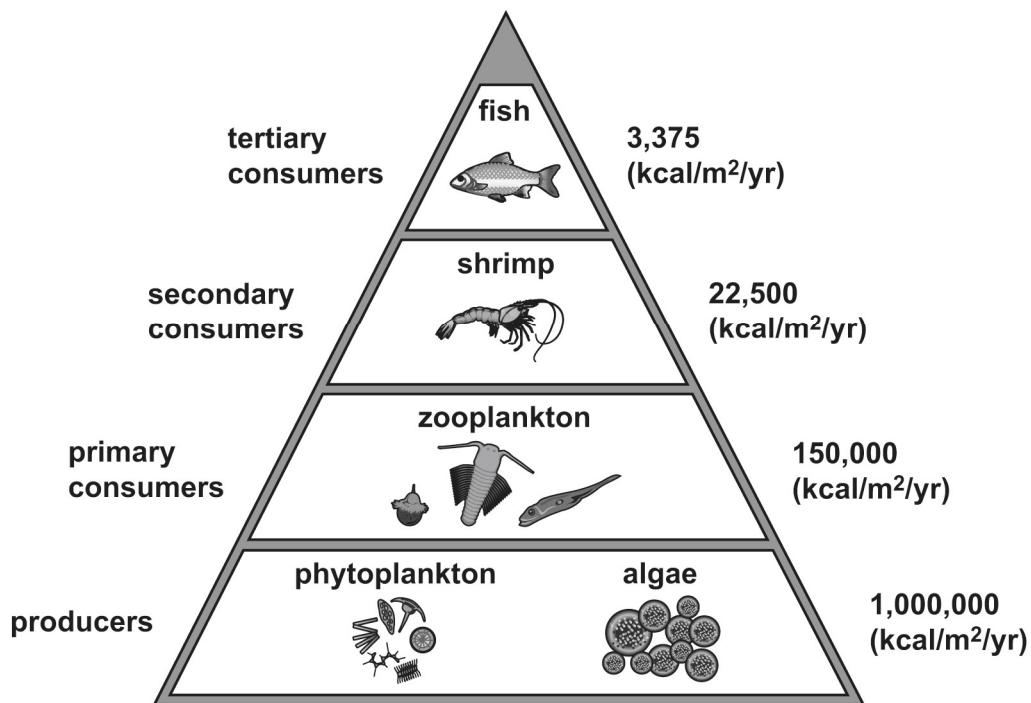
Use the data in the table to justify his conclusion.

The mechanism by which cells make large amounts of energy was not discovered until three decades later.

Describe what happens in respiration after the Krebs process and the role oxygen plays.

20. The energy pyramid shows how much energy is stored at each trophic level in an aquatic ecosystem.

Energy Pyramid of an Aquatic Ecosystem

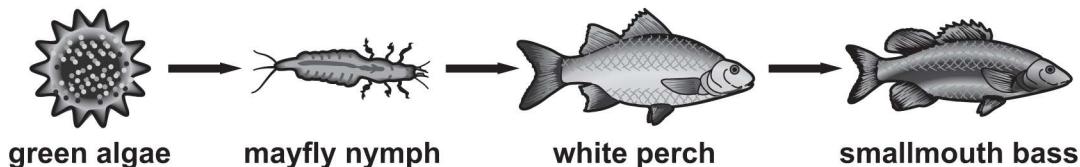


Explain how matter and energy are transferred from one trophic level to another, using producers, primary consumers, and secondary consumers as an example.

Explain how to calculate the energy transfer efficiency based on the energy data in the model.

- 21.** Lake Erie is a freshwater lake located in the Great Lakes region that borders Michigan, Ohio, Pennsylvania, and New York. The food chain shows an example of some of the relationships within this ecosystem.

Great Lakes Food Chain



Describe how carbon enters and exits this specific food chain.

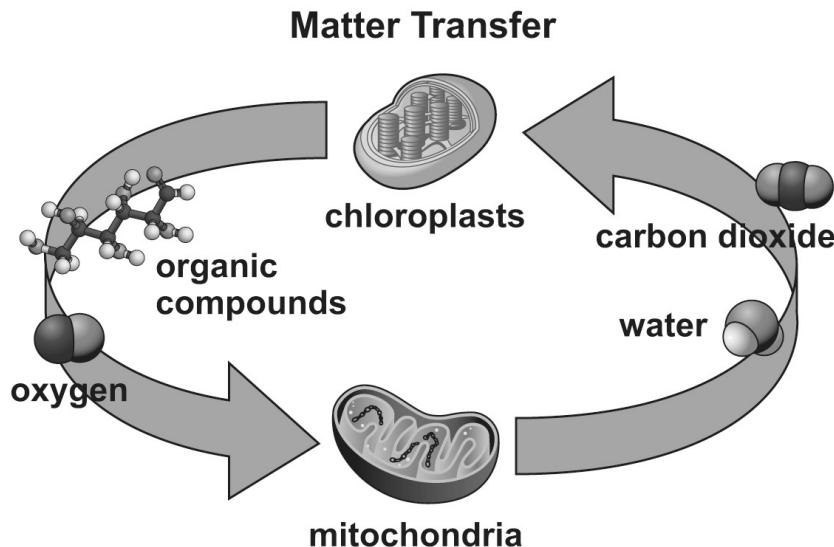
In the 1950s, Lake Erie experienced very low levels of oxygen, which resulted in the disappearance of mayflies from the ecosystem.

Predict how this would alter the flow of carbon in the food chain.

Directions: Read the passage, then answer the questions that follow.

Respiration and the Movement of Matter

A scientist is researching the role that respiration plays in the movement of matter in ecosystems. She has developed the model shown here to illustrate the transfer of matter.



22. The scientist is conducting an experiment on cellular respiration in which she supplies a cell culture with radioactively labeled oxygen gas. After a period of time, she samples the culture. Which of these molecules will contain the radioactive oxygen atoms? Circle the letter of the correct answer.

- A.** ATP
- B.** water
- C.** carbon dioxide

23. The scientist is studying the processes for which cellular respiration provides work, such as the contraction of muscles. Number the processes from 1 to 5 to show how respiration provides energy to a muscle fiber for contraction to take place. Number 1 should be the first step, and number 5 should be the last step.

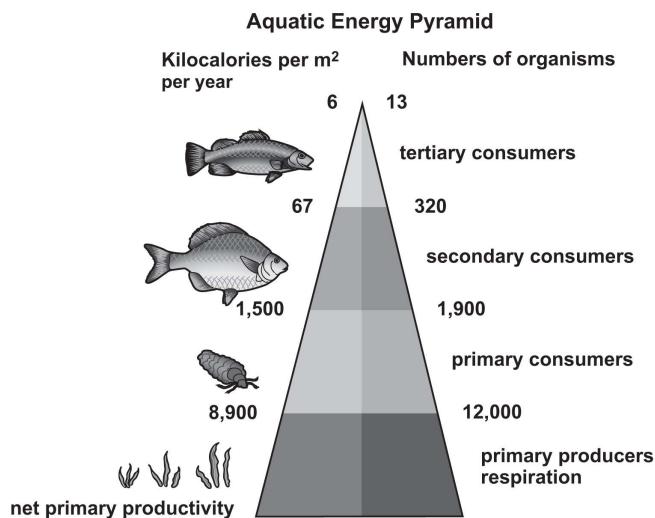
- _____ The energy in ATP is used to make muscle cells contract.
- _____ Glucose molecules are broken down into smaller sugars.
- _____ The electron transport chain is used to produce ATP.
- _____ Energy is captured during the Krebs cycle.
- _____ Glucose molecules in the bloodstream are absorbed by a muscle cell.

- 24.** The scientist places a small organism into a sealed container and the organism is allowed to undergo respiration for a one-hour period. The container holds water, oxygen, carbon dioxide, and nitrogen gas. The scientist measures the amount of each substance in the container both before and after the one-hour period. Write a letter to each substance in the correct box.

Increase	Decrease	Remain the same

- A. water
B. oxygen
C. nitrogen gas
D. carbon dioxide

- 25.** As part of her studies, the scientist is researching the ways that respiration and photosynthesis provide the energy for an ecosystem. The diagram illustrates how matter and energy move through an aquatic ecosystem.



Write your answer on the lines.

Explain the apparent loss of matter and energy during photosynthesis and respiration that results in the shape of the energy pyramid.
