Unlike a plant, this runner must get the energy he needs from the food he eats.

As fats burn in a lamp, they combine with oxygen and produce carbon dioxide and water. They also release energy in the form of heat and light.

In the cells of organisms, a more controlled version of the process releases energy stored in molecules.

Reactions that take place in cells follow the same rules as reactions that take place in a research laboratory or classroom.

- Some reactions go to completion, and some reach an equilibrium point.
- Many reactions occur in solution, and catalysts are often needed.
- Energy is transferred, and energy is converted from one form to another.

Photosynthesis

- **What energy conversion takes place during photosynthesis?**
- **During photosynthesis, energy from sunlight is converted into chemical energy.**

Photosynthesis

The sun is the primary source of energy for most plants and animals.

During photosynthesis, plants chemically combine carbon dioxide and water into carbohydrates. This equation summarizes the process.

$$6H_2O + 6CO_2 + \text{Energy (light)} \rightarrow C_6H_{12}O_6 + 6O_2$$

Photosynthesis

Photosynthesis involves a complex series of chemical reactions.

When all the reactions are complete, the energy from sunlight has been stored in the covalent bonds of molecules.

Cellular Respiration

- **How are photosynthesis and cellular respiration related?**
- **During cellular respiration, the energy stored in the products of photosynthesis is released.**

Cellular Respiration

What does your body need energy for, besides maintaining a constant body temperature?

It takes energy to laugh or cry, to heal a bone or a paper cut, or even to sleep.

Like photosynthesis, cellular respiration is a complex series of reactions. This equation is a summary of the overall process.

$C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2 +$ Energy (heat)

Cellular Respiration

Products of cellular respiration are reactants during photosynthesis. Cellular respiration and photosynthesis are two parts of the same cycle.

Light Energy

Carbon Dioxide

Water Vapor

Cellular Respiration

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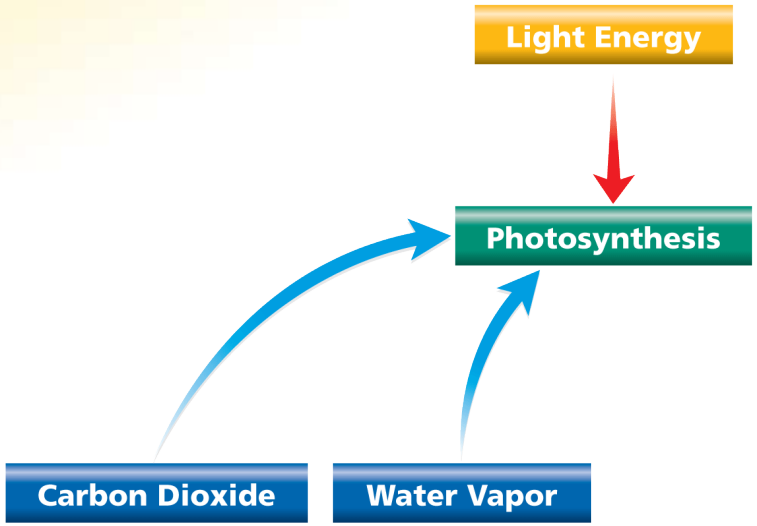

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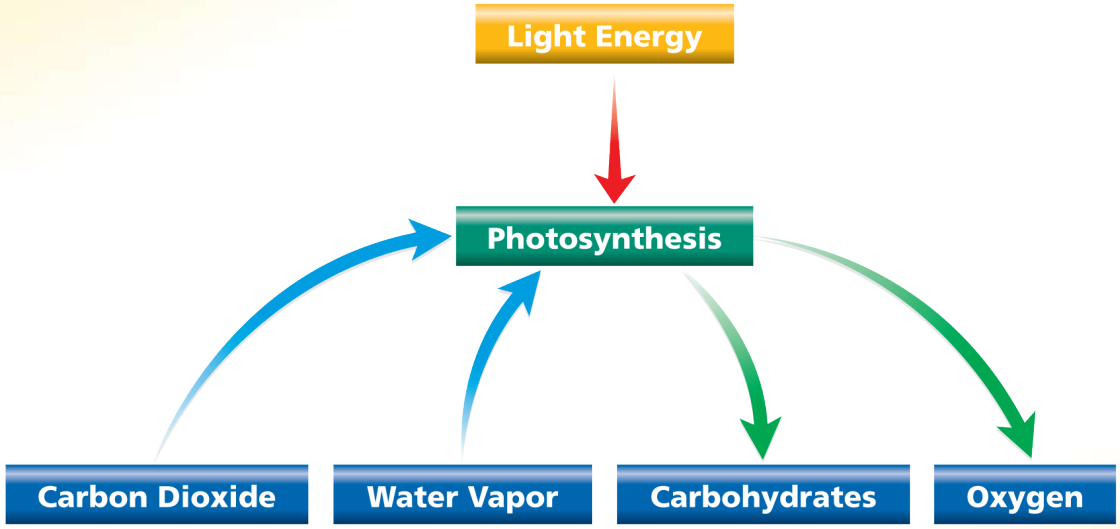

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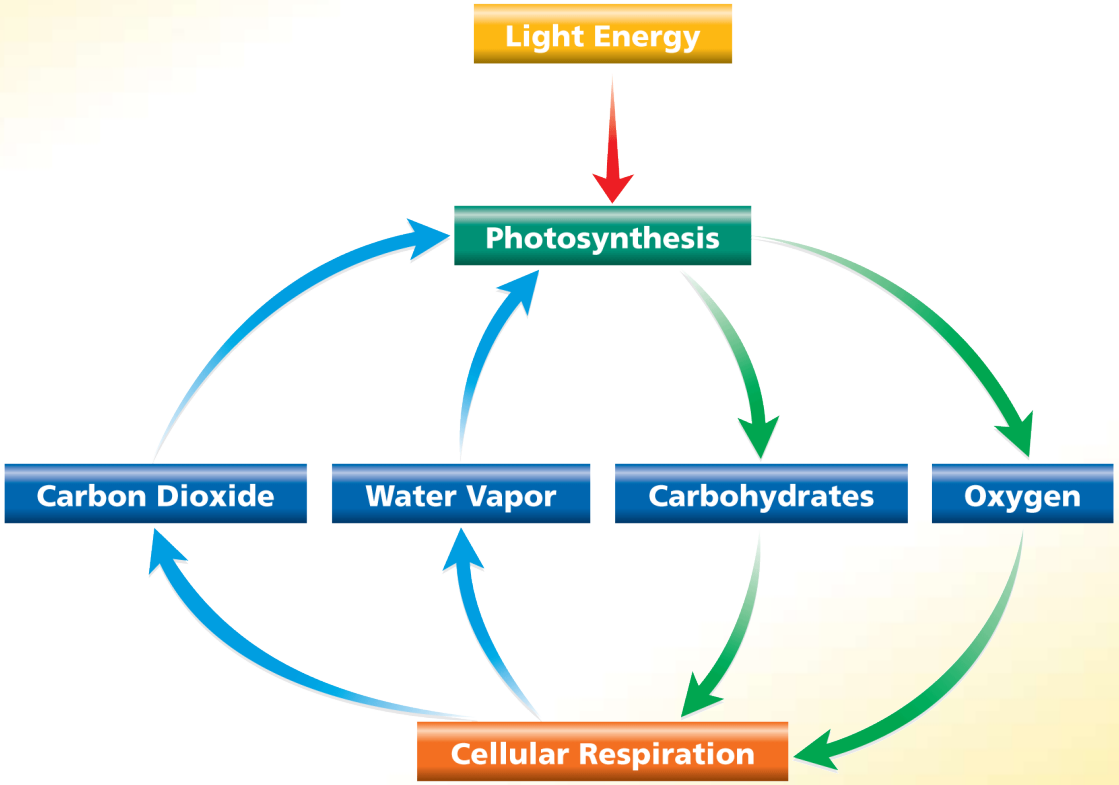

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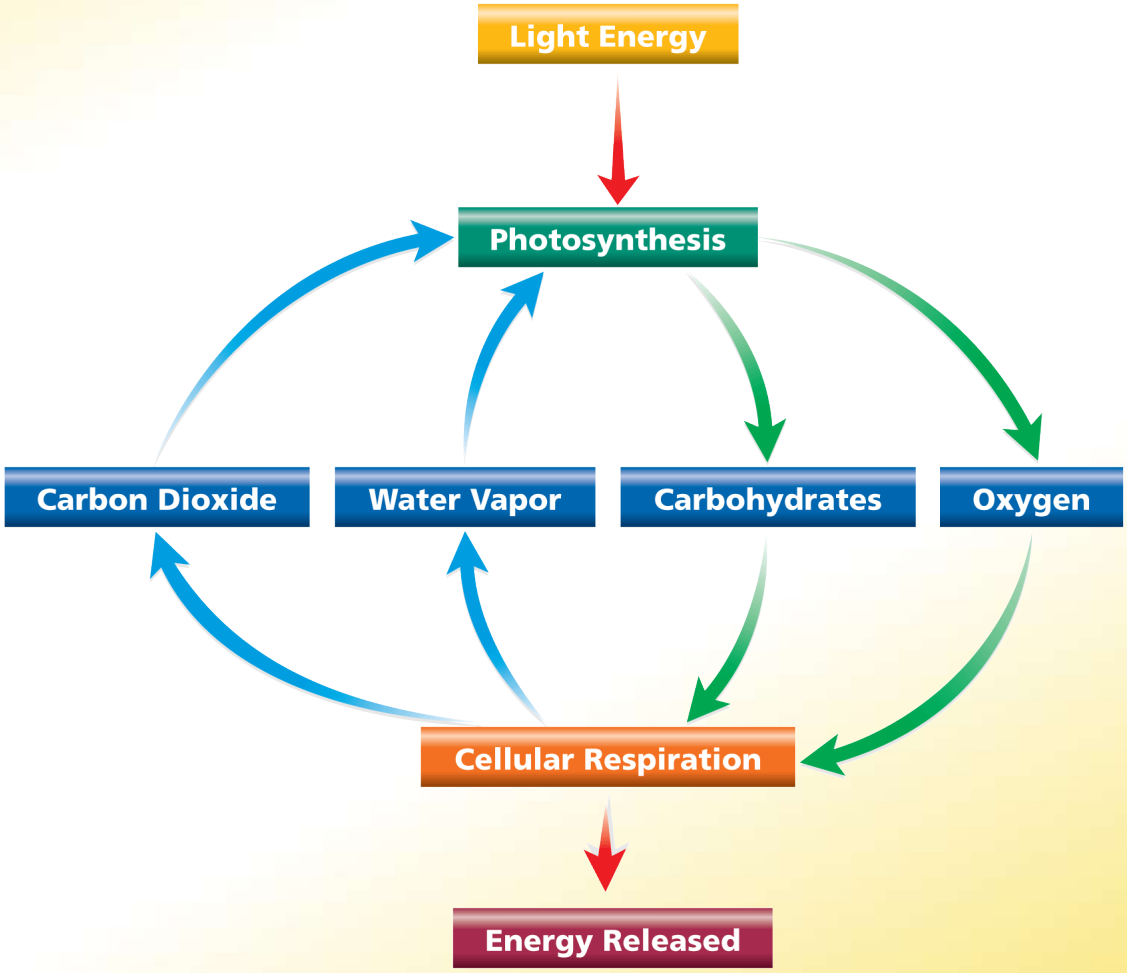

Cellular Respiration

In cellular respiration, glucose reacts with oxygen.

The glucose can come from simple sugars or from starches, because starch is a polymer of glucose.

During digestion, starch breaks down into glucose. This process is an example of depolymerization.

Enzymes and Vitamins

- **What molecules help cells function efficiently?**
- **Enzymes and vitamins are compounds that help cells function efficiently at normal body temperature.**

Enzymes and Vitamins

Enzymes

Enzymes are proteins that act as catalysts for reactions in cells.

- Without enzymes, cells could not digest food or extract energy from food.
- Enzymes allow reactions to proceed faster at much lower temperatures than would normally happen.

Enzymes and Vitamins

Vitamins

Vitamins are organic compounds that organisms need in small amounts, but cannot produce.

- A vitamin that dissolves in water, such as vitamin C, gets eliminated from the body and must be replaced daily.
- A vitamin that dissolves in fats, such as vitamin A, can build up over time in body tissues.

Enzymes and Vitamins

Lemons, limes, and oranges are sources of vitamin C.

Assessment Questions

- What is the energy source for photosynthesis?
  - thermal heat from Earth
  - chemical energy from the bonds in water
  - energy from the sun
  - chemical energy from the bonds in oxygen

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  ANS:C

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- Which of the following statements about enzymes is true?
  - Enzymes are compounds that the body needs but cannot produce.
  - Enzymes react with other biochemicals to produce energy in your body.
  - Enzymes are reactants in metabolic reactions.
  - Enzymes allow reactions to occur at lower temperatures than normal.

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