Energy

Biology

Big Picture

Energy exists in different forms, such as light, heat, and chemical energy, and can be converted from one form into another. All living things, including cells, depend on a constant intake of energy to perform all necessary functions. Organisms obtain the energy they need from food. The food is either made by the organism or is obtained by consuming other organisms.

Key Terms

Energy: The ability to do work.

Food: Organic molecules that are broken down by organisms to make energy.

Glucose: Serves as food for nearly all organisms. Its chemical formula is $C_6H_{12}O_6$, and the carbons are broken apart for the various steps of cellular respiration.

Photosynthesis: The process that takes light and carbon dioxide to create glucose (food).

Cellular Respiration: The process by which a cell takes carbons from its food (usually comes in the form of glucose) and creates energy.

Autotroph: Organism that creates its own food.

Producer: Autotrophs are known as producers because they create food for themselves and for those around them.

Heterotroph: Organism that does not make its own food. Thus, they rely on autotrophs for food and energy.

Consumer: Heterotrophs are known as consumers because they do not make their own food but consume food instead.

Chemical Reaction: The process by which one or more substances undergoes changes to produce different substances.

Activation Energy: The amount of energy needed to start the reaction.

Catalyst: Reduces the activation energy needed for the reaction to occur.

Enzyme: Protein that catalyzes a chemical reaction.

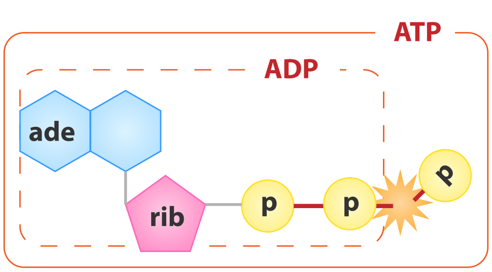
Glucose and ATP

There are two types of molecules used by organisms for **energy**:

glucose: used to store and transport energy

adenosine triphosphate (ATP): the form that cells actually use for energy

All molecules store energy in their chemical bonds. By breaking the chemical bonds, the stored energy is released and can be used by the cells. In ATP, breaking apart one of the three phosphate groups releases energy. When ATP loses a phosphate group, it is known as ADP, or adenosine diphosphate.



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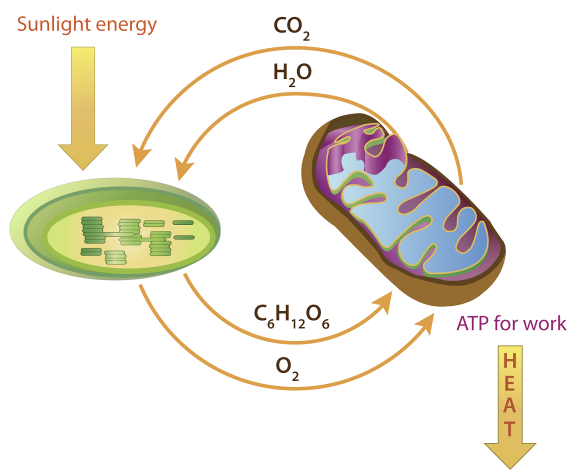
Glucose and ATP are key molecules in **photosynthesis** and **cellular respiration**. (See *Photosynthesis* and *Cellular Respiration* guides for more information.)



Photosynthesis

- It takes place in a chloroplast.
- Carbon dioxide and water react, using light energy, to produce glucose and oxygen.
- Light energy from the sun changes to chemical energy in glucose.

Cellular respiration

- It takes place in a mitochondrion.
- Glucose and oxygen react to produce carbon dioxide, water, and energy (ATP).
- Chemical energy in glucose changes to chemical energy in ATP.

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Energy cont.

How Organisms Get Energy

Autotrophs are **producers** that provide **food** for themselves and for other organisms. There are two types of autotrophs:

Chemoautotrophs can create their own food without light

- Example: bacteria that live in deep sea vents without light

Photoautotrophs make their own food with light.

- Example: plants that use light to undergo photosynthesis to create their own food

Heterotrophs are **consumers** that need to consume autotrophs or other heterotrophs as food.

Chemical Reactions

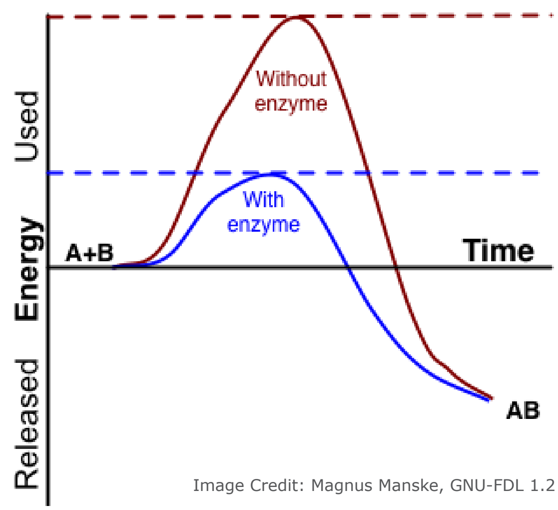
Both photosynthesis and cellular respiration involve many **chemical reactions**. In a chemical reaction, chemical bonds are being broken and formed. Chemical reactions can be generalized with the equation:

Reactants → Products

reactants are present at the start of a reaction, products are the result of a reaction

All chemical reactions need energy to get started. This **activation energy** is the energy required for the reactants to collide. When the collision force is strong enough, the reaction should occur. However, even if the reactants' collision is strong enough, the reactants may not be aligned properly for the reaction to occur.

Figure: Here is a graph comparing the energy used and released in a reaction with and without an enzyme to align the reactants beforehand.



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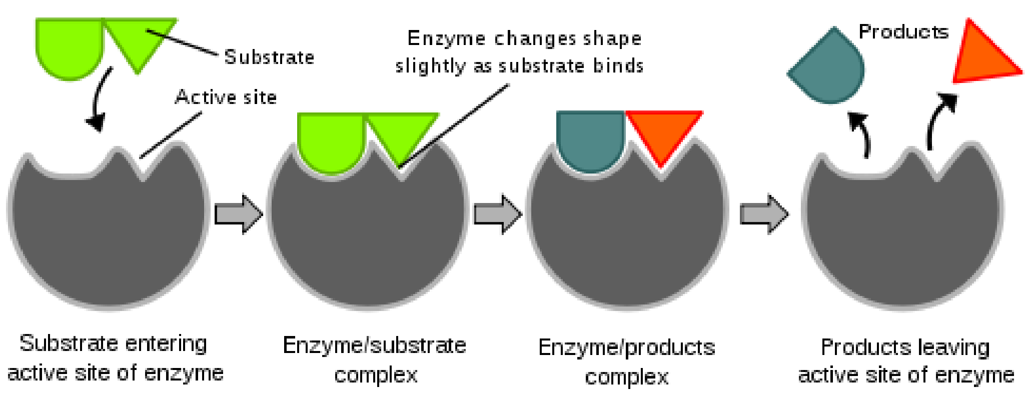
For the reaction to start, the reactants also need to bump into each other in the right orientation. A **catalyst** helps reduce the activation energy needed. Catalysts are necessary for almost all chemical reactions that occur in the body. They can speed up reactions, although there are some catalysts called inhibitors that slow down reactions.

Enzymes are proteins that speed up a chemical reaction by aligning reactants properly so that they are more likely to react to each other and reduce the activation energy needed.



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