

## Chapter 7

Use with Section 3

## ENRICHMENT

## ● Chemical Energy

## Enzymes and Nutrition

Enzymes, or biological catalysts, carry out chemical reactions in a much more efficient manner than chemical catalysts. Nearly every chemical process has its own specific enzyme. The human body contains thousands of enzymes to carry out life processes, including digestion, blood clotting, hormone production, and binding of oxygen to red blood cells. One method of increasing the rate of these and other chemical reactions is to increase the temperature. However, this is not practical for the biological systems of humans and other animals. Enzymes can speed up reactions without raising the temperature. How does this process work?

Substance #1 (undigested food, for example) contains a certain amount of energy. It requires additional energy to be transformed into substance #2 (such as chemical energy that the body's cells can use). As #1 proceeds with the transformation, it reaches its highest possible level of energy. At this point it's in the transition state, 1+. The physical structure of one particular digestive enzyme is a perfect match for the transition state 1+. The enzyme binds to the transition state and stabilizes it. After the transition state is formed, 1+ completes its conversion to substance #2.

The difference in energy between the substance and its transition state is called the activation energy. Enzymes reduce the activation energy by stabilizing the transition state. This allows more molecules of the substance to reach the transition state, which can then be converted into the new substance.

Metabolic enzymes are found throughout the body's blood, tissues, and organs. Digestive enzymes are secreted by the stomach, pancreas, small intestine, and other digestive organs. If a person lacks the ability to produce a certain digestive enzyme, she will be unable to convert specific foods into chemical energy that her body can use. The results of this may include malnutrition (not from lack of ingesting food, but from the inability to use it), bloating, and allergies. The production of enzymes is directed by a person's DNA. A genetic "mistake" or an inherited genetic condition may affect enzyme production.

Food enzymes are present in raw foods. They include protease to digest proteins, amylase to digest starch, lipase for fats, and cellulase to digest cellulose. These enzymes help us digest the foods that contain them. Cooking food at temperatures above 54°C, however, will destroy the enzymes. Microwaving food and irradiation can also harm enzymes. This is unavoidable in some situations. Meat and fish must be cooked thoroughly in order to kill disease-causing microbes. In order to digest cooked foods, the body's own enzymes must work extra hard. Nutritionists recommend that people eat a lot of fresh fruits and vegetables, not just for the nutrients, but also for the natural enzymes.

1. How do enzymes increase the efficiency of chemical reactions in the body?

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2. What are the three types of enzymes that the body uses and where are they found?

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