

Enzymes: Speeding Up Chemical Reactions

What is a Catalyst?

- 1. Catalyst – a “helper” that speeds up chemical reactions
Ex: lighter fluid helps a person get a fire started faster and with less energy (one match).
- 2. Without catalysts, it would take a long time to get energy from food.
- 3. Catalysts are very important to life because they help organisms carry out life activities more quickly.

What are Catalysts Made Of?

- 4. Your body has **different** catalysts for different chemical reactions.

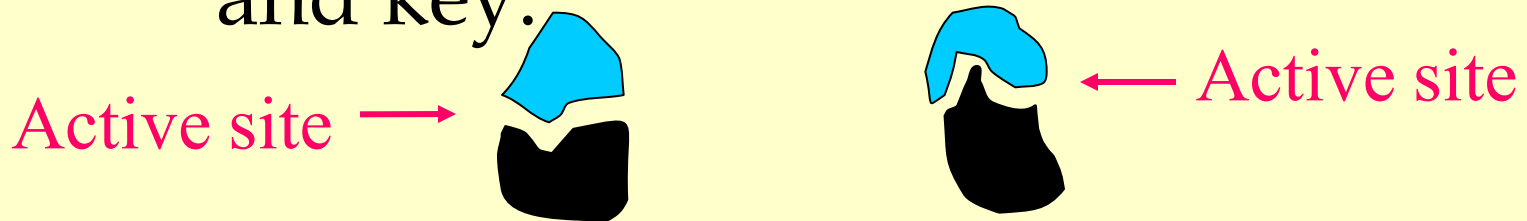
Your tool box has different tools

A hammer helps you sink a nail more quickly, but won't help you screw in a screw more quickly.

- 5. Catalysts **catalyze** (speed up) specific chemical reactions.
- 6. Most of the catalysts in your body are **PROTEIN** molecules called **ENZYMES**.

Enzymes

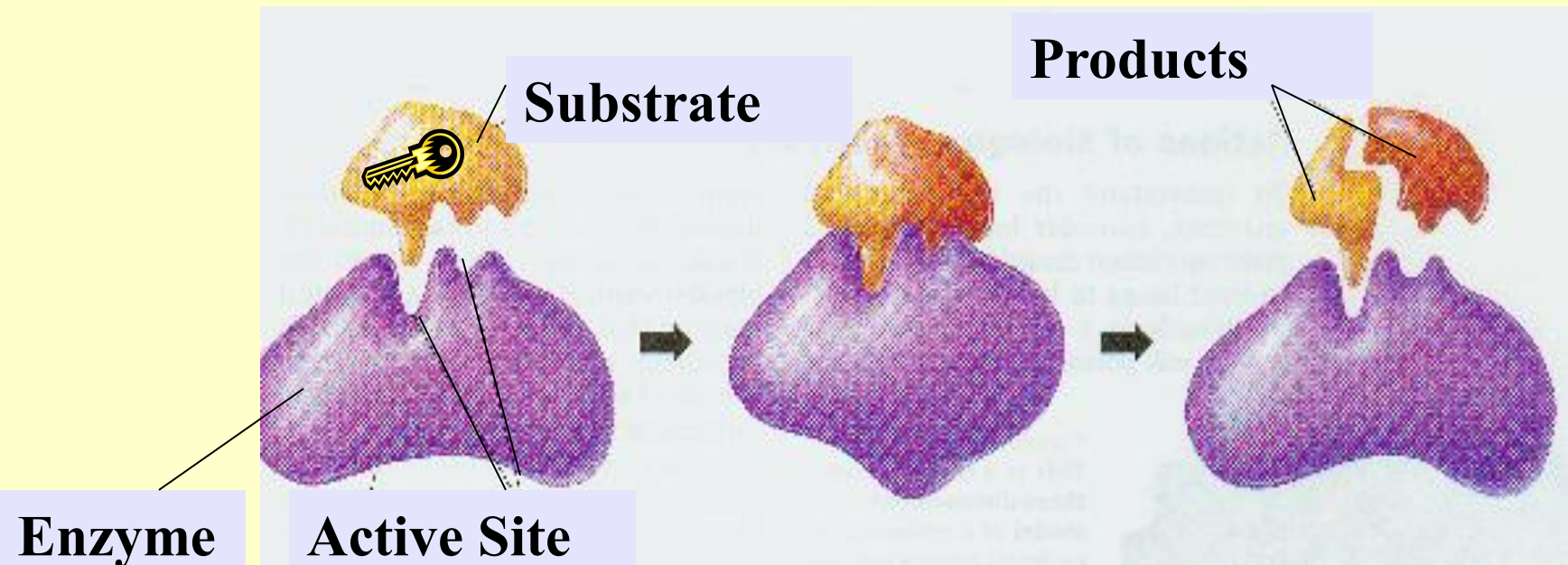
- 7. Enzyme - protein polymer that acts as a catalyst for a biochemical reaction
- 8. An enzyme can combine only with molecules that fit its shape, like a lock and key.



- 9. The molecule must bind to the enzymes active site (where they hook together).

How Does An Enzyme Work?

- 10. The enzyme helps to **break** some of the **bonds** in the molecule (**substrate**) that fits into it.
- 11. The enzyme **catalyzes** (speeds up) the splitting of the molecule (**substrate**) into two molecules (**products**).



Chemical Reactions Need Energy to Start

- 12. Activation energy – the **energy** it takes to **start** a chemical reaction.
 - Striking a match provides the “**activation**” energy the match needs to burn.
 - Striking the match **activates** the chemical reaction (burning).

How Do Enzymes Speed Up Chemical Reactions?

- 13. Enzymes catalyze chemical reactions by **changing** a chemical reaction's **activation energy**.
- 14. A chemical reaction needs a **lower** activation energy with an enzyme than without an enzyme.

- 15. Without enzymes, many chemical reactions in the body **could not** occur causing various disorders:

A. Lactose intolerance – a condition where the body is unable to digest milk sugars due to the missing enzyme resulting in intestinal problems.

B. Cystic fibrosis – disease in which an enzyme necessary to break down mucous in the lungs does not function therefore the lungs fill up with this sticky mucous. This is a genetic disorder which results in chronic lung infections and limits life span.

C. PKU – an enzyme necessary for normal brain development does not function properly, leading to mental retardation.

- 16. Therefore, having a **single** enzyme in the body that does **not** function properly can have devastating results.
- 17. Enzymes are so important to our survival.
- 18. It is our DNA (**nucleic acid polymer**) that determines which enzymes we make and which ones we are unable to make.

Enzymes in Other Kingdoms

- Plants
 - RuBisCo (ribulose-bisphosphate carboxylase)
 - Used for breaking down CO_2 during photosynthesis.
 - Most abundant protein in leaves
- Fungi
 - Glucanase
 - Helps breakdown dead organic material

Enzymes in Other Kingdoms

- Protists
 - Digestive enzymes helps in food breakdown (such as breaking down bacteria)
- Bacteria
 - Some have restriction enzymes that keep bacteriophages (viruses that attack bacteria) from copying their DNA