

Chemical Reactions & Enzymes

Biology Bellringer:

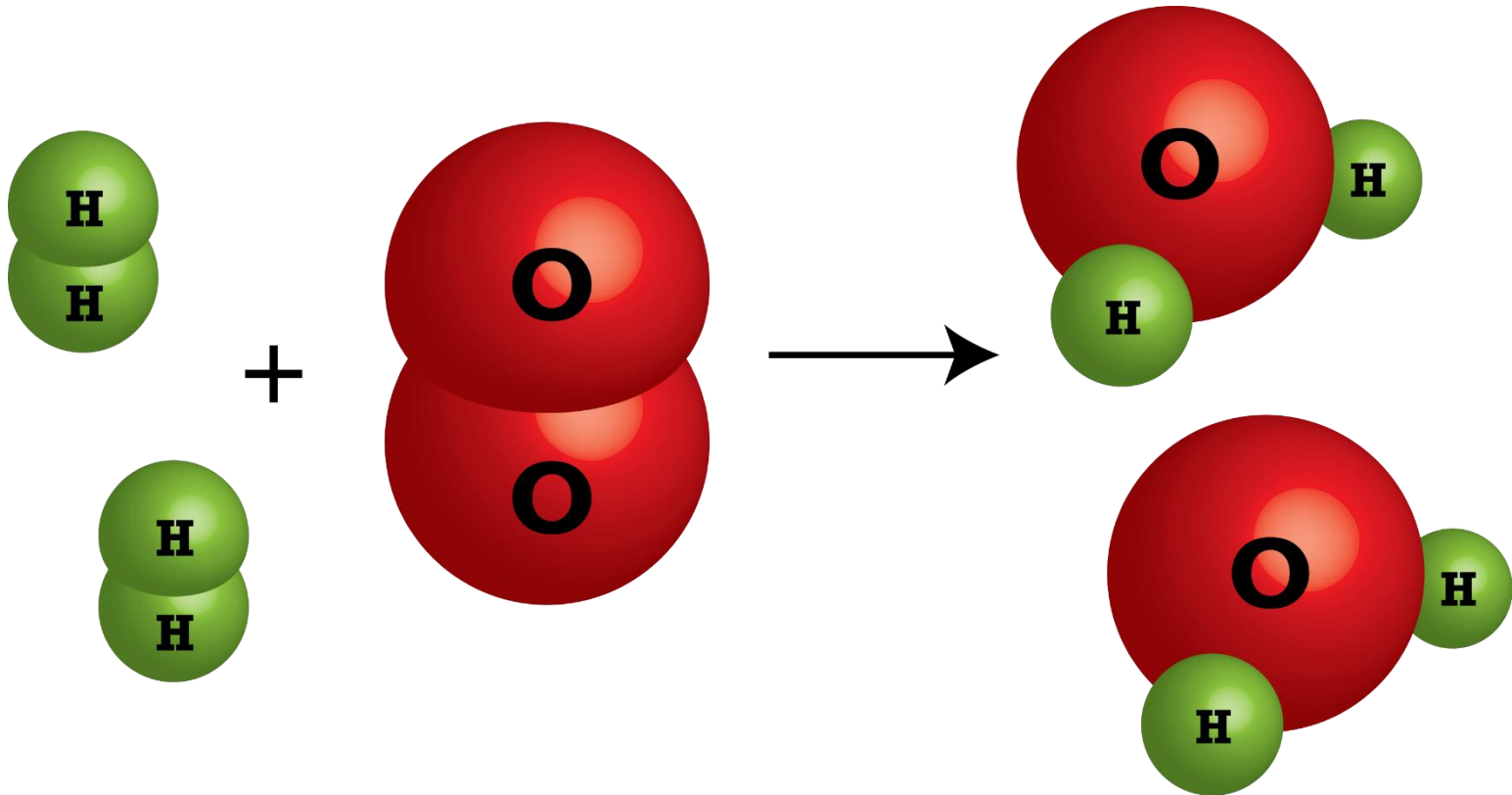
What chemical reactions are happening in your body right now?

What is the term for the chemical reactions that happen in your body?

Chemical Reactions

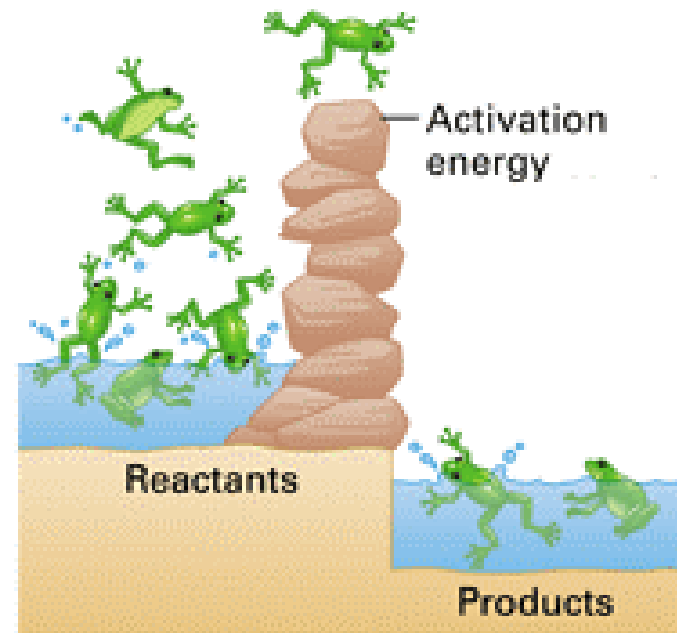
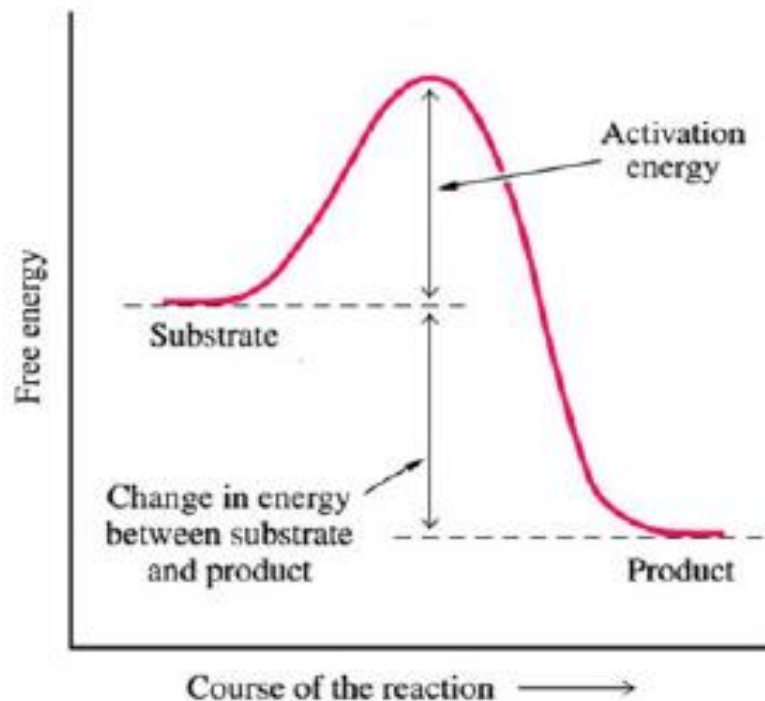
- A **chemical reaction** is a process that changes, or transforms, one set of chemicals into another by changing chemical bonds.
- Parts of a Reaction
 - **Substrates (a.k.a. Reactants)**
 - **Products**
- Reactants enter a chemical reaction and are turned into products

A chemical reaction:



Energy

- **Activation energy** is the amount of energy needed in order for a chemical reaction to take place

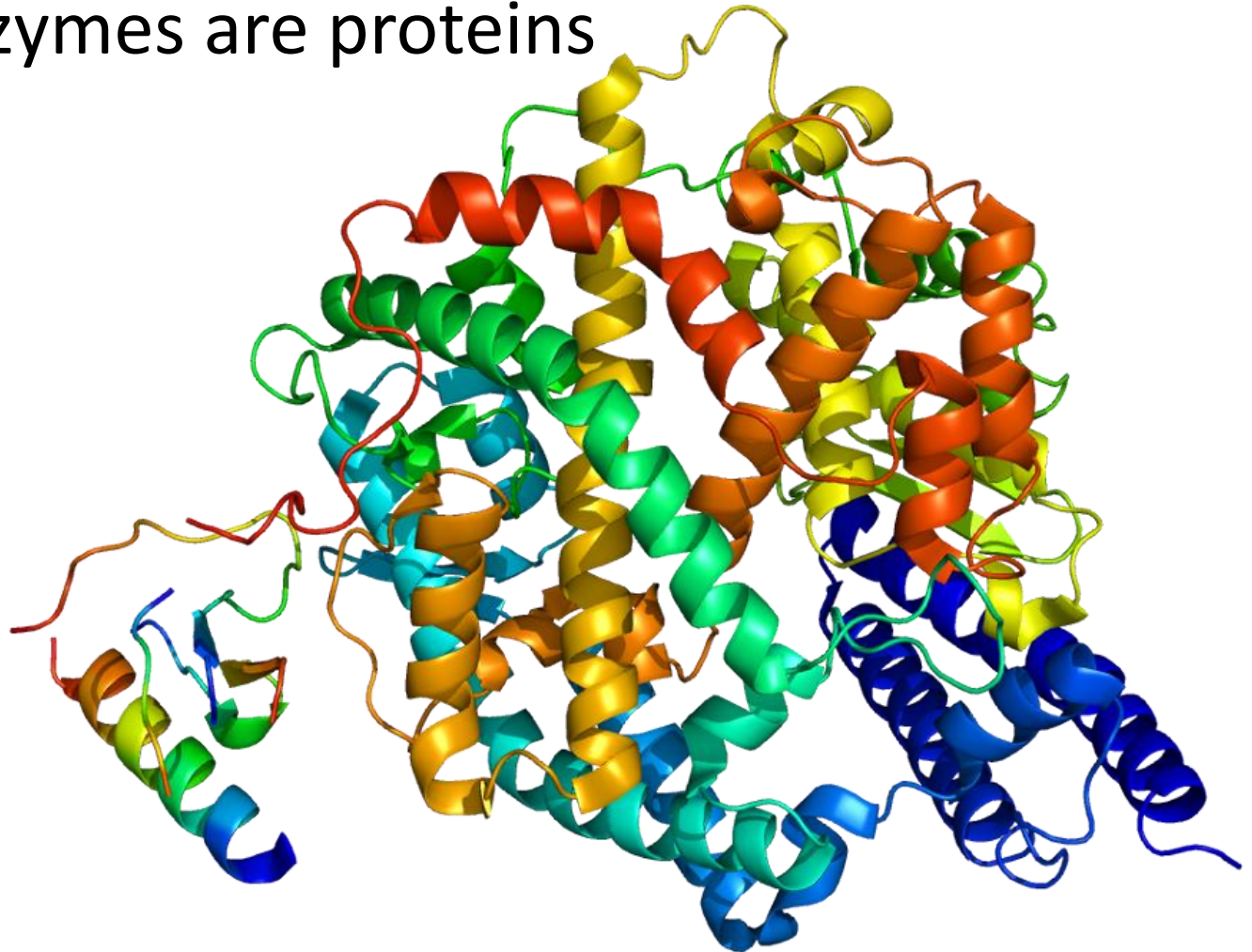


Rate of Chemical Reactions

- Things that affect the rate of chemical reactions include:
 - **Catalysts**
 - Inhibitors
 - **Temperature**
 - **pH**
 - Concentration (of substrates, catalysts, or inhibitors)

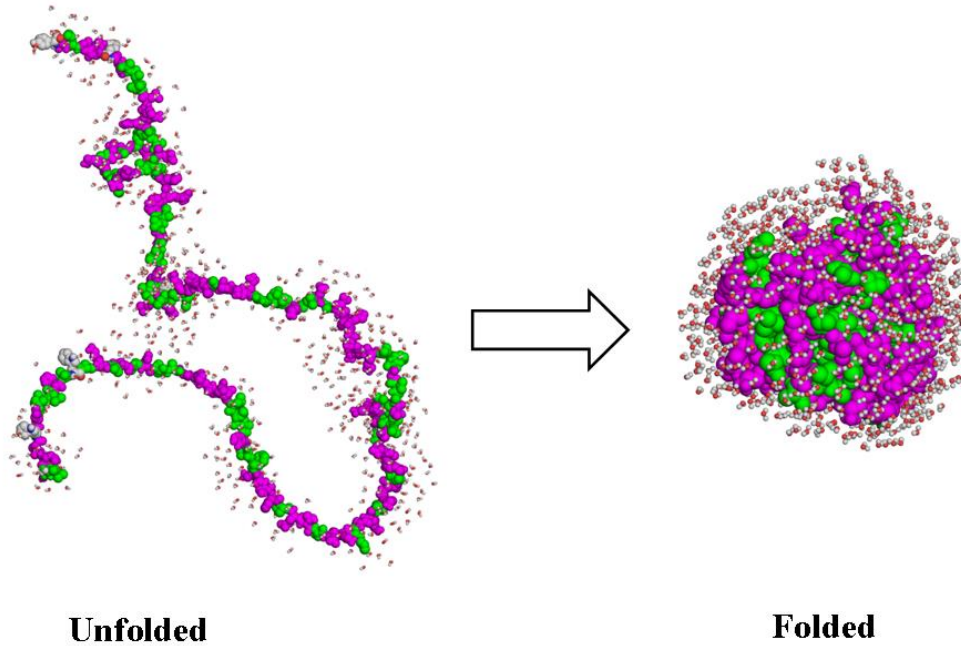
Enzyme Structure

- Most enzymes are proteins



Protein Structure

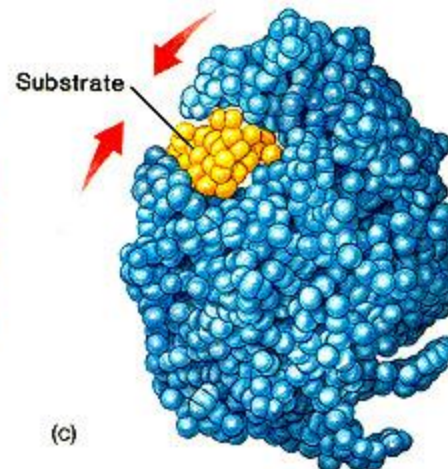
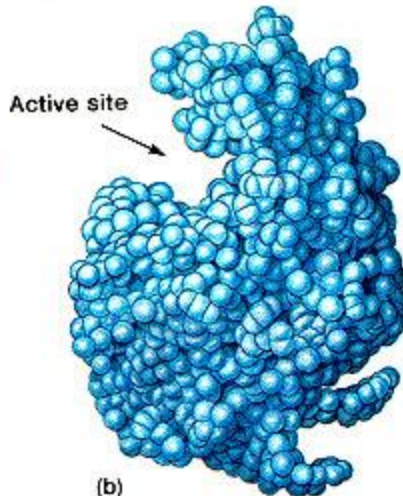
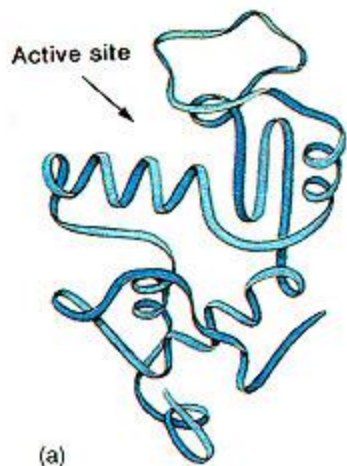
- The order of amino acids determines the shape of the protein.



- Enzyme Shape

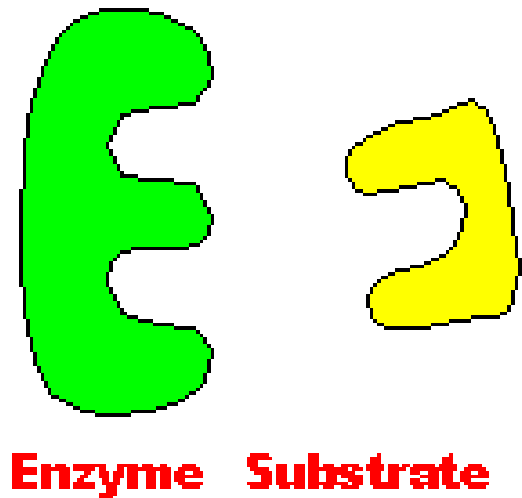
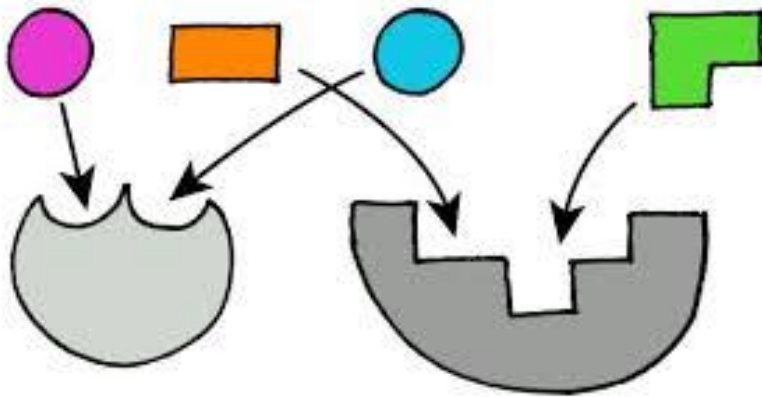
- The shape of an enzyme determines which substrates it can interact with. Substrates fit into an enzymes active site much like a key fits into a lock.

- An enzyme's **active site** is the place where the substrate binds to the enzyme



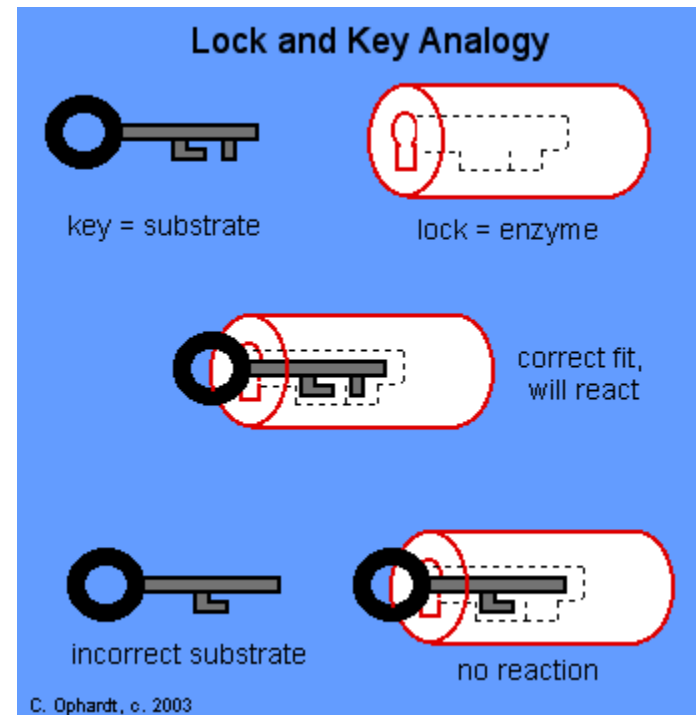
- Enzyme Shape, continued

- Enzymes are substrate-specific, i.e. they will only work on one type of substrate
- Enzymes are not used up during a chemical reaction; therefore, they can be used again and again



Lock & Key Analogy

- Lock—enzyme
- Keyhole—active site
- Key—substrate (a.k.a. reactant)



1 Substrates enter active site; enzyme changes shape so its active site embraces the substrates (induced fit).

2 Substrates held in active site by weak interactions, such as hydrogen bonds and ionic bonds.

3 Active site (and R groups of its amino acids) can lower E_A and speed up a reaction by

- acting as a template for substrate orientation,
- stressing the substrates and stabilizing the transition state,
- providing a favorable microenvironment,
- participating directly in the catalytic reaction.

4 Substrates are converted into products.

5 Products are released.

6 Active site is available for two new substrate molecules.

Substrates

Enzyme-substrate complex

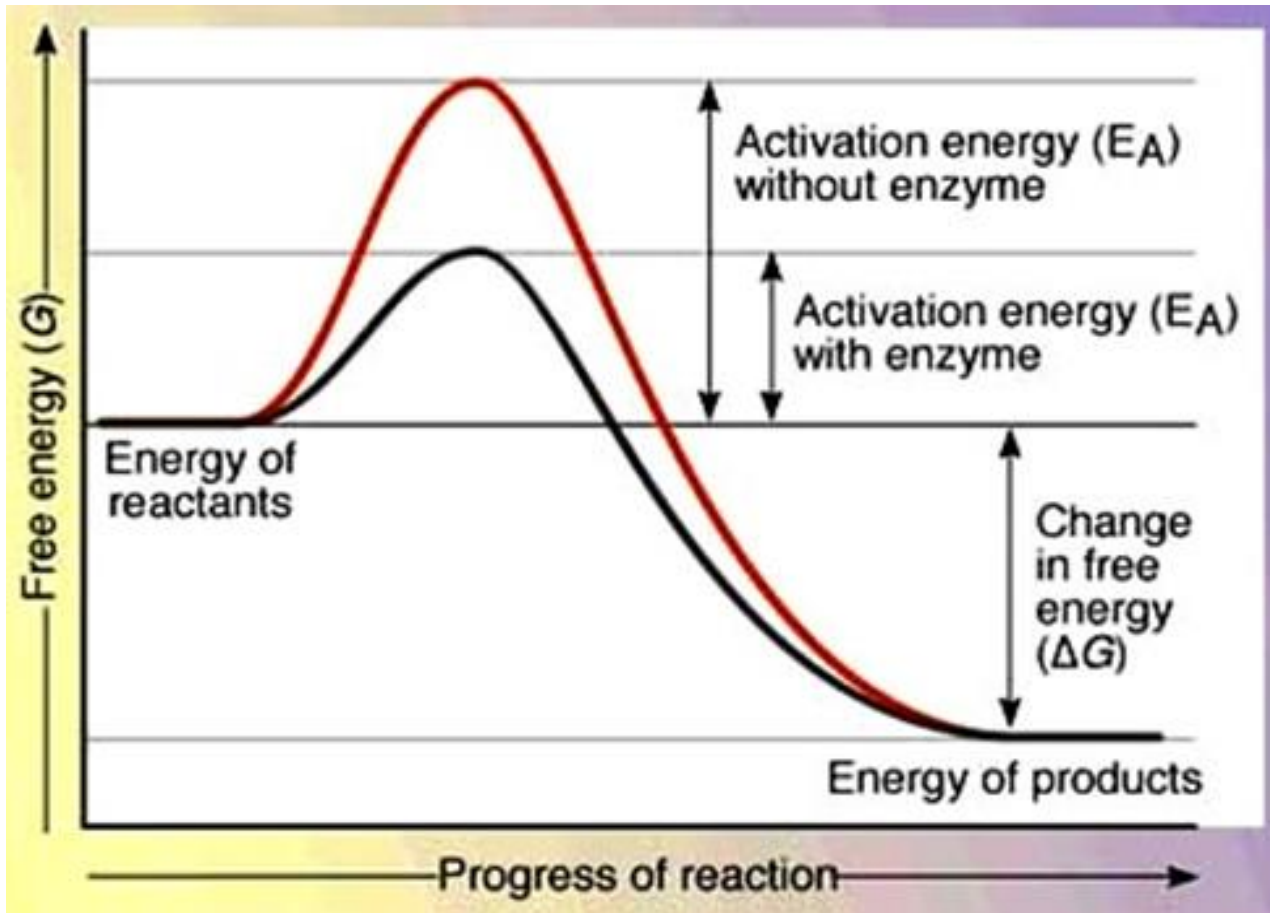
Enzyme

Products

Enzyme Function

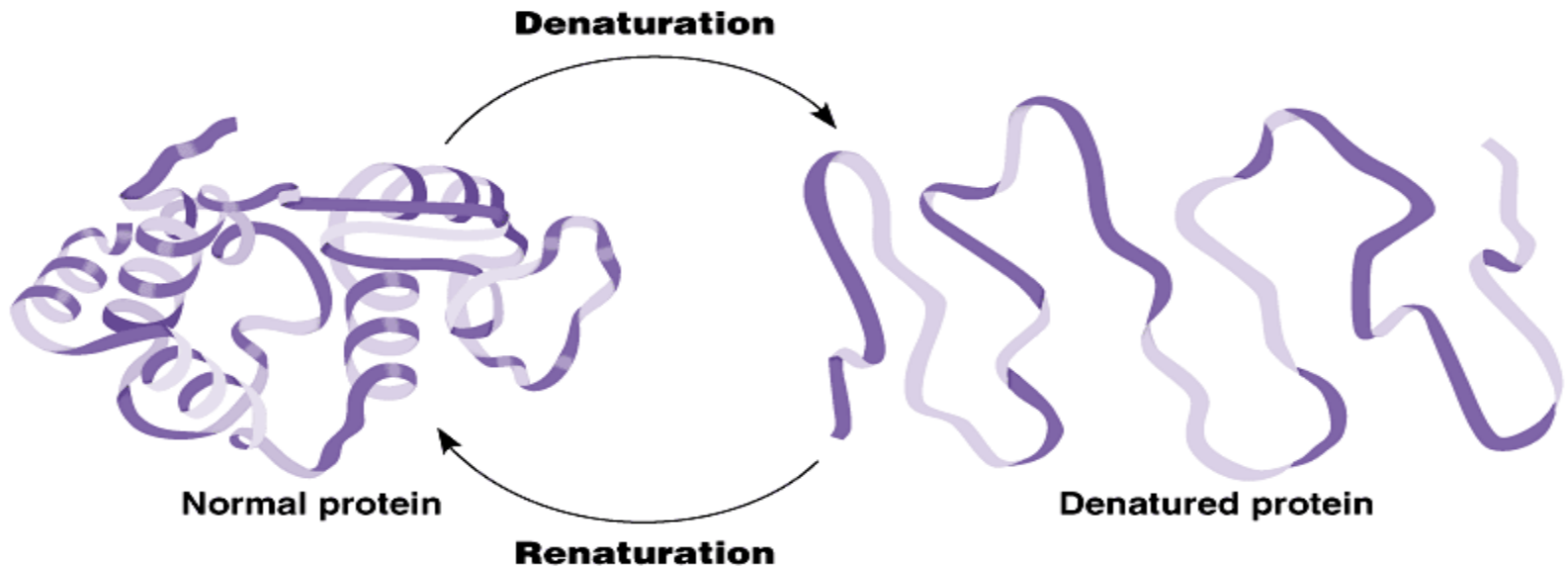
- **Enzymes** are proteins that function as biological **catalysts**
 - A **catalyst** is something that speeds up the rate of chemical reactions
- Enzymes catalyze biochemical reactions by lowering the activation energy required for the reaction to occur

A reaction with and without an enzyme



Enzyme Structure & Function

- An enzyme's function depends on its shape. If an enzyme's shape is changed, it is said to be **denatured**. A denatured enzyme will function poorly, or not at all.



Two Ways to Denature a Protein

Expose to high
temperature



Expose to sub-optimal **pH**
(too acidic or too basic)



Optimal Performance

- Enzymes (proteins in general) have an optimal temperature and pH. In other words, the temperature and/or the pH cannot be too high or too low or the enzyme's performance will be affected.
- Different enzymes have different optimal pH/temp.

