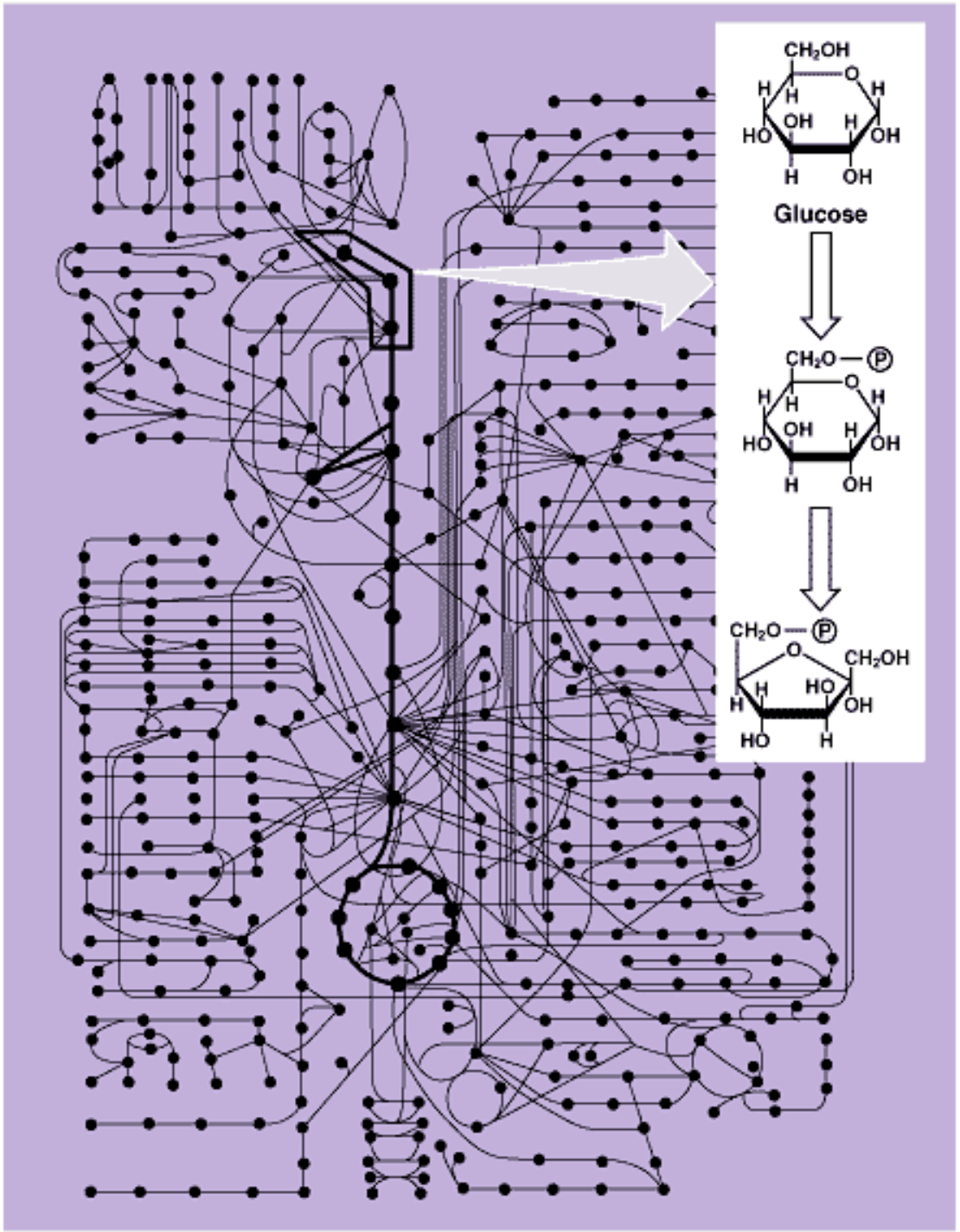

Glucose

Review: this reaction is exergonic.

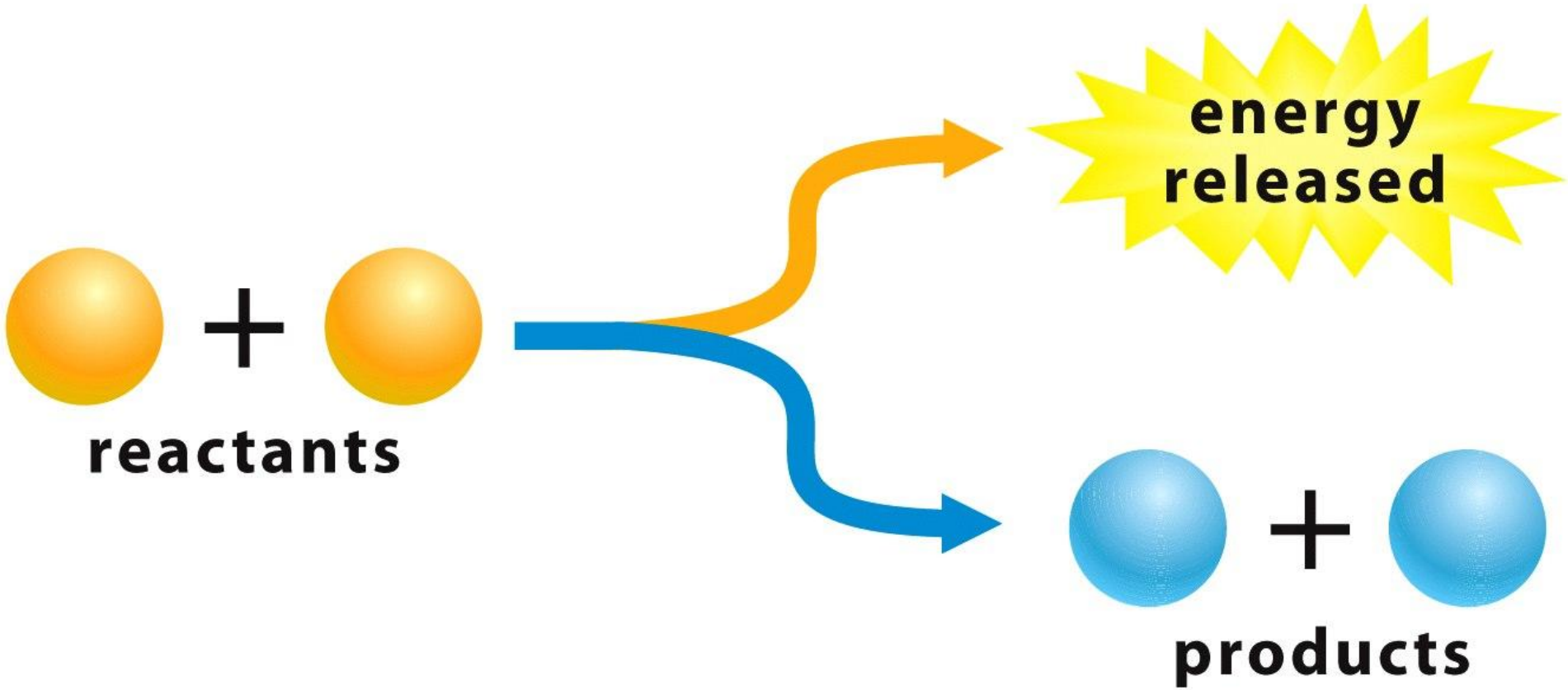


Figure 6-3 Biology: Life on Earth, 8/e

Review: this reaction is endergonic.

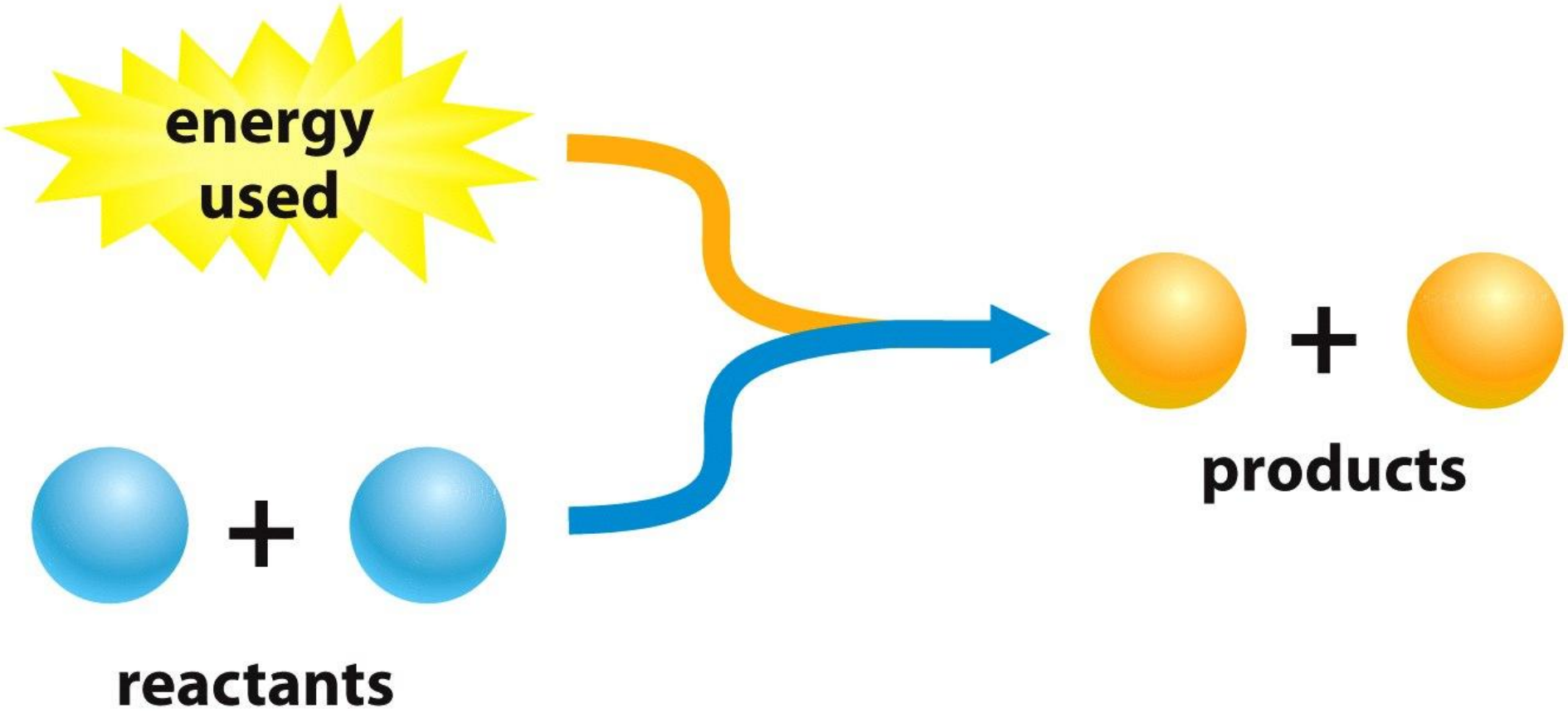


Figure 6-4 Biology: Life on Earth, 8/e

- **All** chemical reactions require an initial energy input to get started
  - Reactants need to have bonds broken
  - Molecules need to reorient
  - New bonds need to be formed

- The initial energy input in the reaction is called the **activation energy**

Burning glucose (sugar) : an exergonic reaction

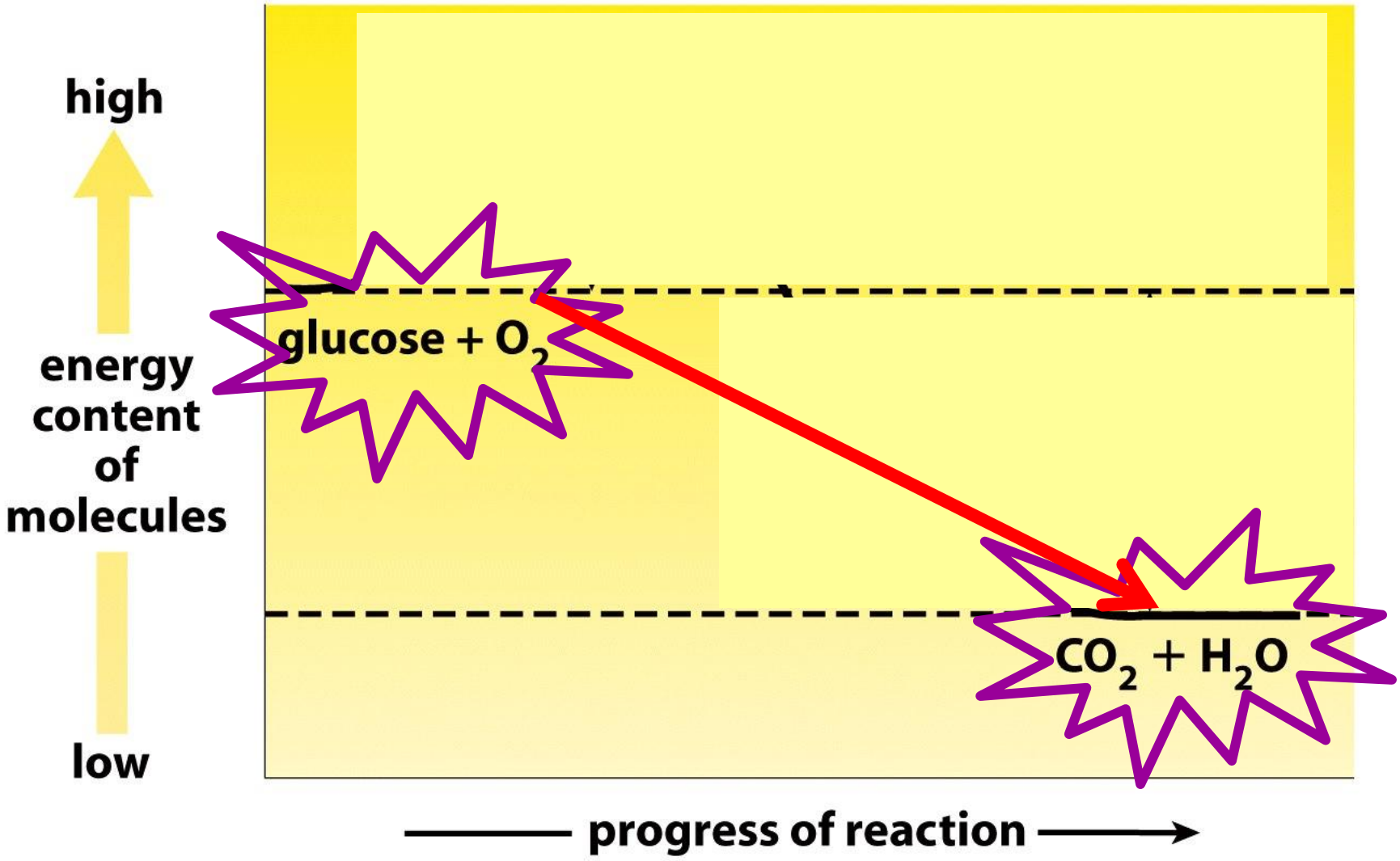


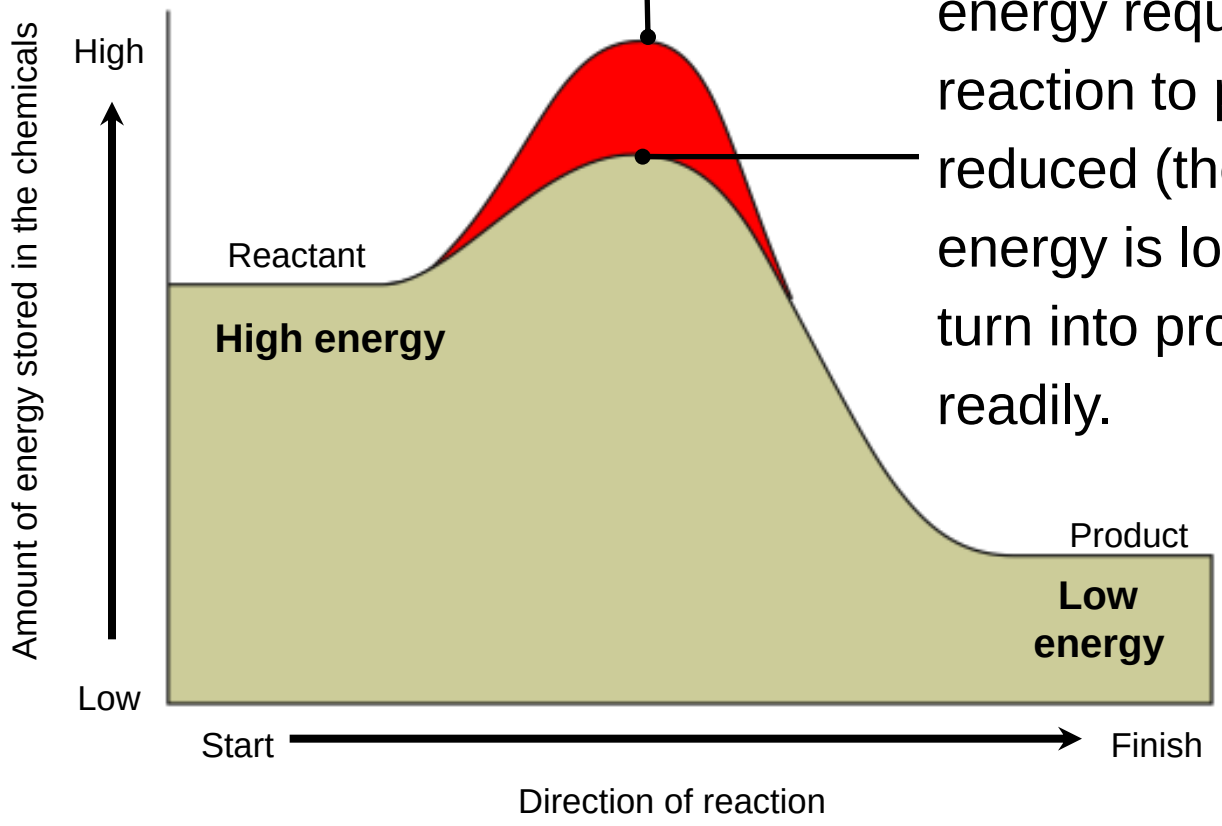
Figure 6-6 Biology: Life on Earth, 8/e

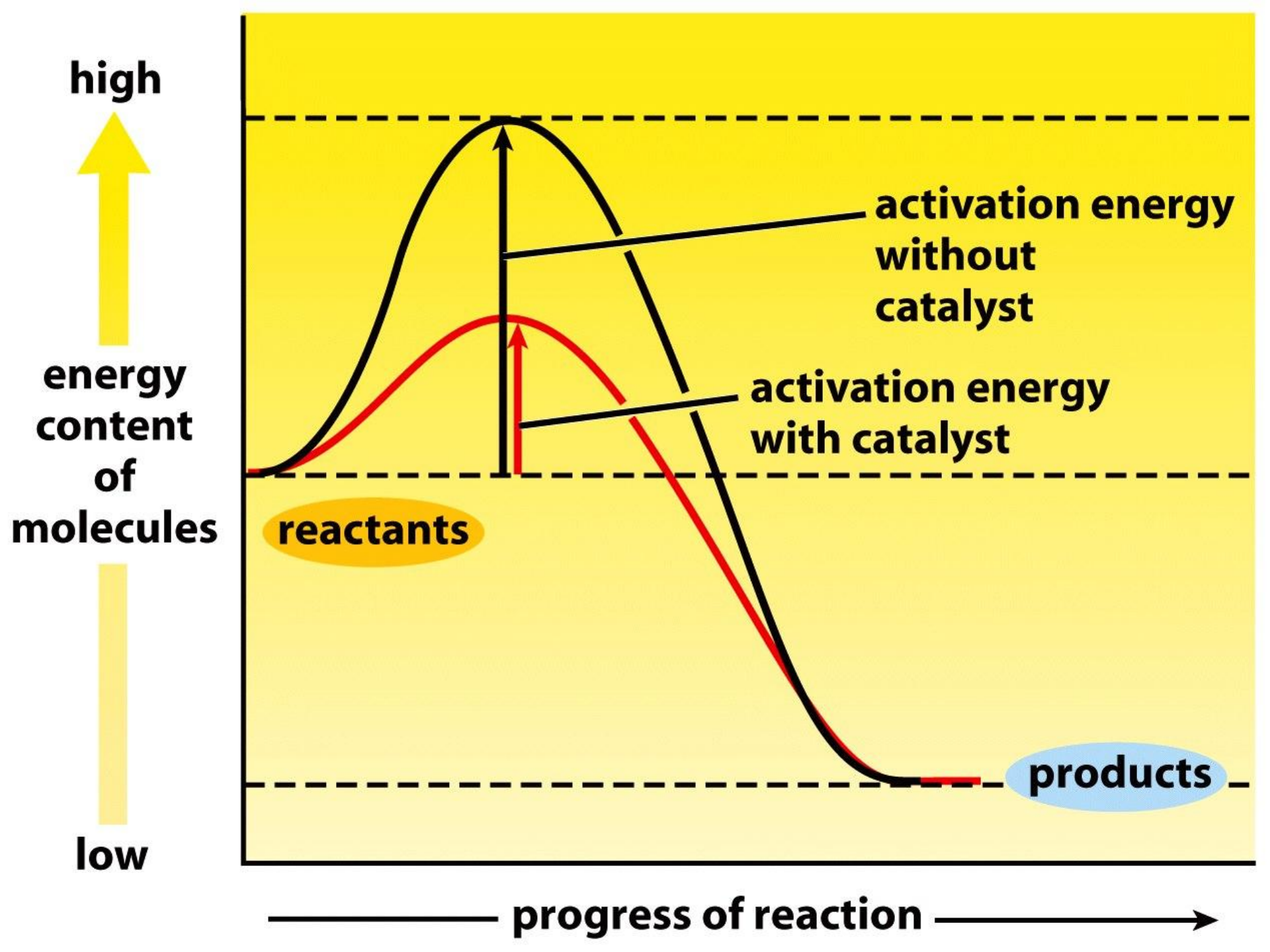
ENZYMES

- **Enzyme**s are employed to **catalyze** (speed up) chemical reactions in cells
  - Catalysts speed up the rate of a chemical reaction without themselves being used up
  - Catalysts speed up spontaneous reactions by **reducing activation energy**

Without enzyme present, the energy needed to make the reaction proceed in the forward direction (the **activation energy**) is very high.

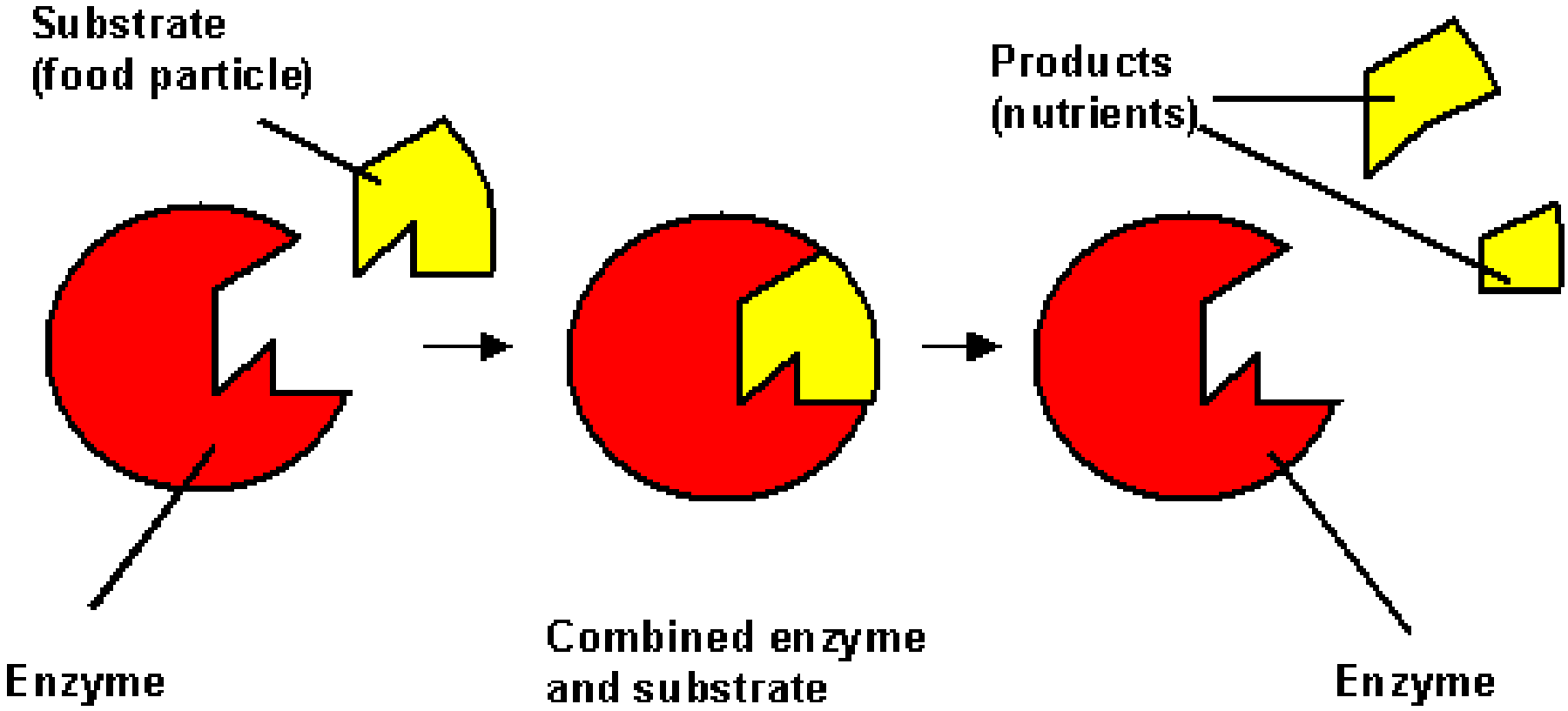
With enzyme present, the energy required for the reaction to proceed is reduced (the activation energy is lower). Reactants turn into products more readily.




high
energy content of molecules
low
activation energy without catalyst
activation energy with catalyst
reactants
products
progress of reaction

Enzyme Structure

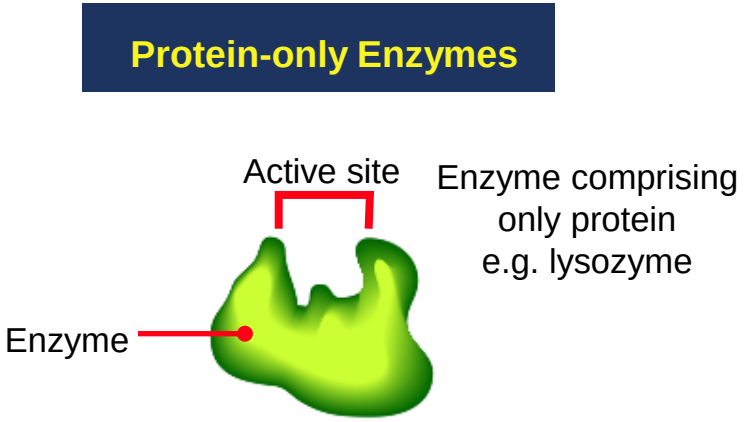
- Enzymes have a pocket called an **active site**
- Reactants (**substrates**) bind to the active site
  - Distinctive shape of active site is complementary and **specific** to the substrate
  - Active site amino acids bind to the substrate and distort bonds to facilitate a reaction



How enzymes break down food into nutrients

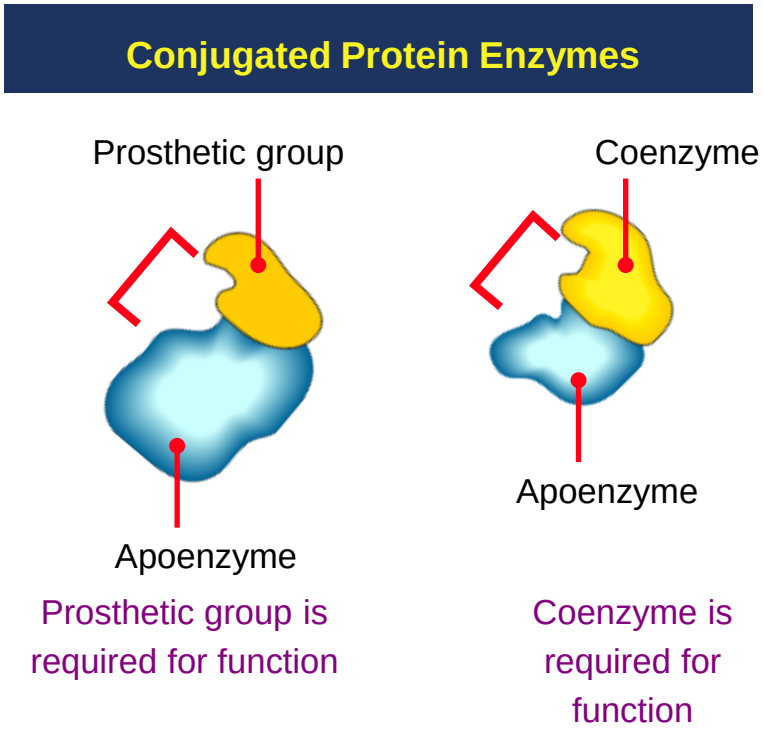
Enzyme Structure

- Some enzymes contain only protein.



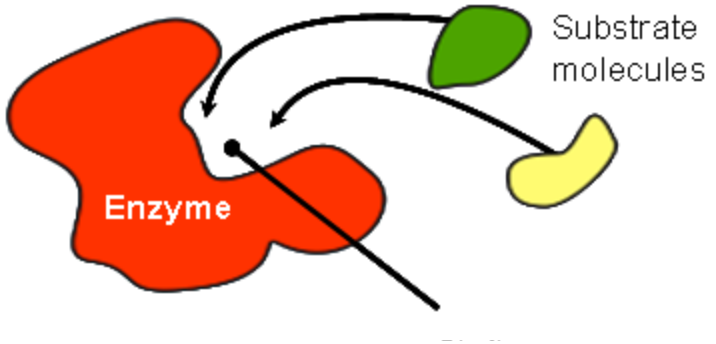
- Others, called **conjugated enzymes**, require additional components to complete their catalytic properties.

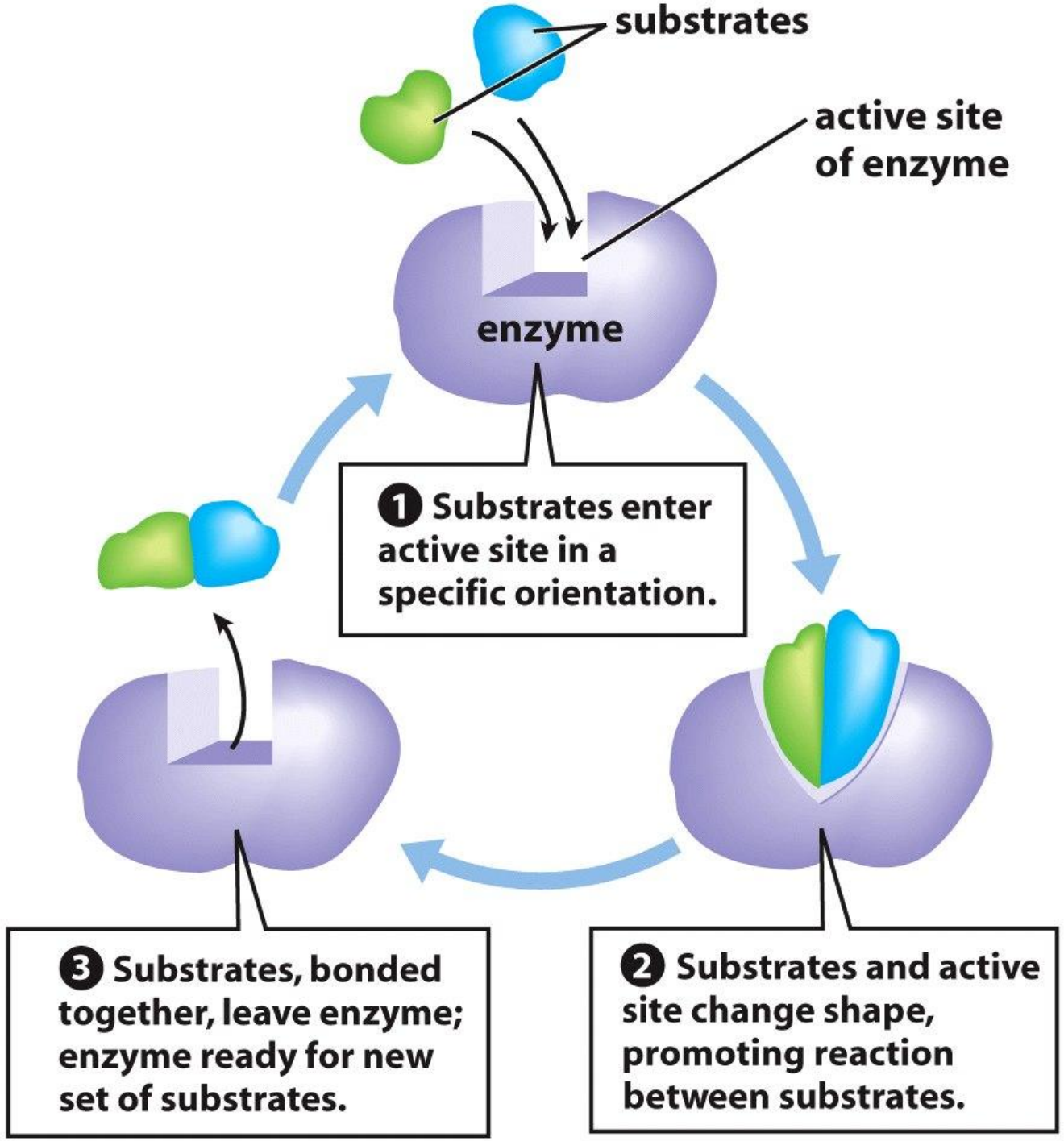
These may be permanently attached parts called **prosthetic groups**, or temporarily attached non-protein **coenzymes**, which detach after a reaction and may then participate with another enzyme in other reactions.

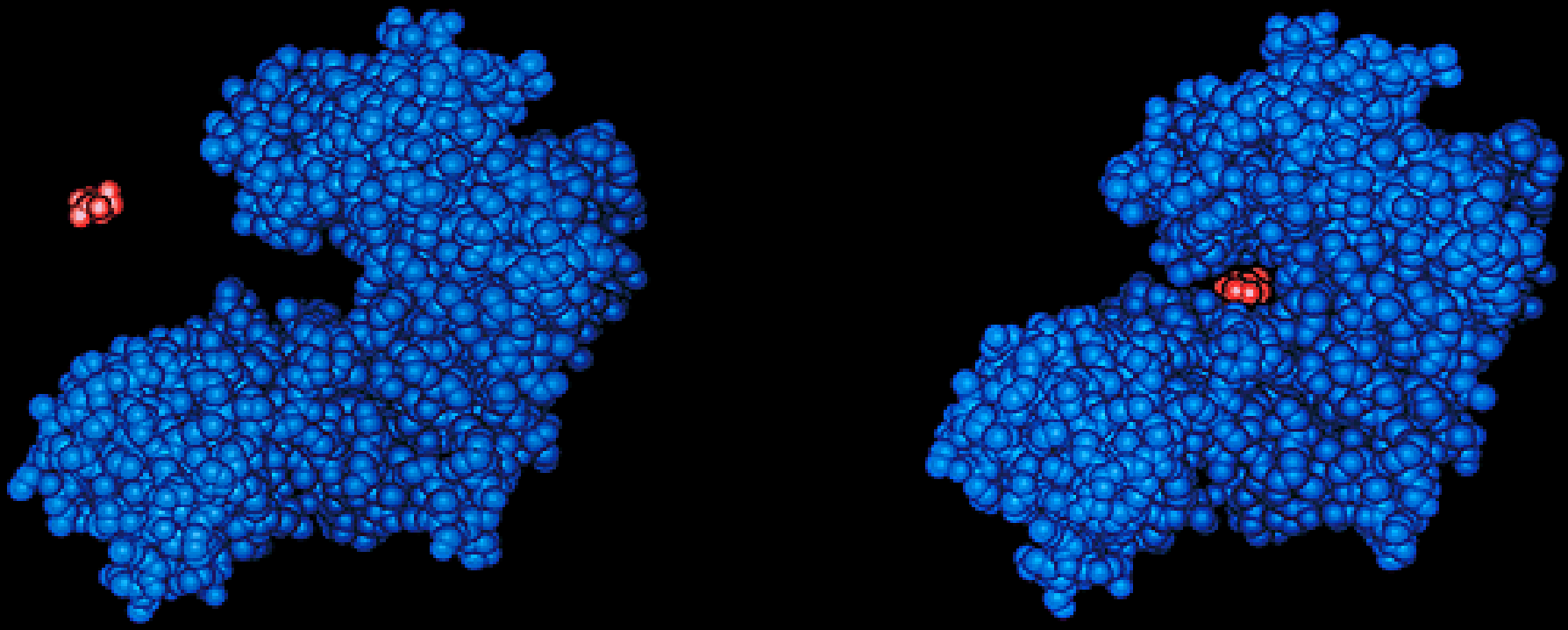


Three steps of enzyme catalysis

1. Substrates enter the active site in a specific orientation




substrates
active site of enzyme
enzyme
1 Substrates enter active site in a specific orientation.
2 Substrates and active site change shape, promoting reaction between substrates.
3 Substrates, bonded together, leave enzyme; enzyme ready for new set of substrates.



- Enzymes are often named for the substrate on which they work
- Sometimes include the suffix -ase:
  - **Lipase** breaks down fats (lipids)
  - **Amylase** breaks down starch (amylose/amylopectin)
  - **Lactase** breaks down milk sugar (lactose)
  - **Cholinesterase** breaks down the neurotransmitter acetylcholine in the nervous system

Cheese making relies on the enzyme rennin, which coagulates milk protein to make a curd