

Chemical Reactions and Enzymes

Chapter 2.4

I. Chemical Reactions

- **The creation of new substances.**
- **Occur when chemical bonds between atoms are broken and/or formed.**
- **Involve either the addition or release of energy.**
- **All chemical rxns are reversible.**
- **Drive most cellular processes or activities.**

Example: CO₂ has low solubility in blood.

Muscles



Lungs

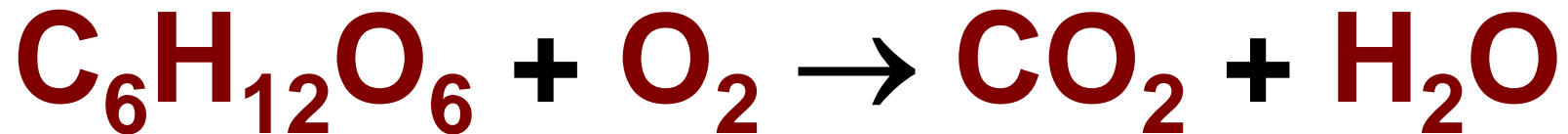


Reactants: the substances that are combined or broken apart during a chemical rxn.

Products: new substances that are formed by a chemical rxn.

Reactants

Products



II. Energy in Reactions

Exothermic

Exo = out

- Rxs where energy is **released** (heat).
- Usually spontaneous

Endothermic

Endo = in

- Rxns where energy is added and **stored** in bonds
- Requires a source of energy

Exothermic

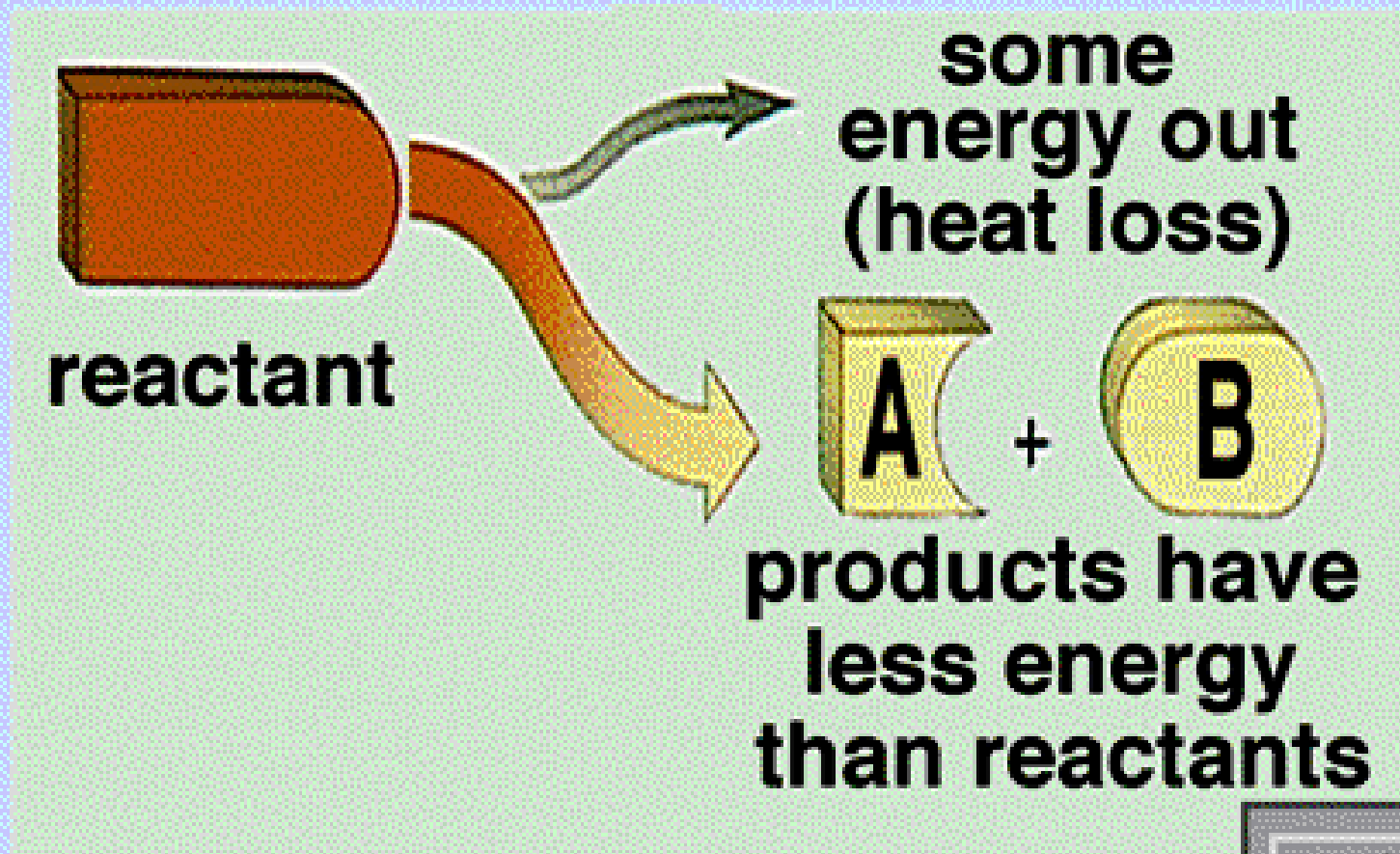


Endothermic



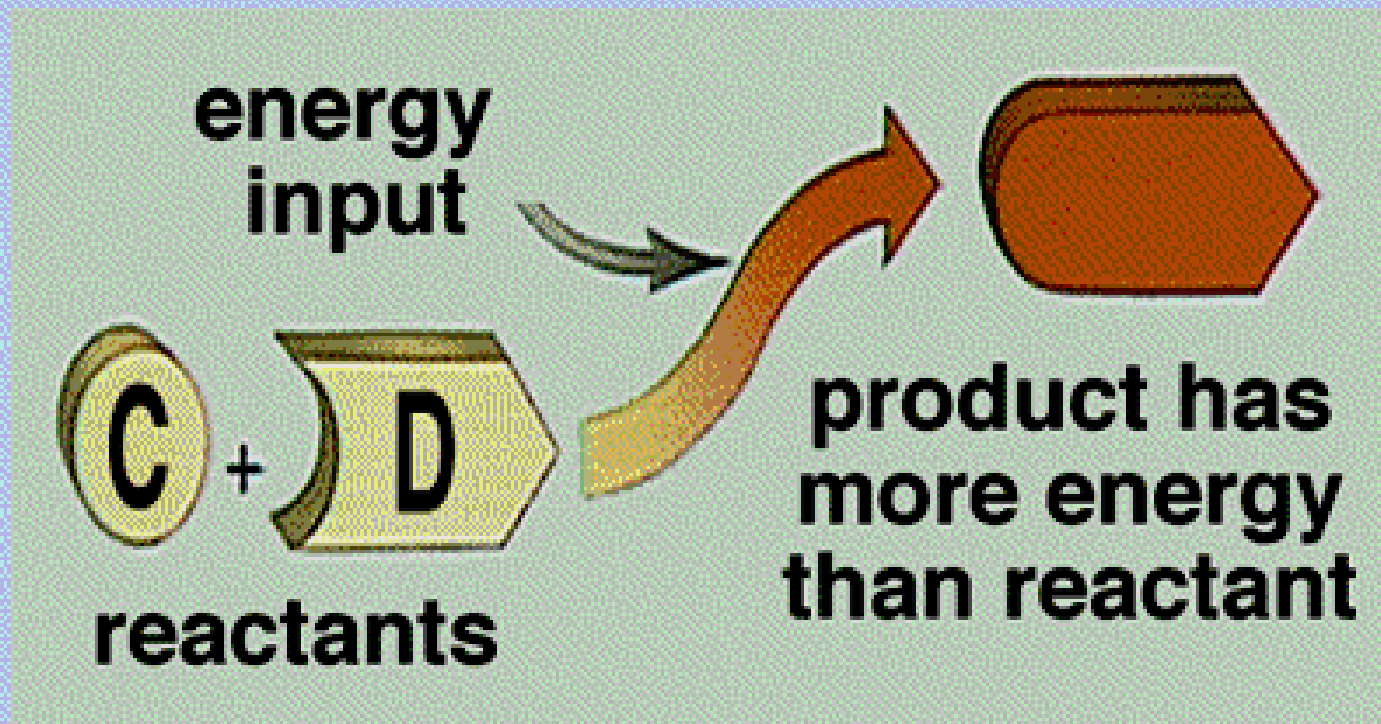
An Exothermic Reaction

Metabolic Reactions



An Endothermic Reaction

Metabolic Reactions



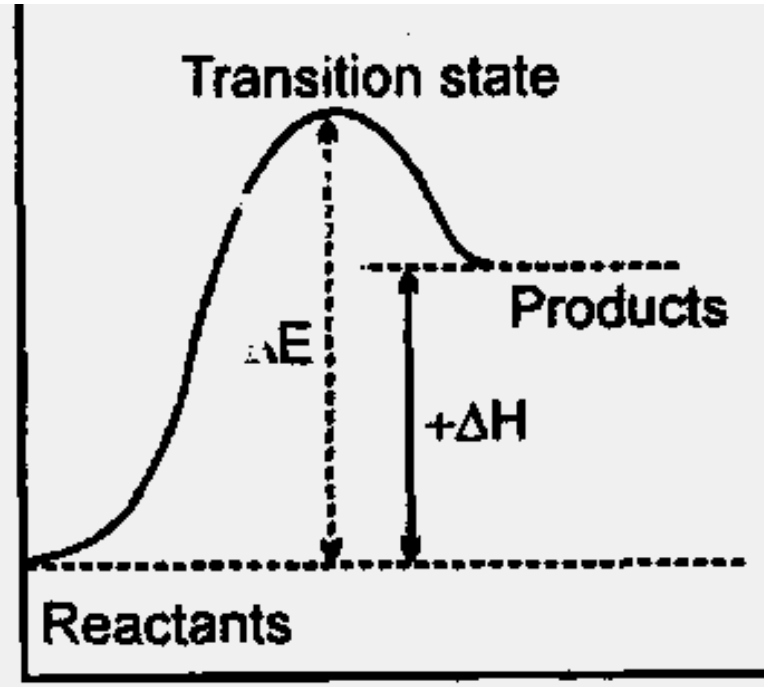
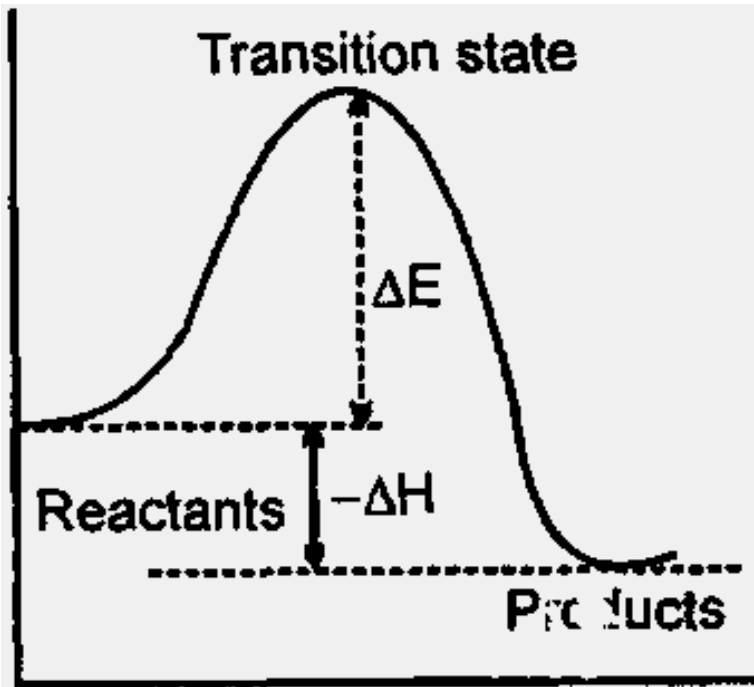
Activation Energy

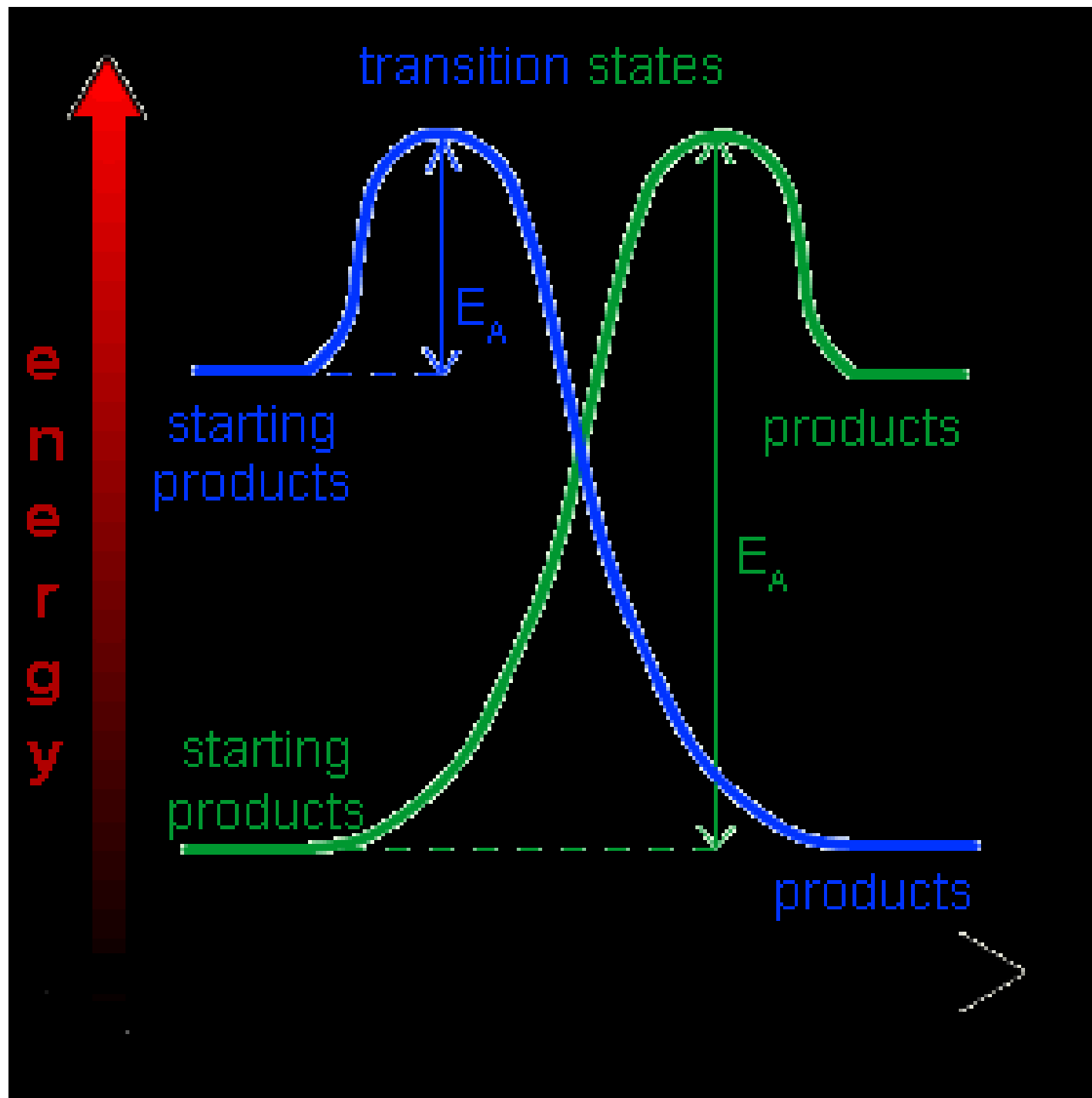
- Even rxns that are spontaneous (like burning sugar) require some energy to get the rxn started.
- This initial energy is called activation energy.

$\Delta E = \text{Activation Energy}$

Exothermic

Endothermic

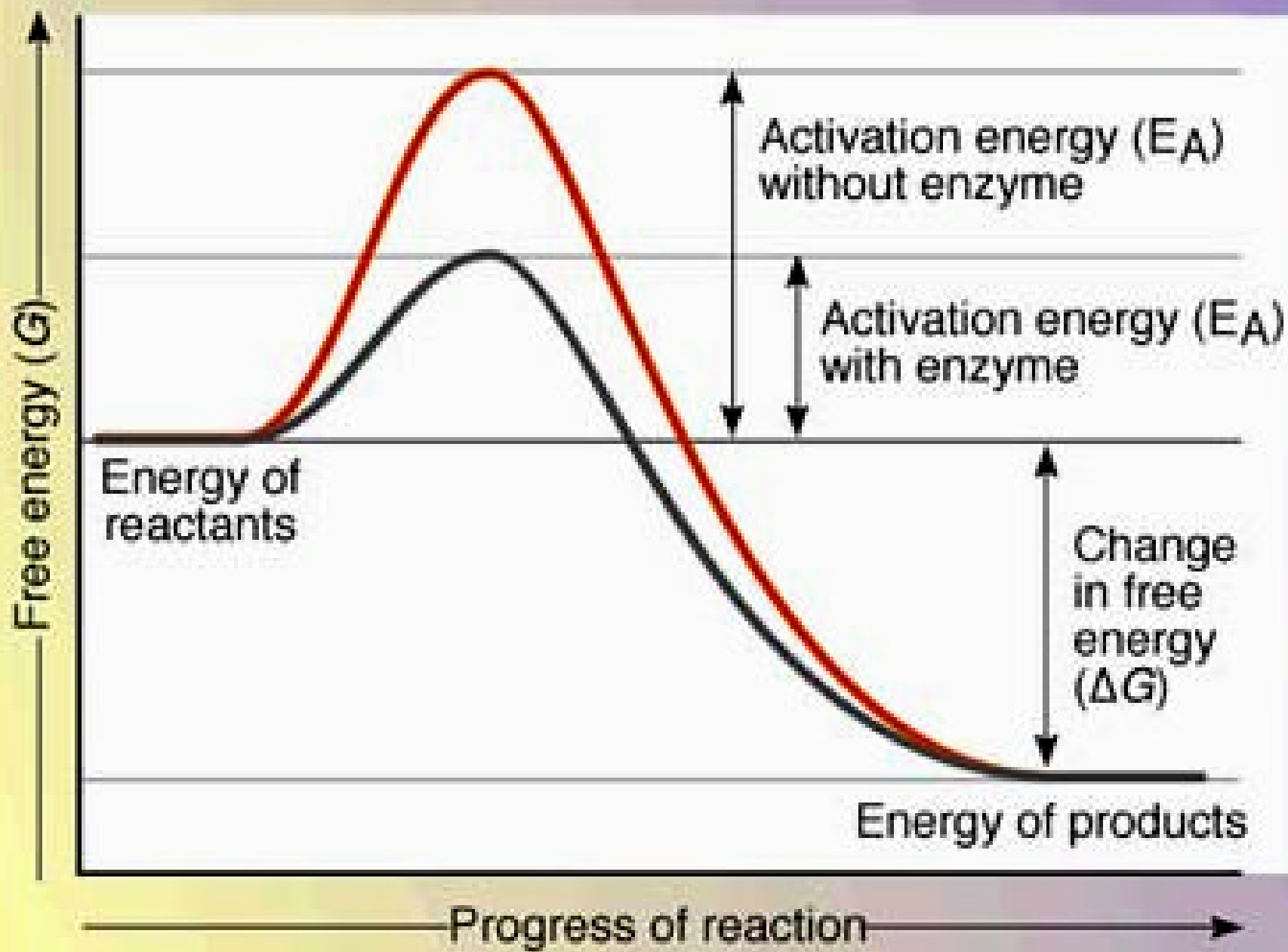


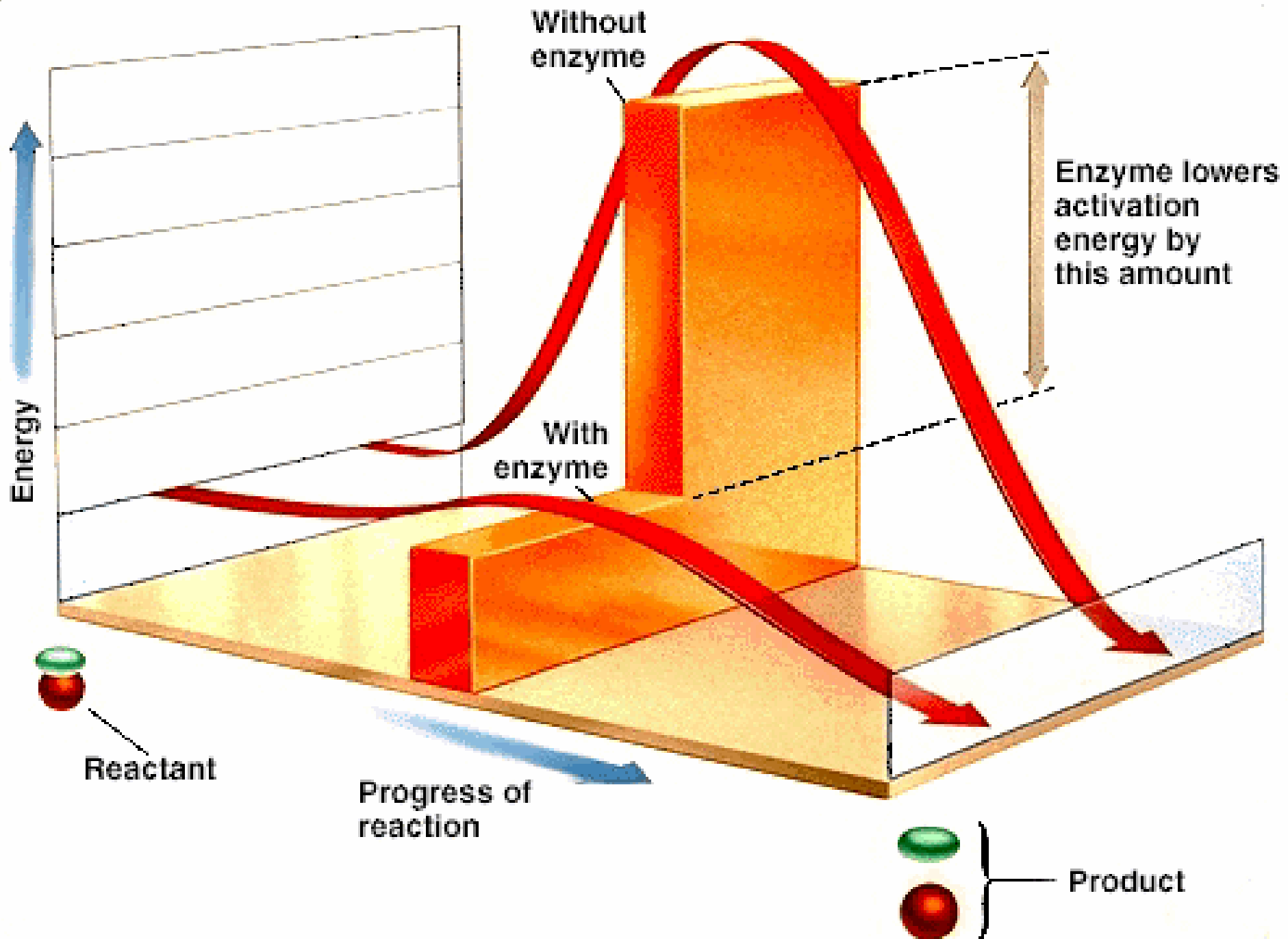


III. Enzymes

Catalyst: A substance that speeds up a rxn without being consumed in the rxn.

- Enzymes are biological catalysts
- Made of proteins
- Lowers the activation energy barrier to allow rxns to occur at normal temperatures.





Without enzyme

Enzyme lowers activation energy by this amount

With enzyme

Energy

Reactant

Progress of reaction

Product

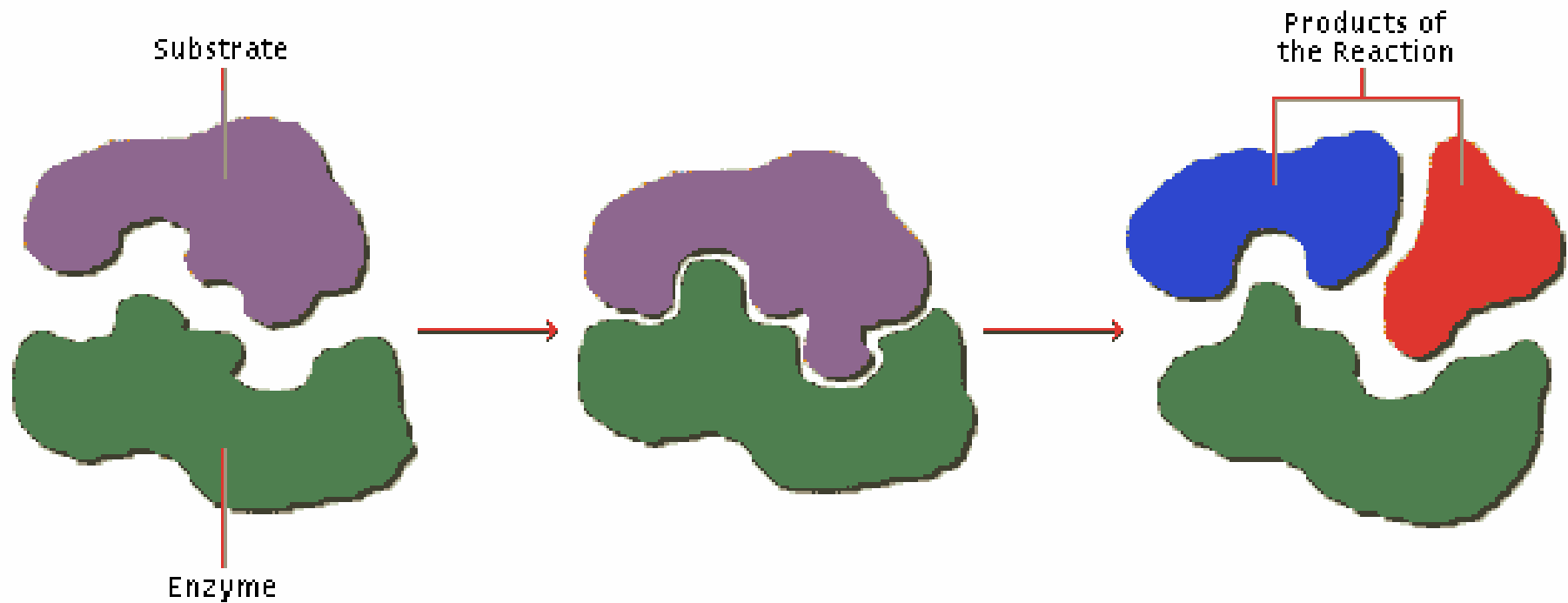
Enzymes

- **“If the cell were a city, the enzymes would be the workers. To keep the city running, raw materials are imported and converted into useful items. Enzymes populate the cellular factories in which this is done.” Philip Ball**

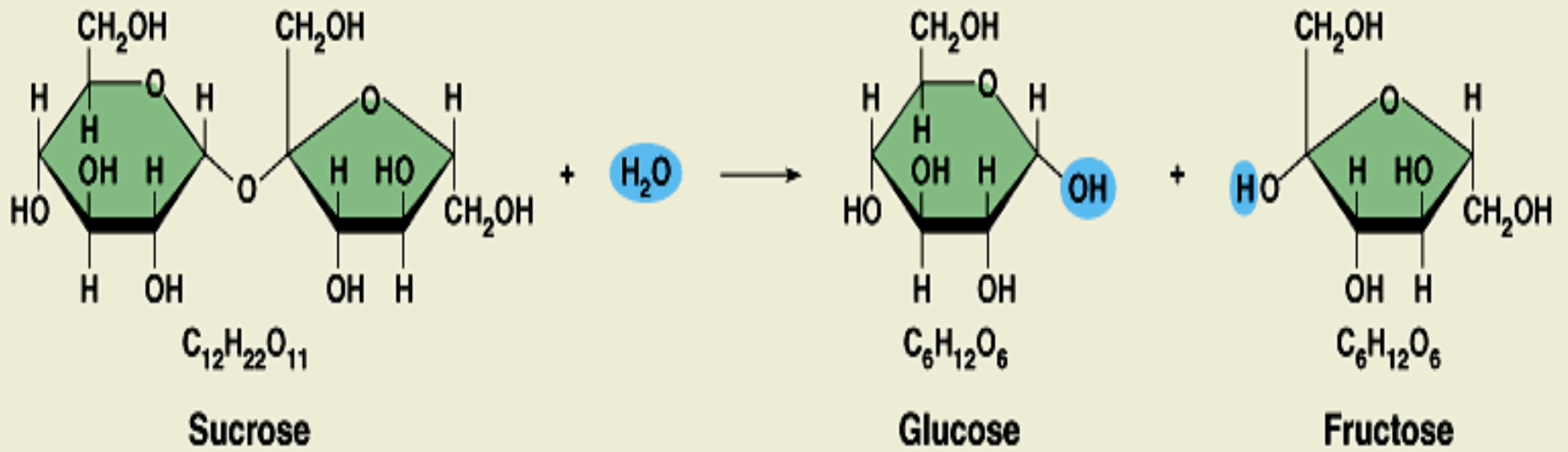
IV. Enzyme Action

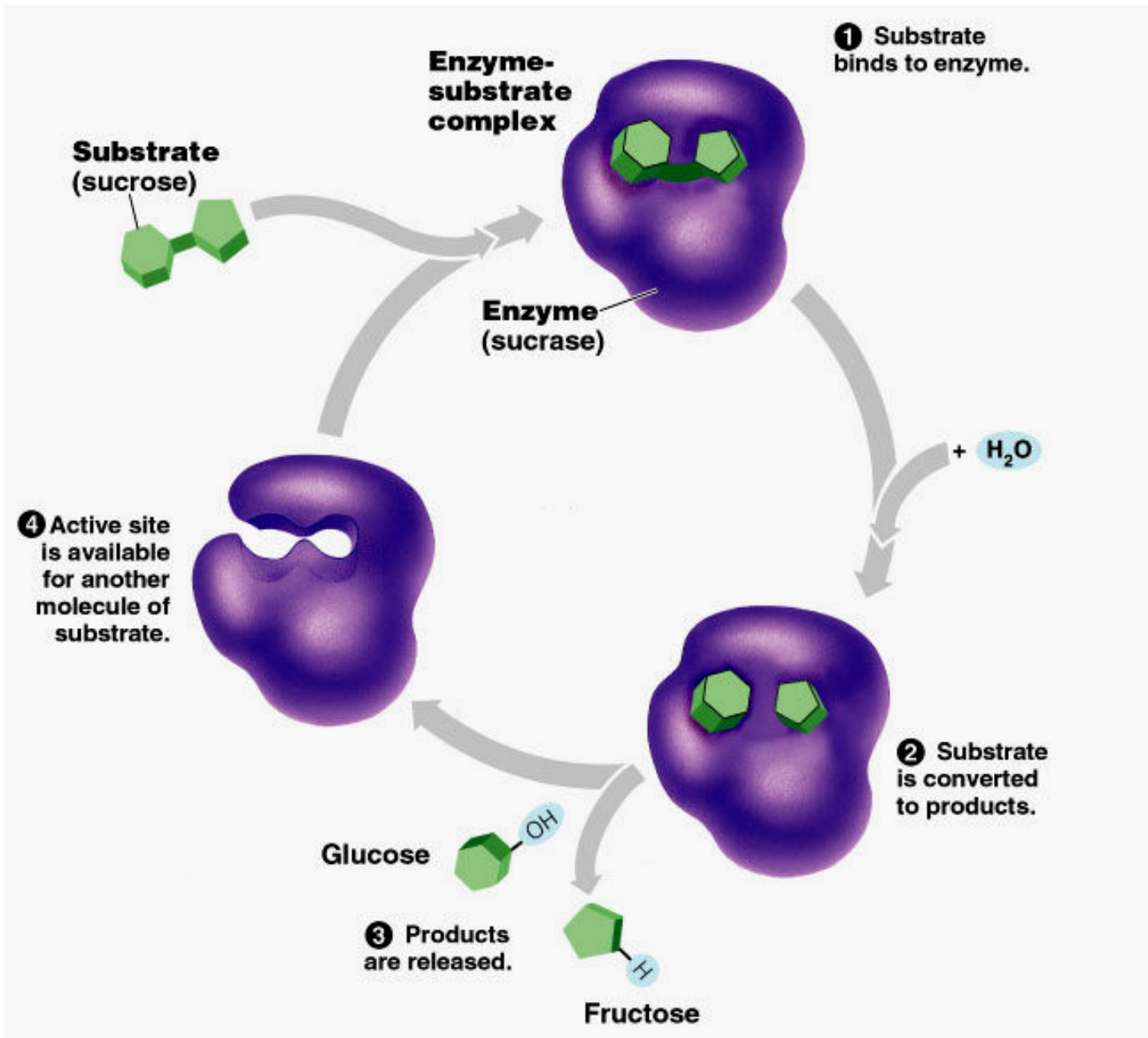
- **Reactants = Substrates**
- **Enzymes and substrates fit together like a lock and key.**
- **Enzymes lower the activation energy by holding reactants close together and in the proper orientation.**

Lock and Key Model

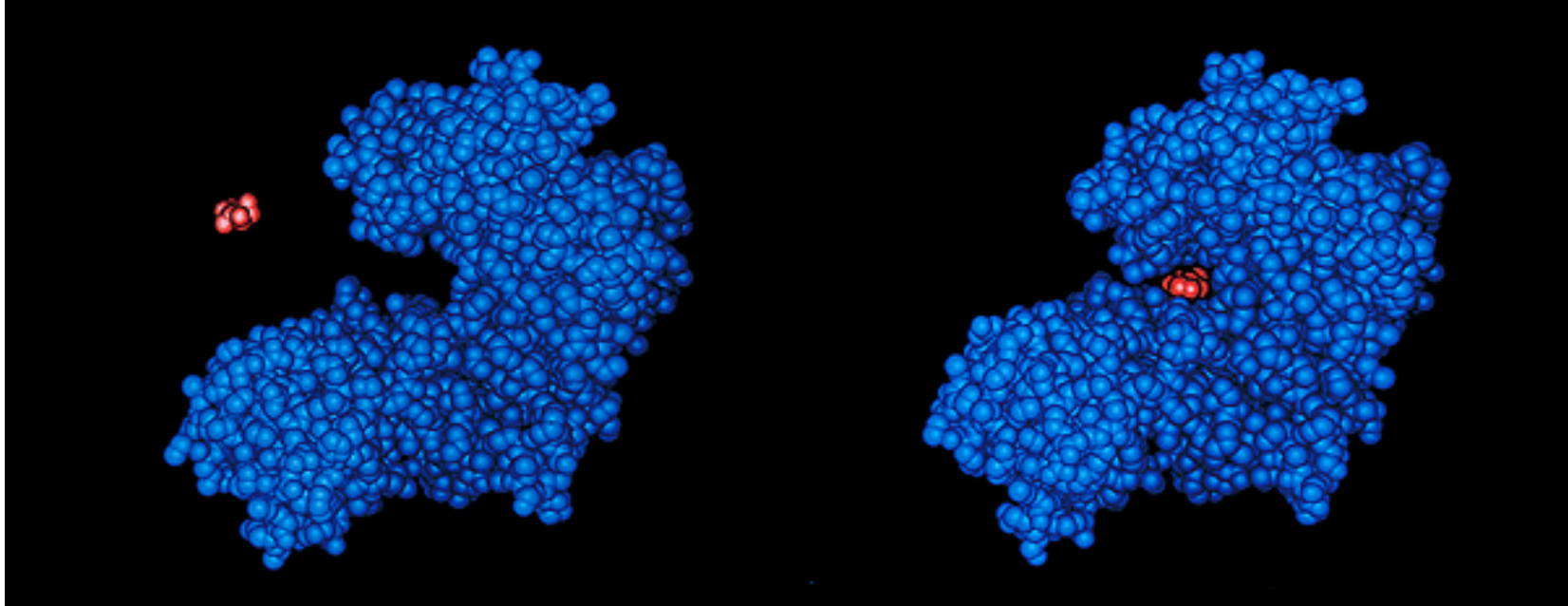


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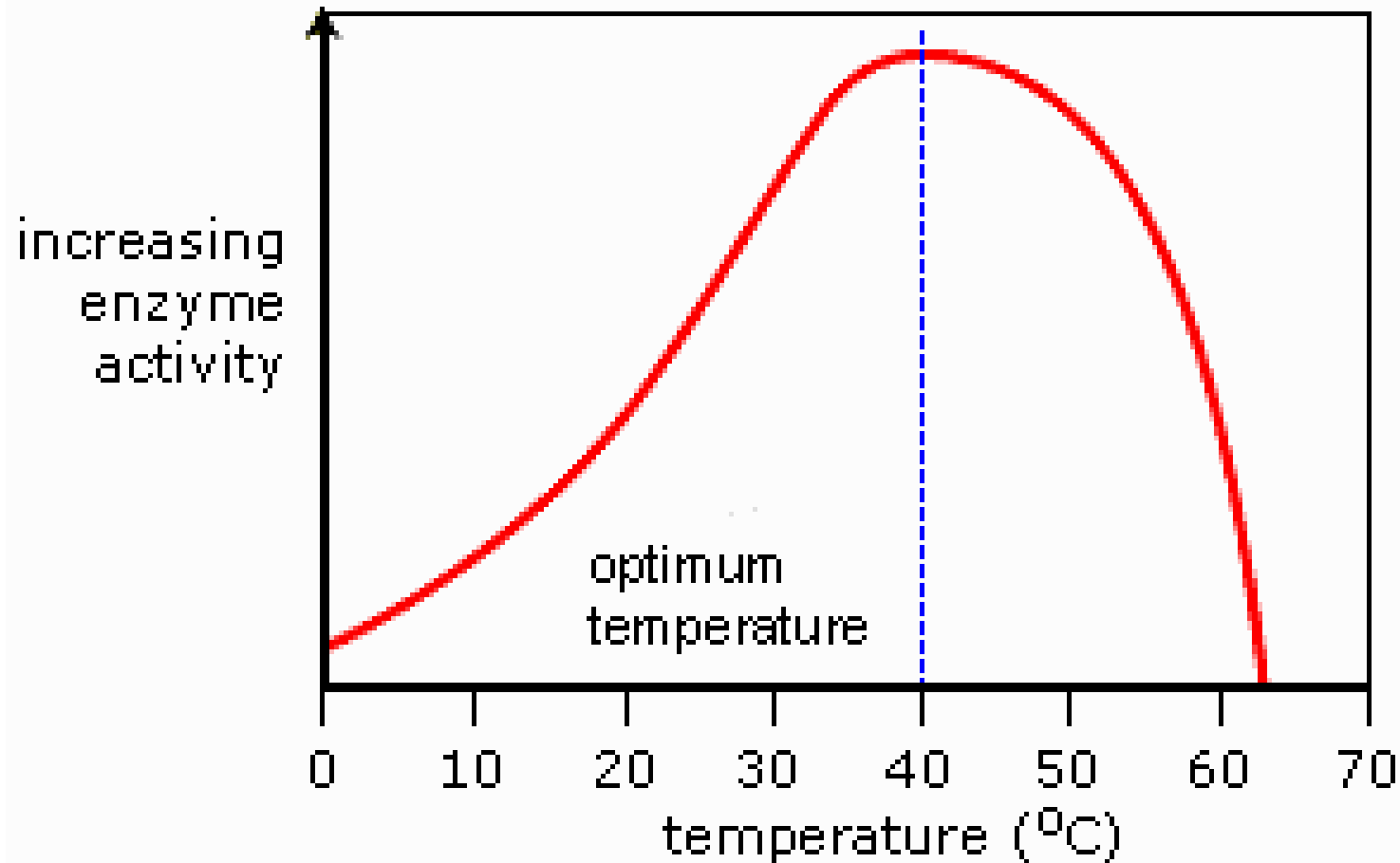


- **As the substrate binds, the enzyme changes shape leading to a tighter induced fit, bringing chemical groups in position to catalyze the reaction.**



Factors Affecting Enzyme Activity

1. Temperature and pH:



- Cofactors (some vitamins and minerals)
- Cells can turn enzymes “on” and “off”

Animations

Cartoon

Slideshow

Animation

Inhibition