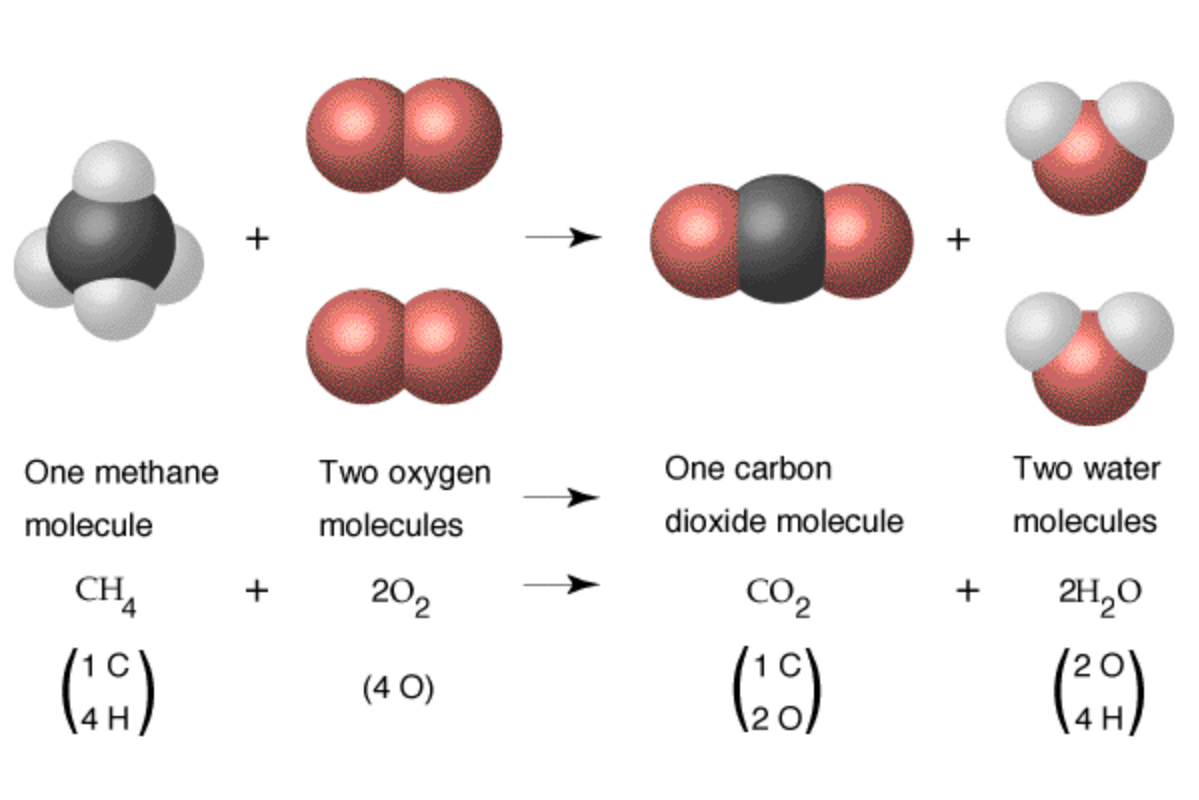
# Chemical Reactions

# What is a chemical reaction?

- The process of breaking chemical bonds, forming new ones, or both




**Reactants** on the left, **Products** on the right

Synthesis—combining atoms to make something new

$$A + B \rightarrow C$$

Decomposition—breaking apart compounds to make something new

$$C \rightarrow A + B$$

Exchange-atoms swap places to make something new

$$AB + C \rightarrow AC + B$$

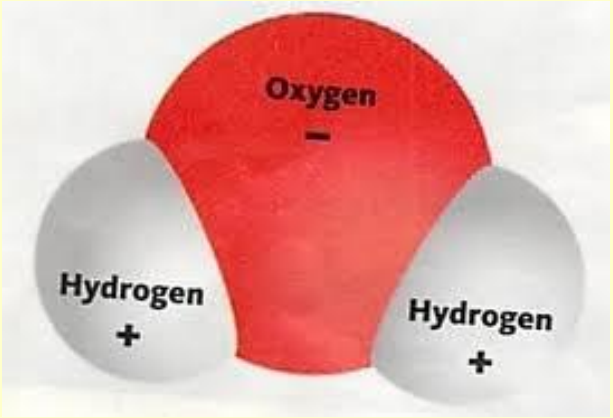
# Energy and Chemical Reactions

- If reactants are at a higher energy level than products—energy is given off—the reaction is **exergonic** (breaking bonds)
- If reactants are at a lower energy level than products—energy is taken in—the reaction is **endergonic** (making bonds)

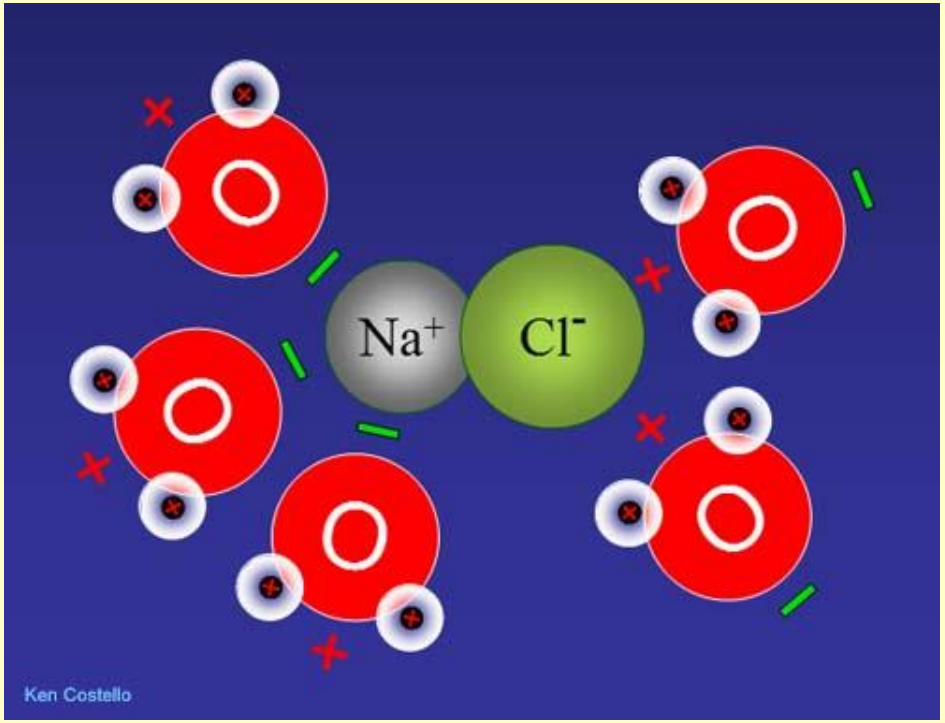
# All chemical reactions take place in WATER!!!

**Water is a POLAR compound**

- A compound with one side having a negative charge and the other side a positive charge

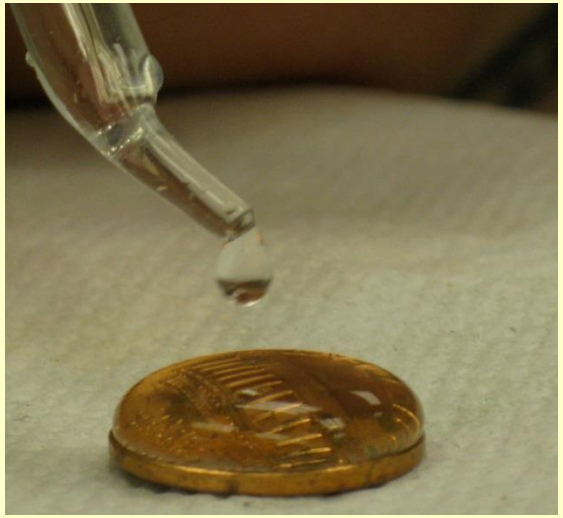



**This means it DISSOLVES other polar molecules**



**COHESION**

- Water molecules stick to EACH other



**ADHESION**

- Water molecules stick to a different molecule

Cohesion

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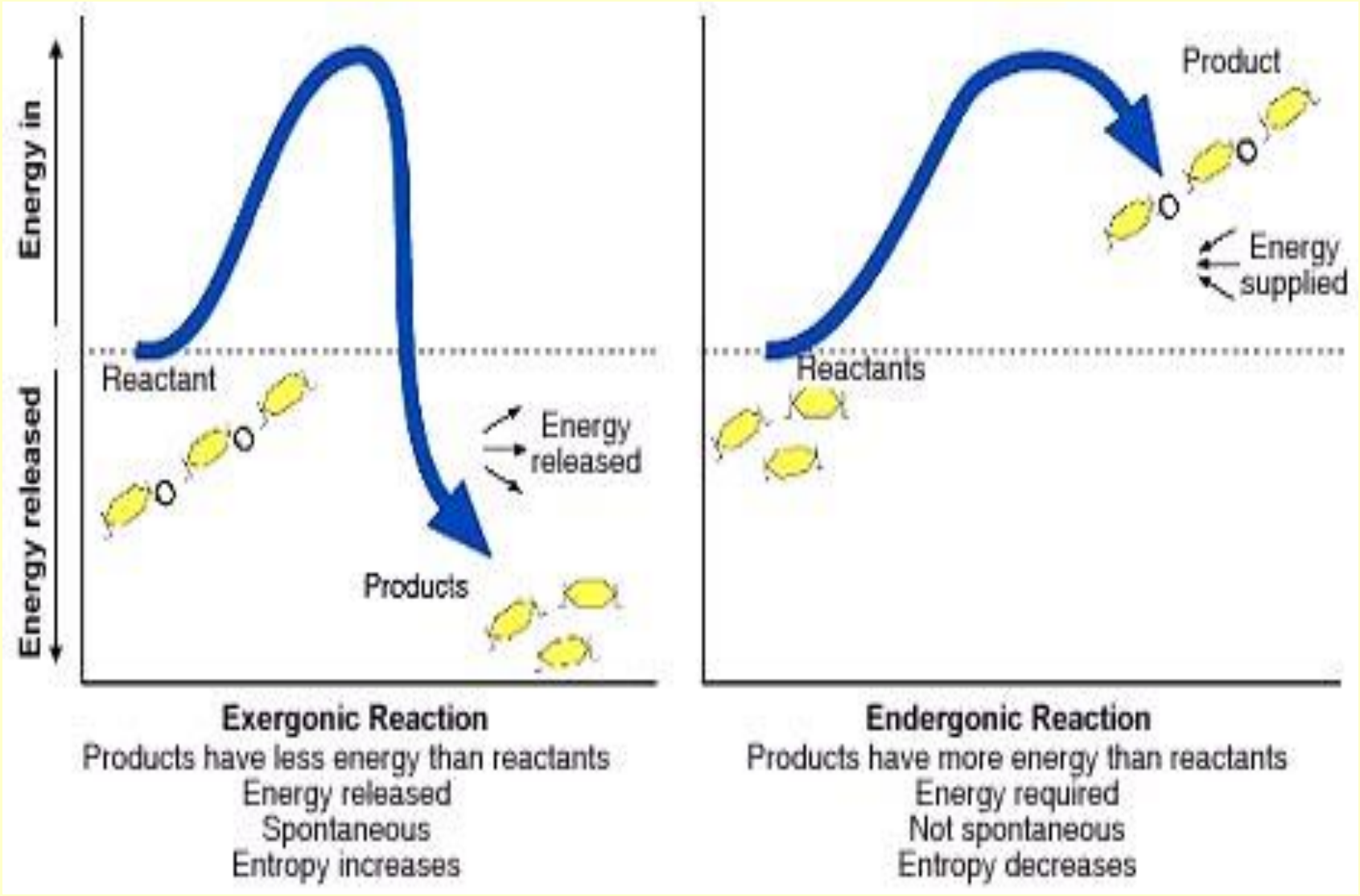
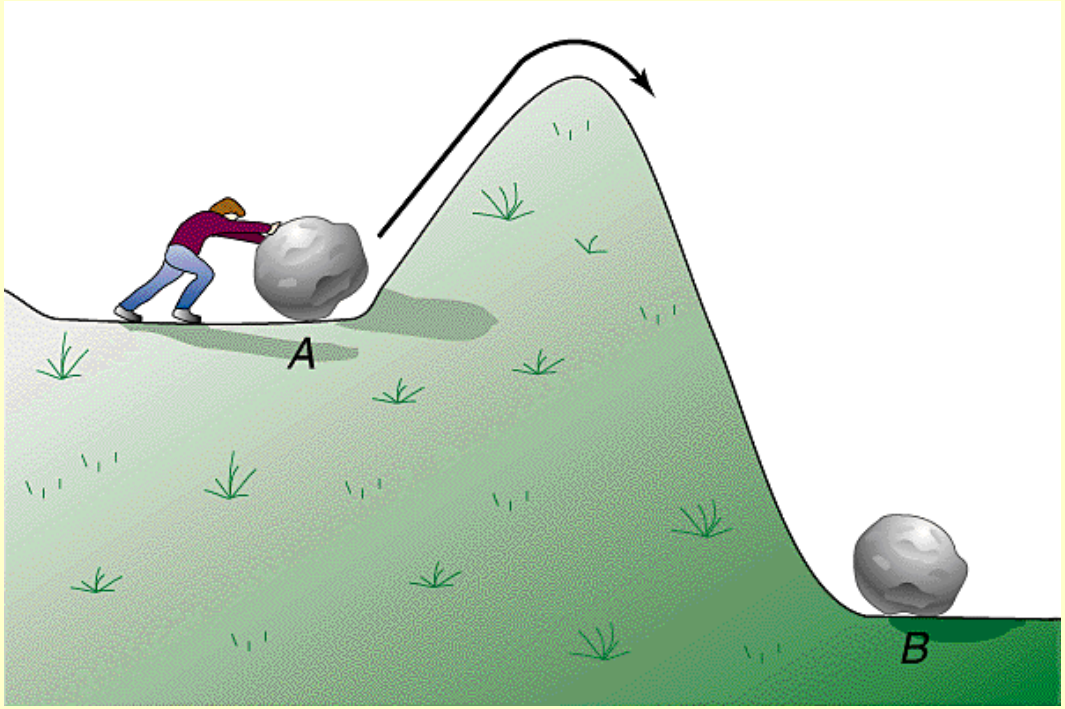
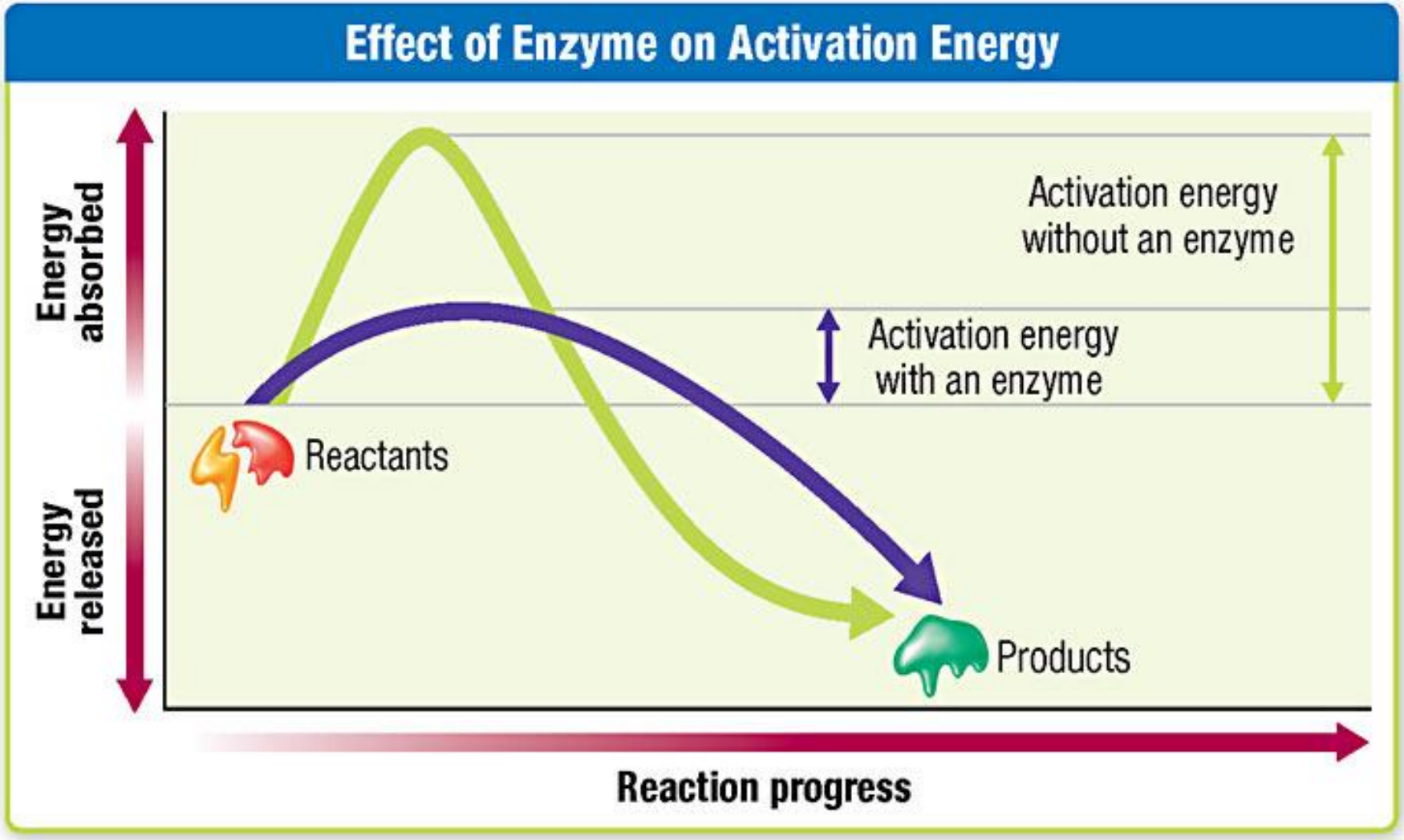
Adhesion


Energy in
Energy released
Reactant
Energy released
Products
Exergonic Reaction
Products have less energy than reactants
Energy released
Spontaneous
Entropy increases
Product
Energy supplied
Reactants
Endergonic Reaction
Products have more energy than reactants
Energy required
Not spontaneous
Entropy decreases

# Activation Energy

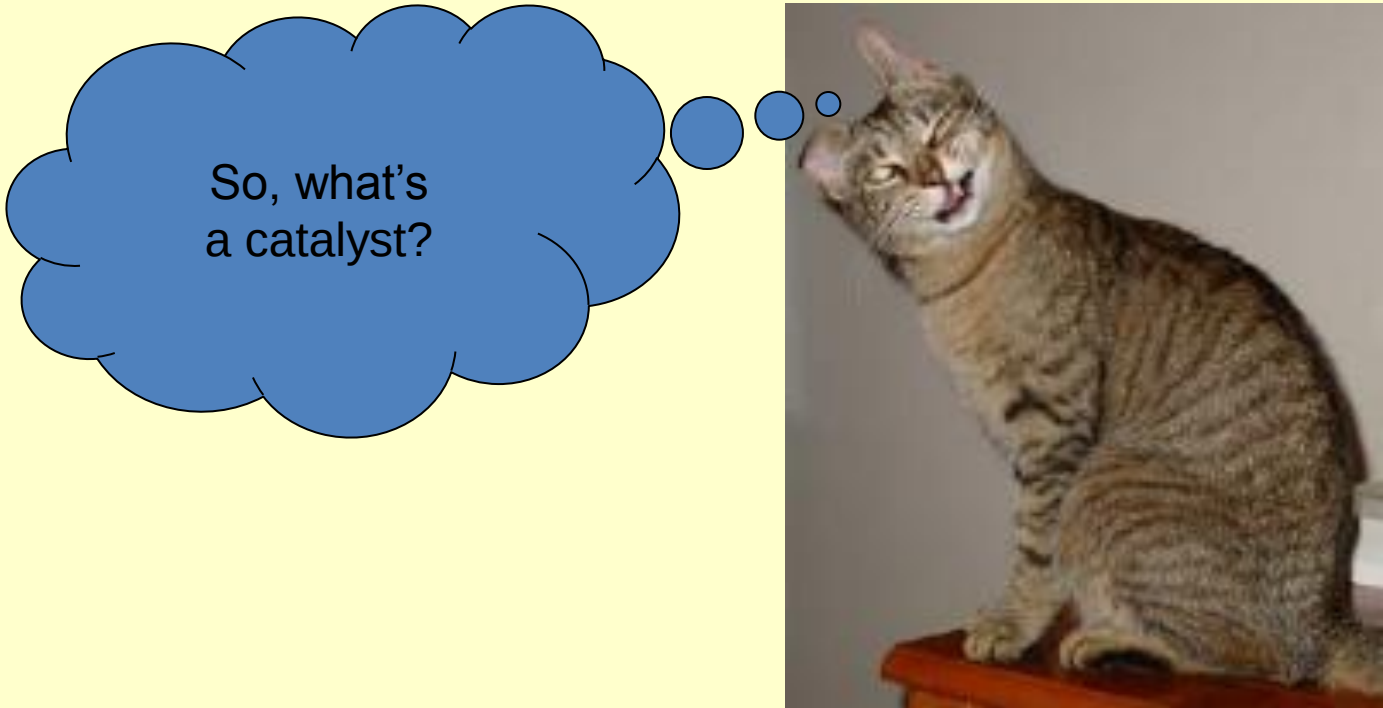
The amount of energy needed to get the reaction started.




Effect of Enzyme on Activation Energy
Energy absorbed
Energy released
Activation energy without an enzyme
Activation energy with an enzyme
Reactants
Products
Reaction progress

# Enzymes!!!

Are organic catalysts



A CATALYST is…a substance that speeds chemical reactions without being changed itself.

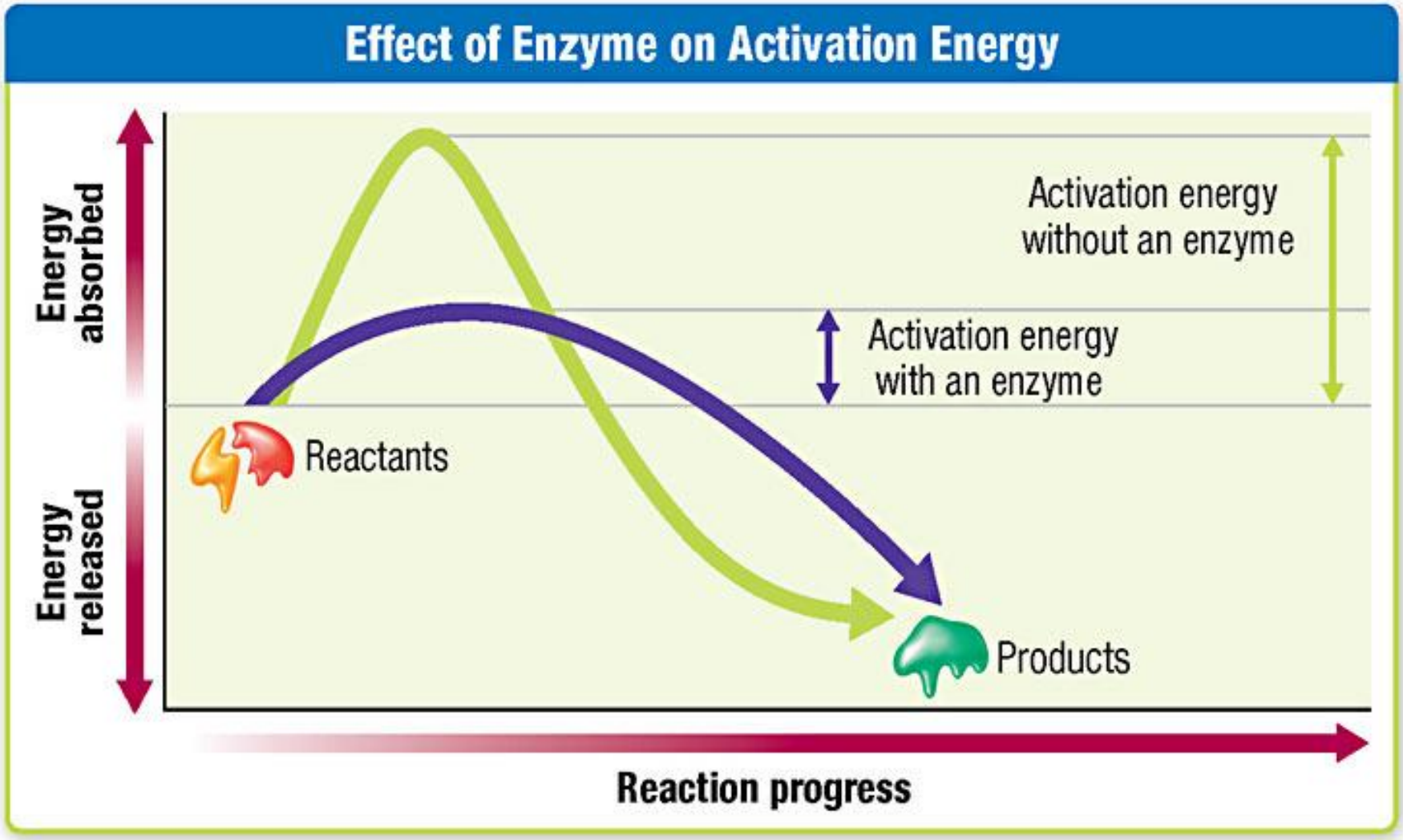
An ENZYME is…a kind of catalyst produced by cells to speed reactions in the body

http://images.encarta.msn.com/xrefmedia/sharemed/targets/images/pho/t046/T046403A.jpg

- Enzymes are neither reactants, nor products
- They are not used up in a chemical reaction
- They make chemical reactions happen faster (up to 1,000,000x!)
- Enzymes are proteins

Enzyme Basics - YouTube

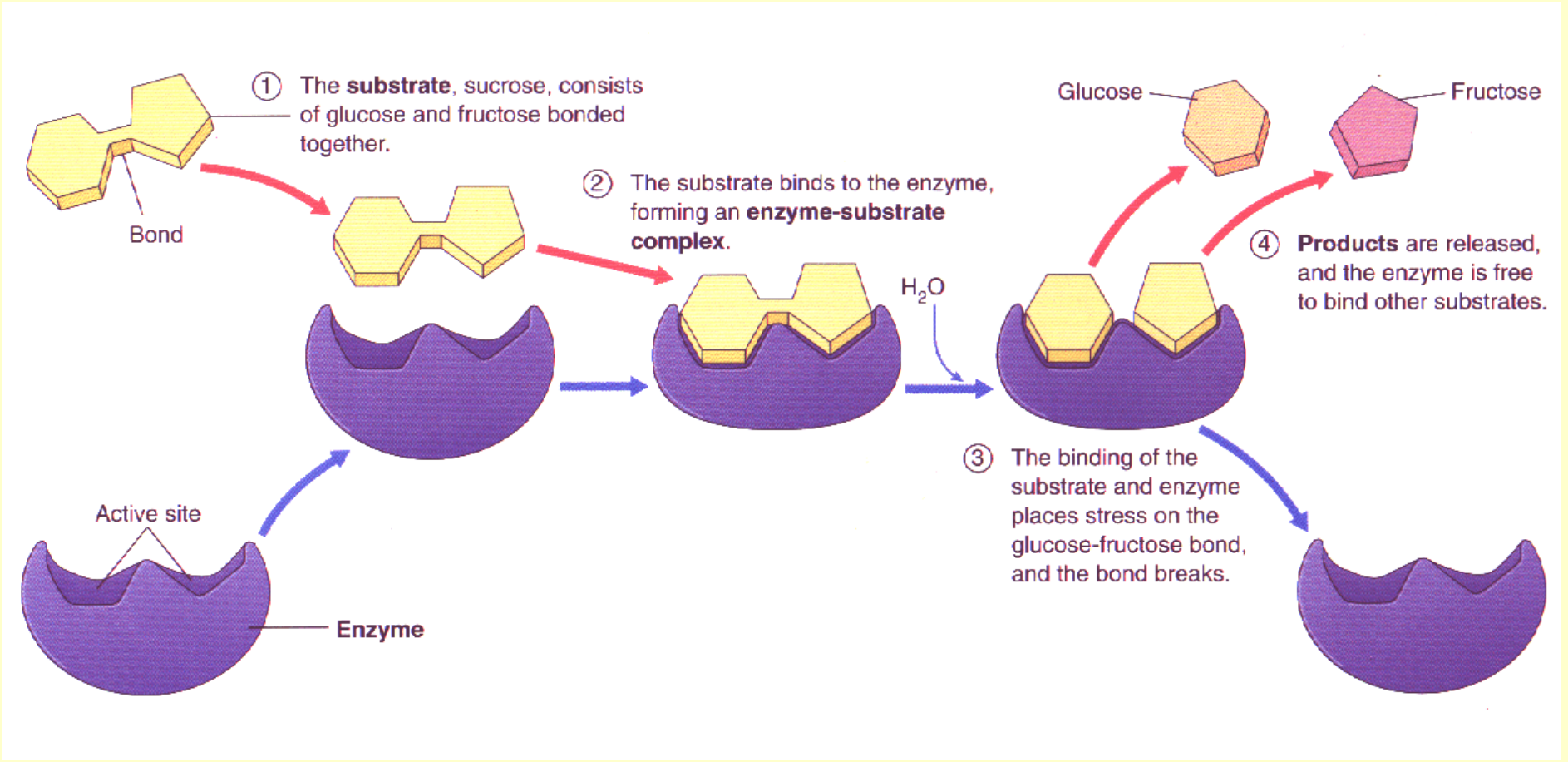
# How do enzymes work?



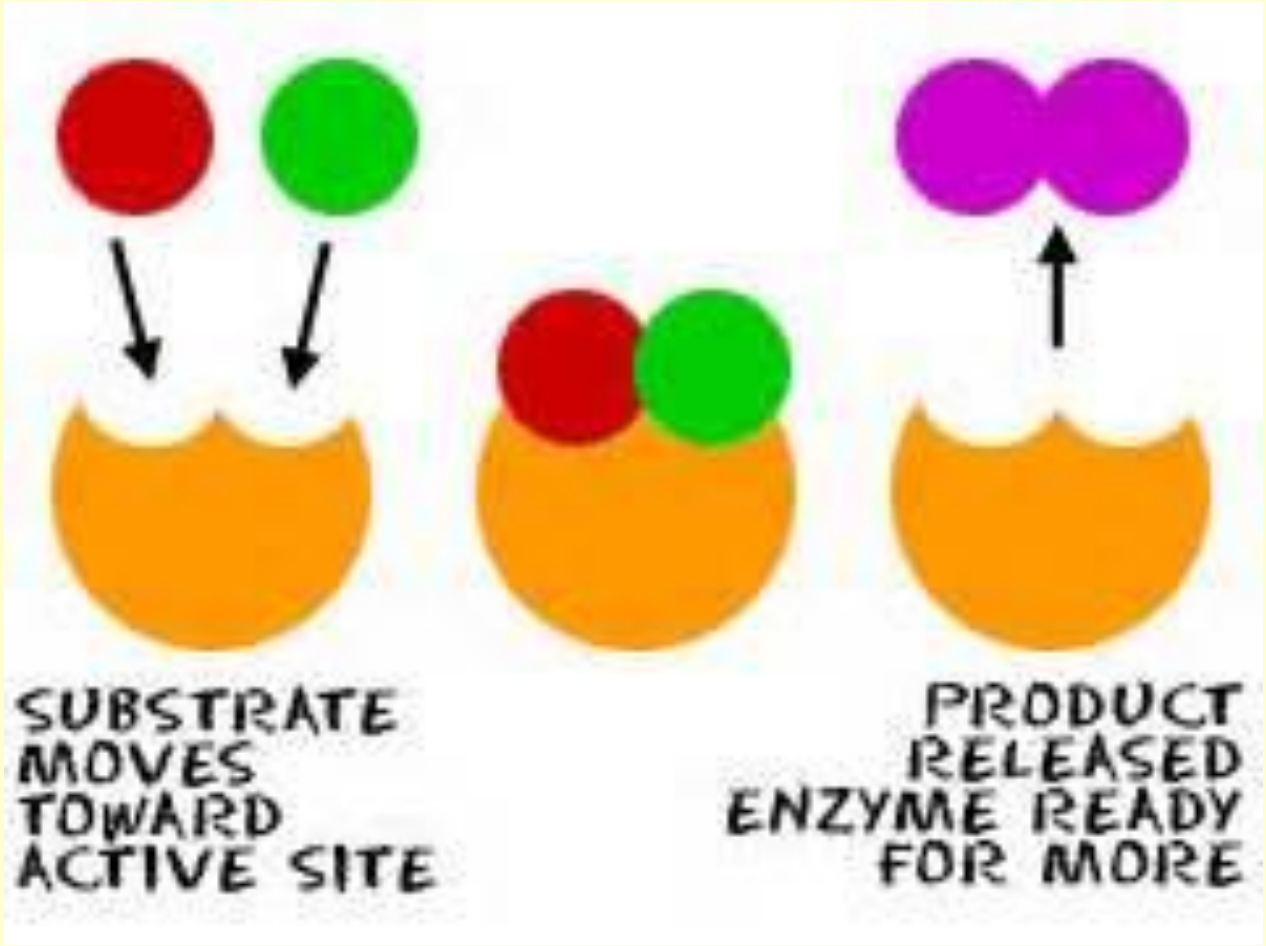
# Ok…so…how do they do that? How do they make these reactions occur faster?

Key terms

- **Substrate**—the reactant that the enzyme will work upon
- **Active site**—the location on the enzyme where the substrate will attach




http://en.wikipedia.org/wiki/Enzyme#.22Lock_and_key.22_model


SUBSTRATE
MOVES
TOWARD
ACTIVE SITE
PRODUCT
RELEASED
ENZYME READY
FOR MORE

# Inhibitors

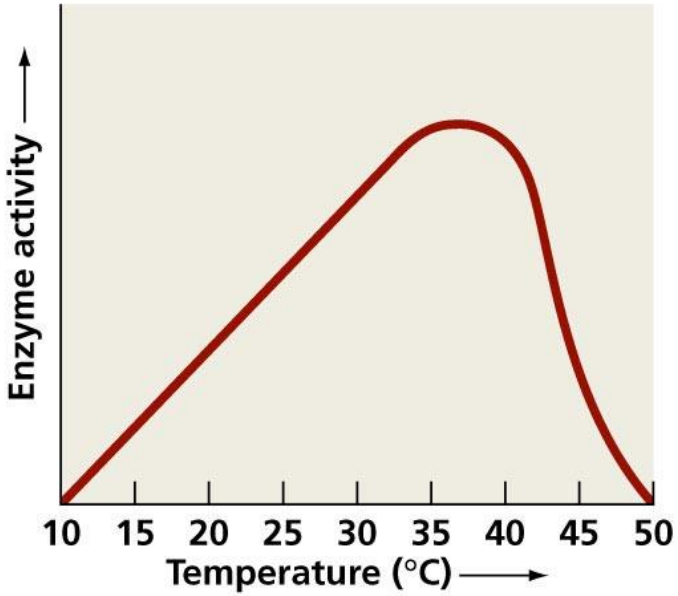
Slow a reaction down by preventing the enzyme from working

**Competitive**—same size and shape as substrate and fills the active site-the substrate can't attach

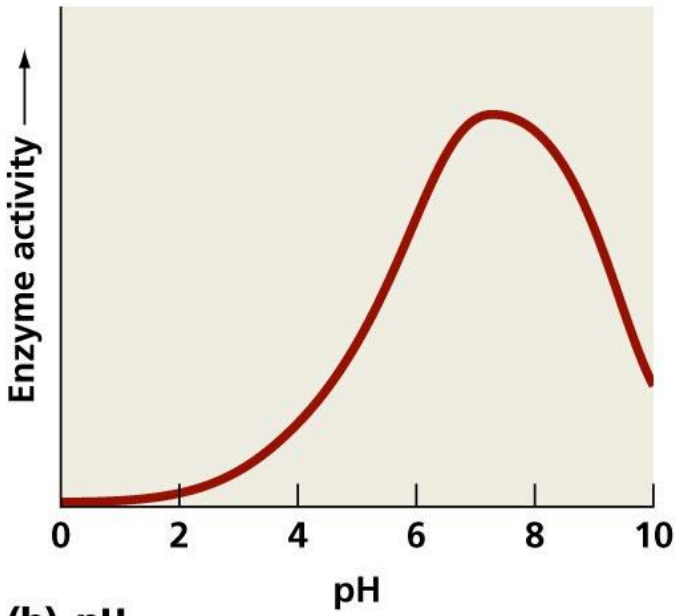
**Non-competitive**—different size and shape than substrate, but changes the shape of the enzyme so it can't work

# Factors that Affect Enzyme Activity

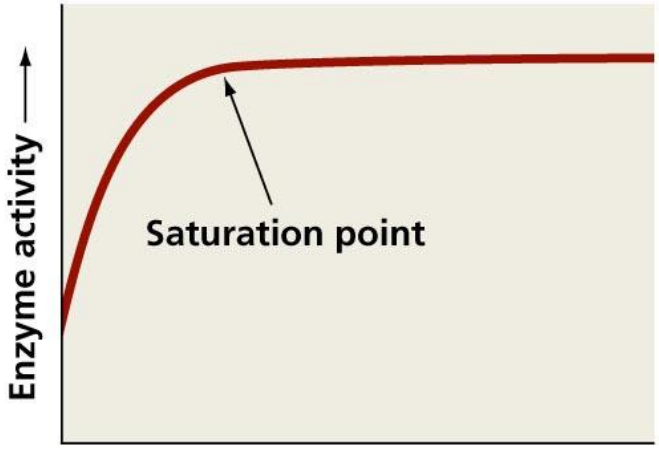
Temperature (most work at body temp.)
pH (most prefer neutral)
Concentration (the more the better)




(a) Temperature




(b) pH




(c) Substrate concentration