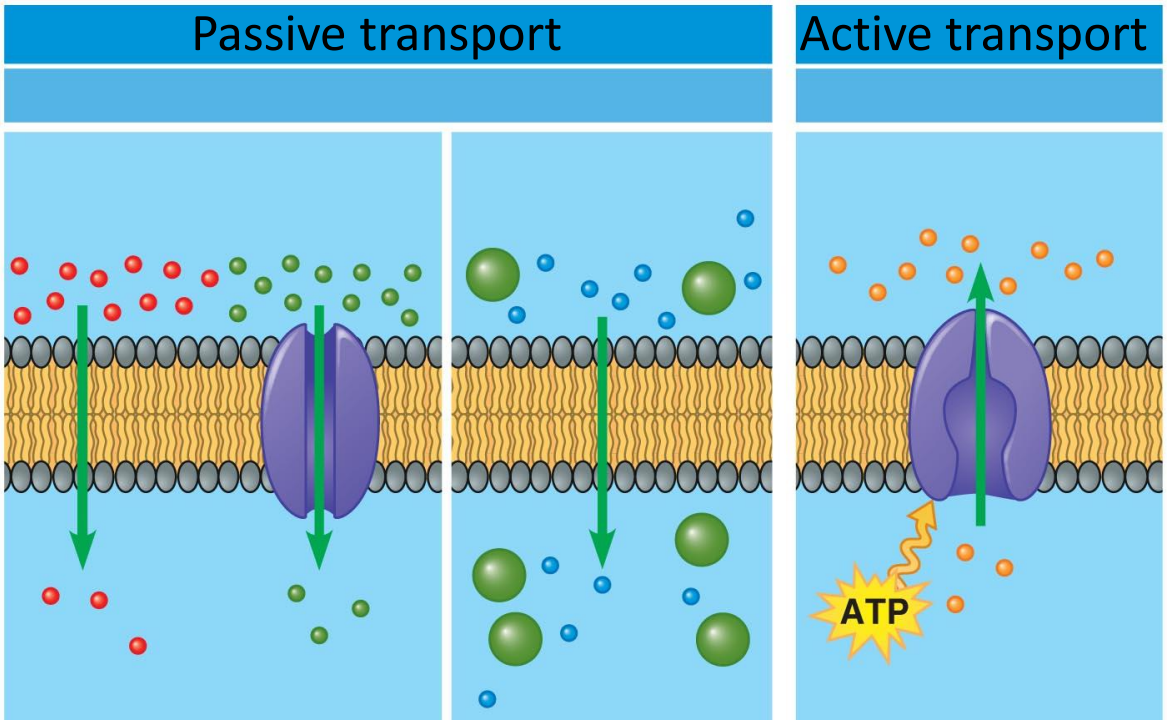
Life is hard work

Get to work!

Living Is Energetically Expensive

- Living things are very different from nonliving things.
- The border between living and non living is the cell membrane and it is always hard at work keeping the living different from the non living.



The border between living and nonliving

Living Is Energetically Expensive

- **Energy** is the capacity to do work or put matter in motion.

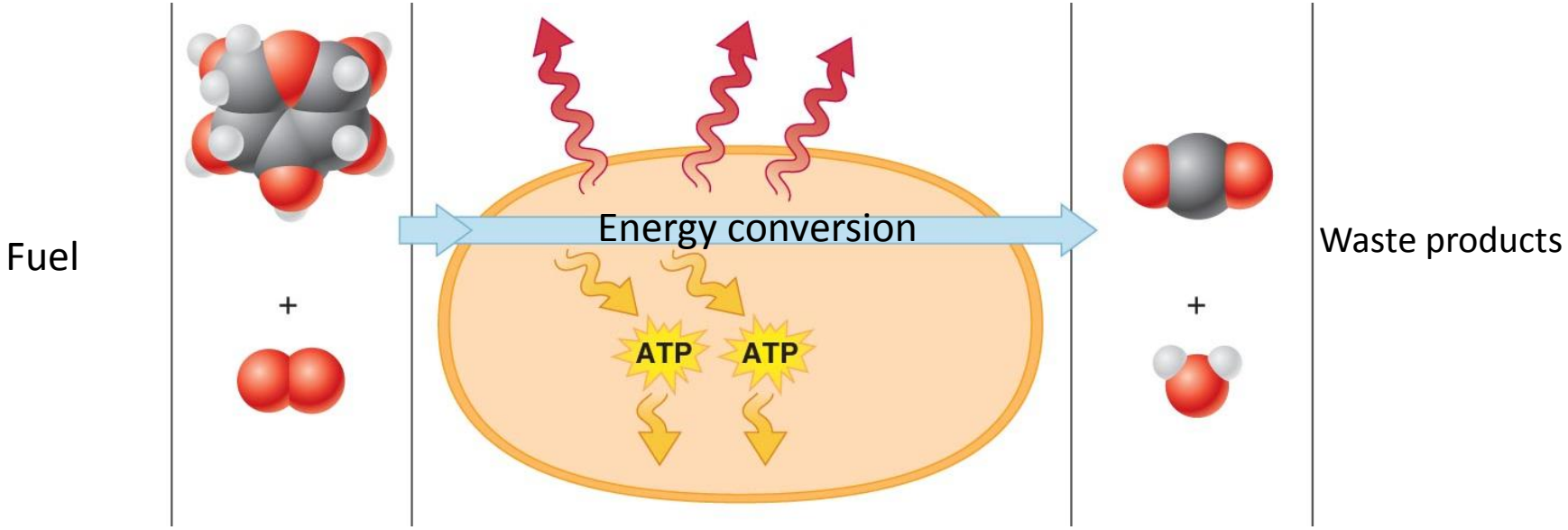
There are many kinds of energy two of them are

Kinetic, energy of motion

Potential, energy that an object possesses because of its location or found in bonds (**chemical energy**)

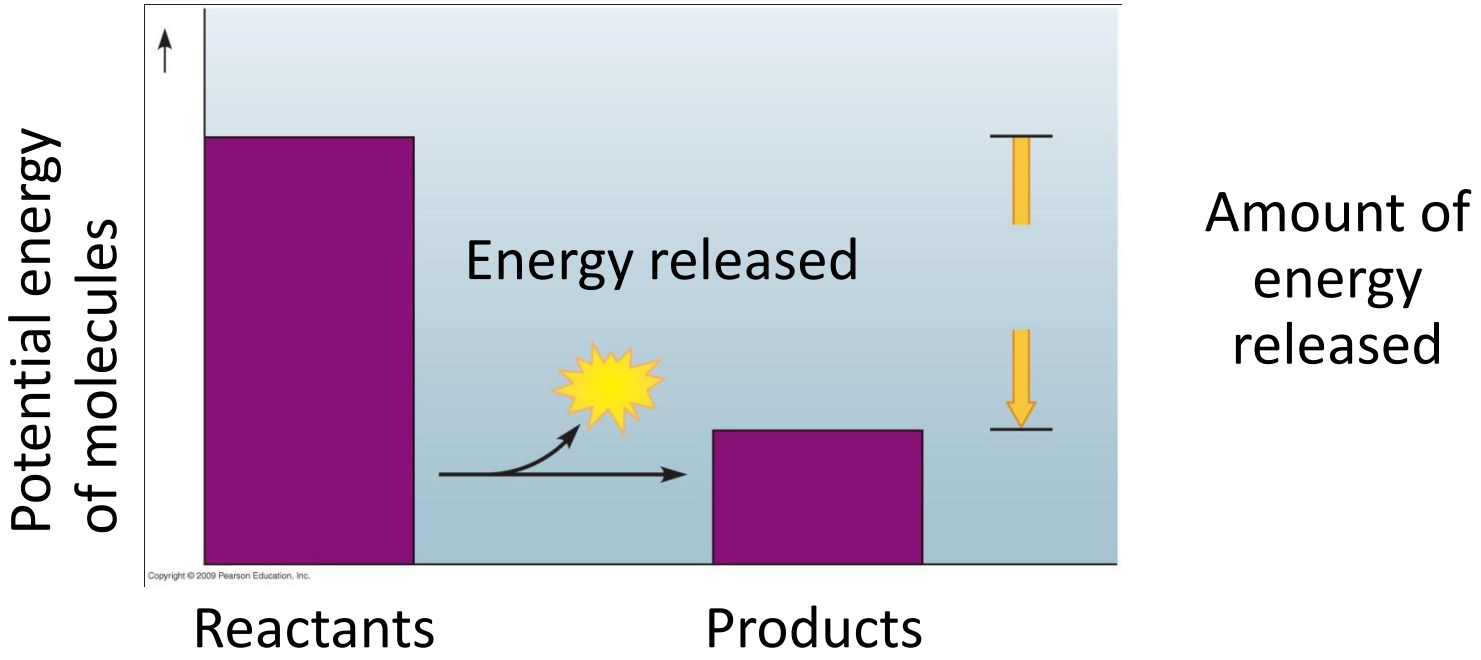
The Laws of Energy

- The laws of **thermodynamics**
  - The **first law of thermodynamics**—energy in the universe is constant or energy cannot be created or destroyed.
  - The **second law of thermodynamics**—energy conversions increase the amount of disorder in the universe or its **Entropy.**



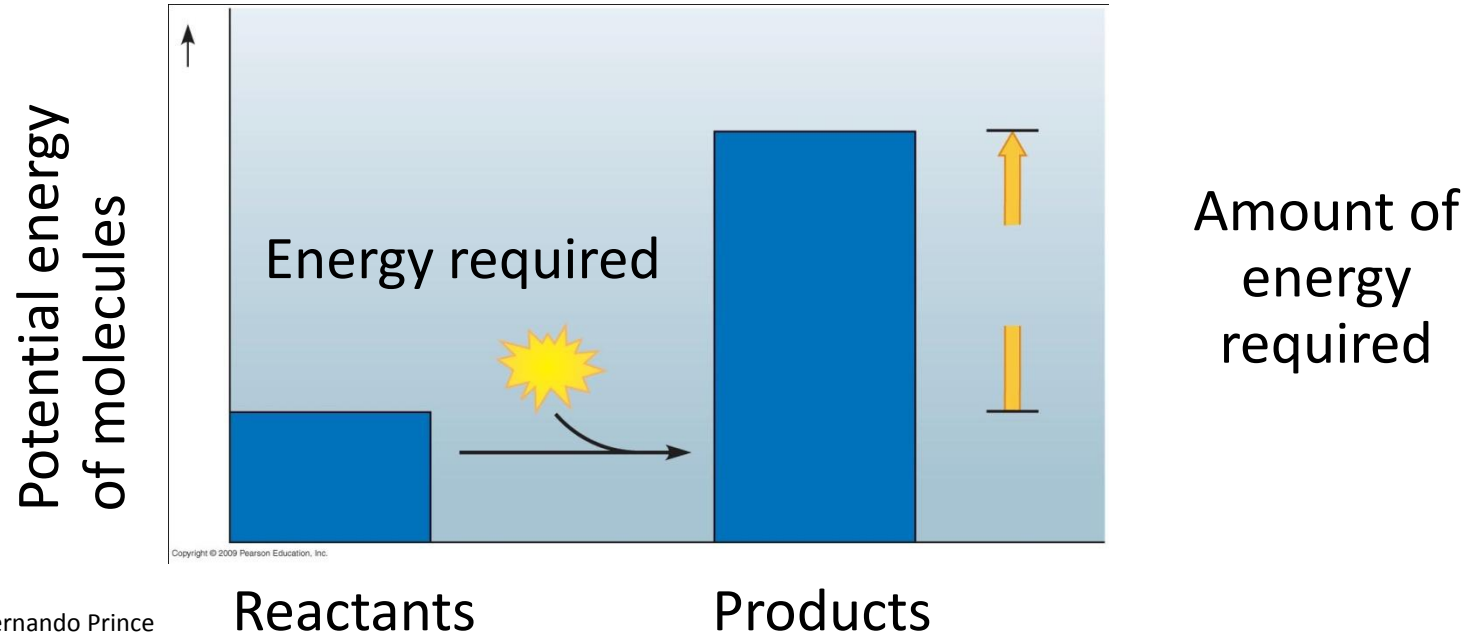
All reactions require energy investment
"Pay before you play!"

- Reactions that putout more energy than was invested are called **exergonic.**
- Examples are the spark that ignites the gasoline in your car, the match that starts the "carne asada", two ATPs to start the metabolic pathway of **Cellular respiration.**



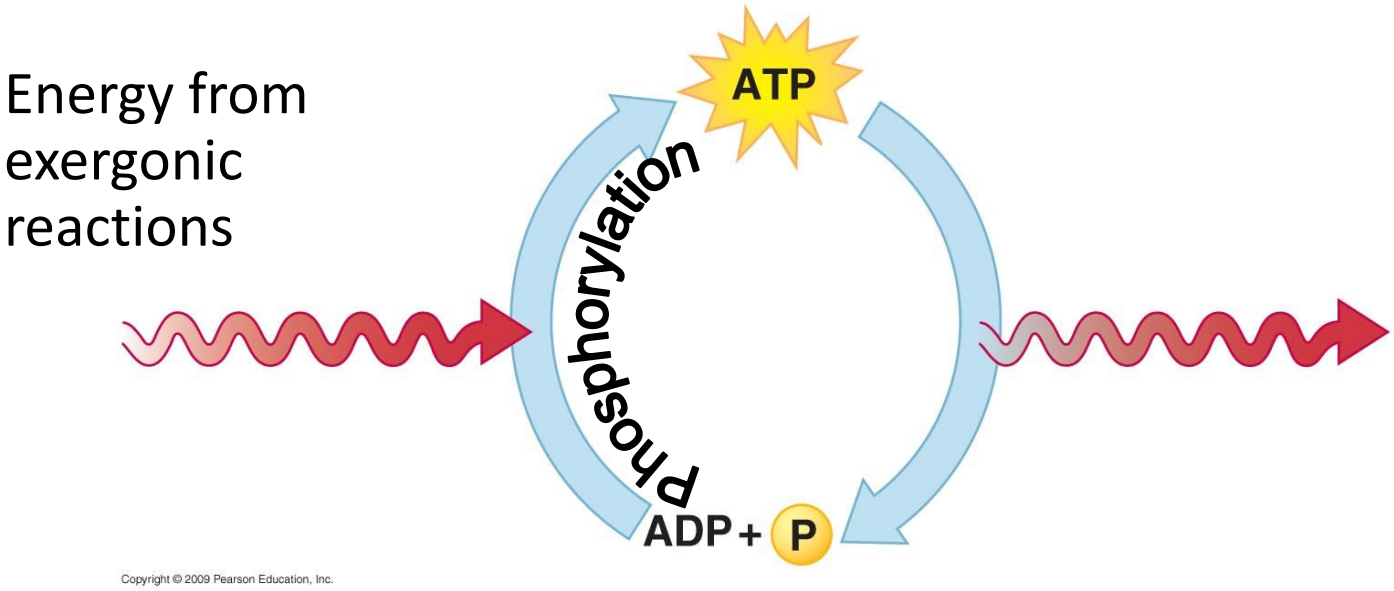
All reactions require energy investment
"Pay before you play!"

- Reactions that absorb energy and store it in new bonds are called **endergonic.**
- Examples of endergonic reactions are those that build the macromolecules of life such as proteins, carbohydrates, and fats.
- In plants photosynthesis is an endergonic metabolic pathway that stores the sun's energy into the bonds of glucose.



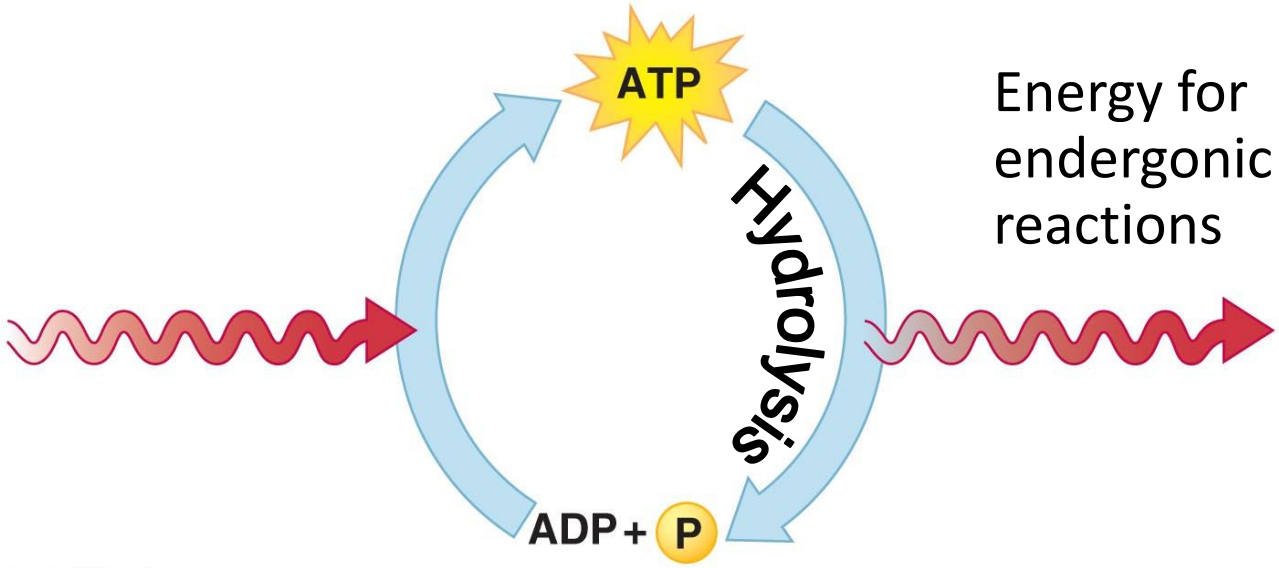
Metabolism is the sum total of all the chemical reactions within your body

- Both the **anabolic (endergonic)** and **catabolic (exergonic)** reactions follow **metabolic pathways** that work together in what is called **energy coupling** to perform cellular work.



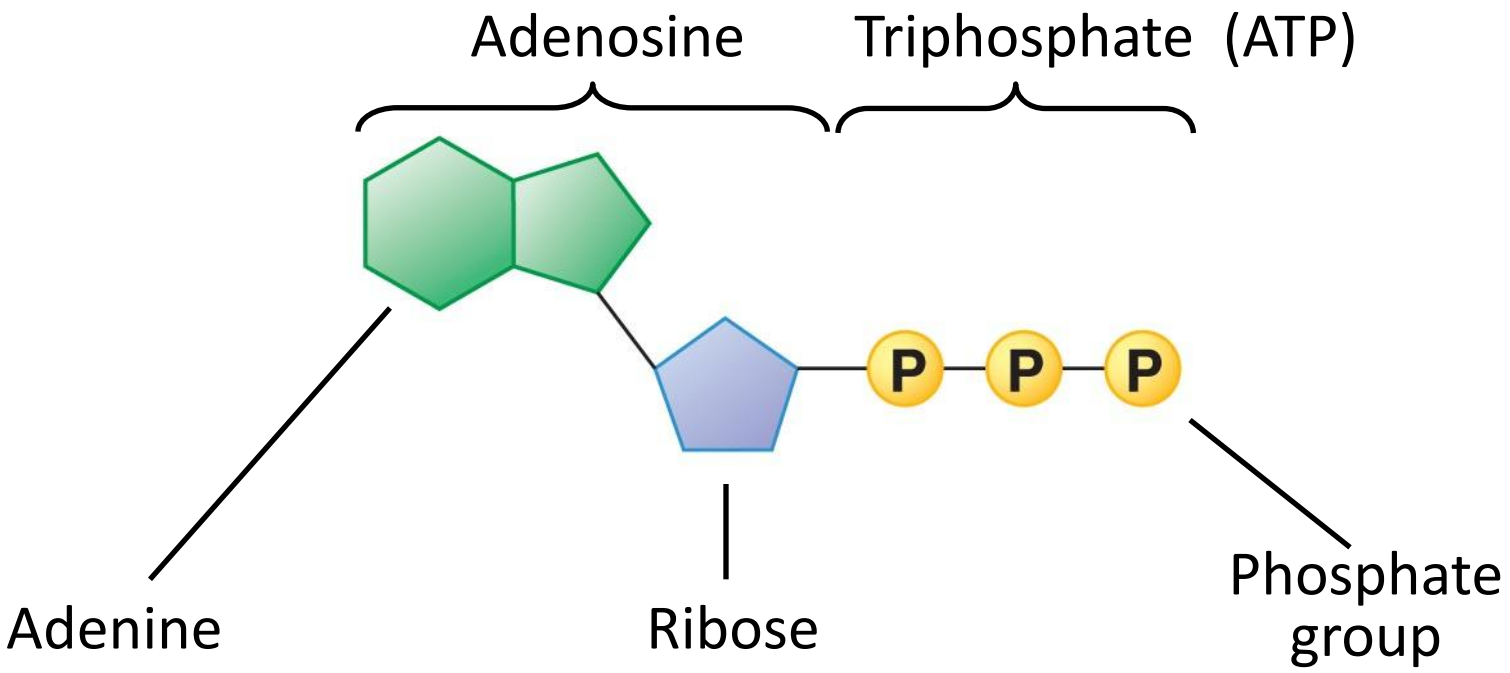
ATP the molecule that does not want to be

- All cellular work requires energy. The energy from food is released and transferred to ATP within the cell's mitochondria.
- ATP is the cells currency. If the cell moves it pays for it in ATP…



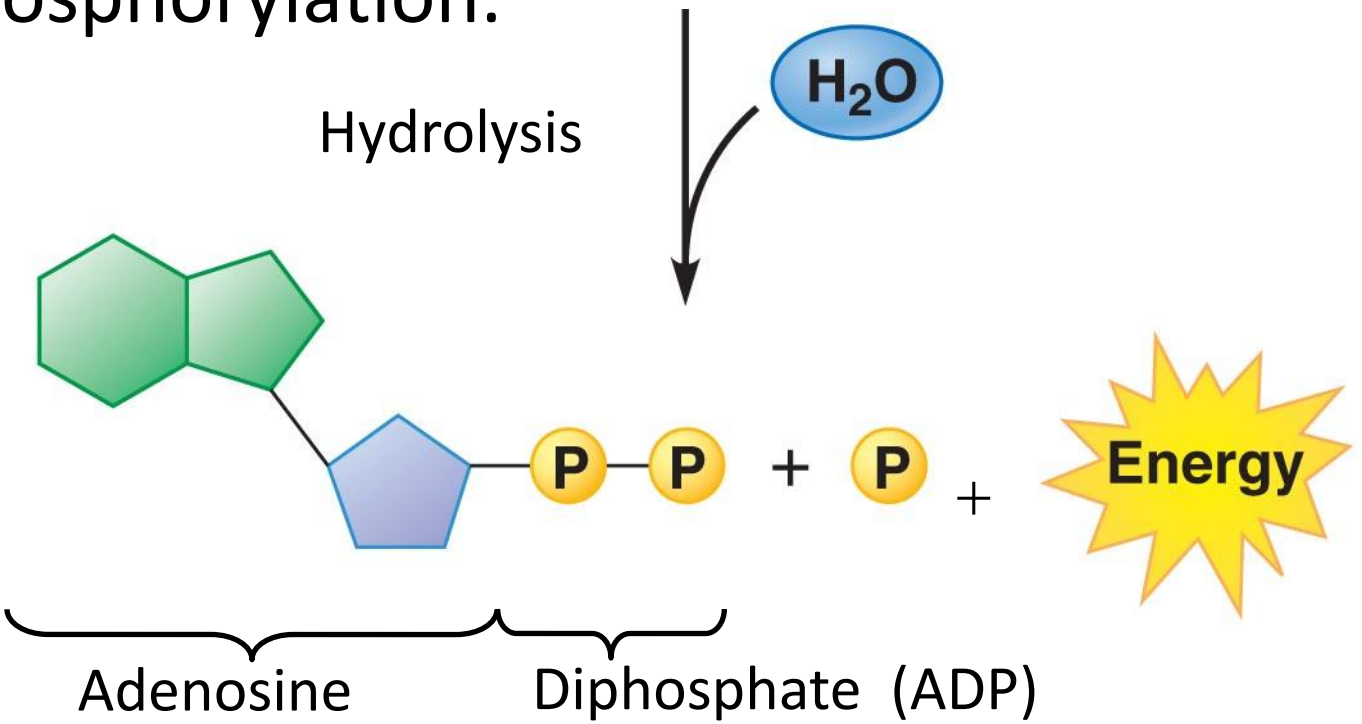
ATP the molecule that does not want to be

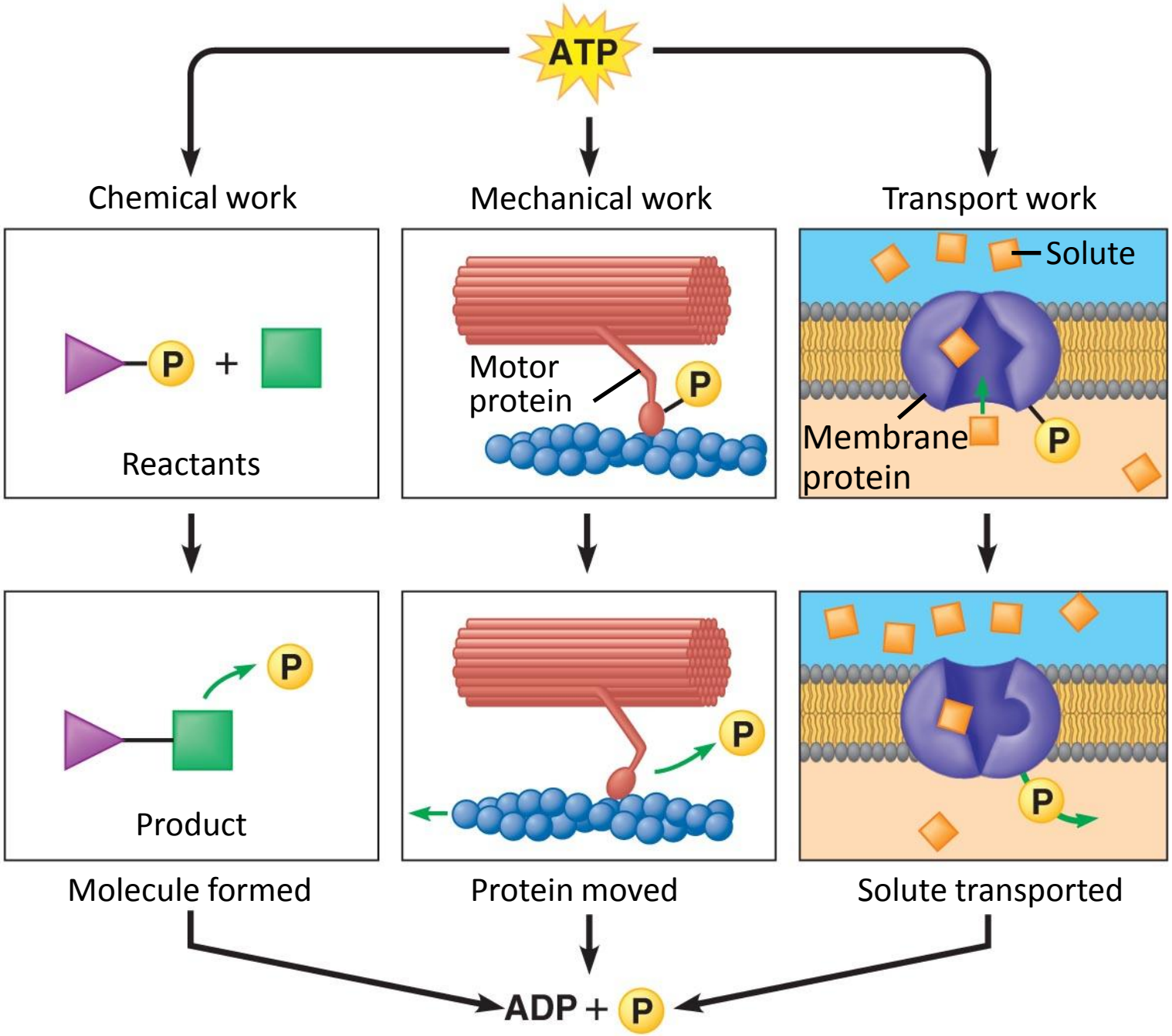
- ATP is not an energy storage molecule it is only used to “shuttle” the energy from place to place.



ATP the molecule that does not want to be

- Hydrolysis of ATP transfers a phosphate and the energy found in its bond to another molecule this transfer is called phosphorylation.





ENZYMES

“Pay Before You Play!”
(energy of activation)

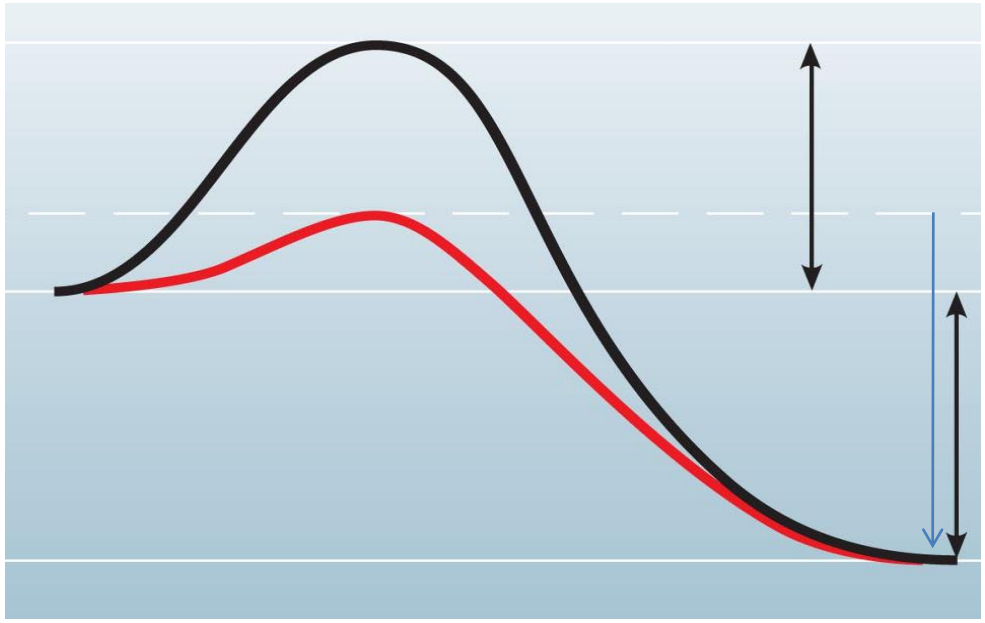
All chemical reactions require a “down payment” to begin. This down payment is called energy of activation.

Enzymes speed up reactions by lowering the amount of energy of activation they require.

Even high energy molecules like glucose will not surrender their energy without some energy input.

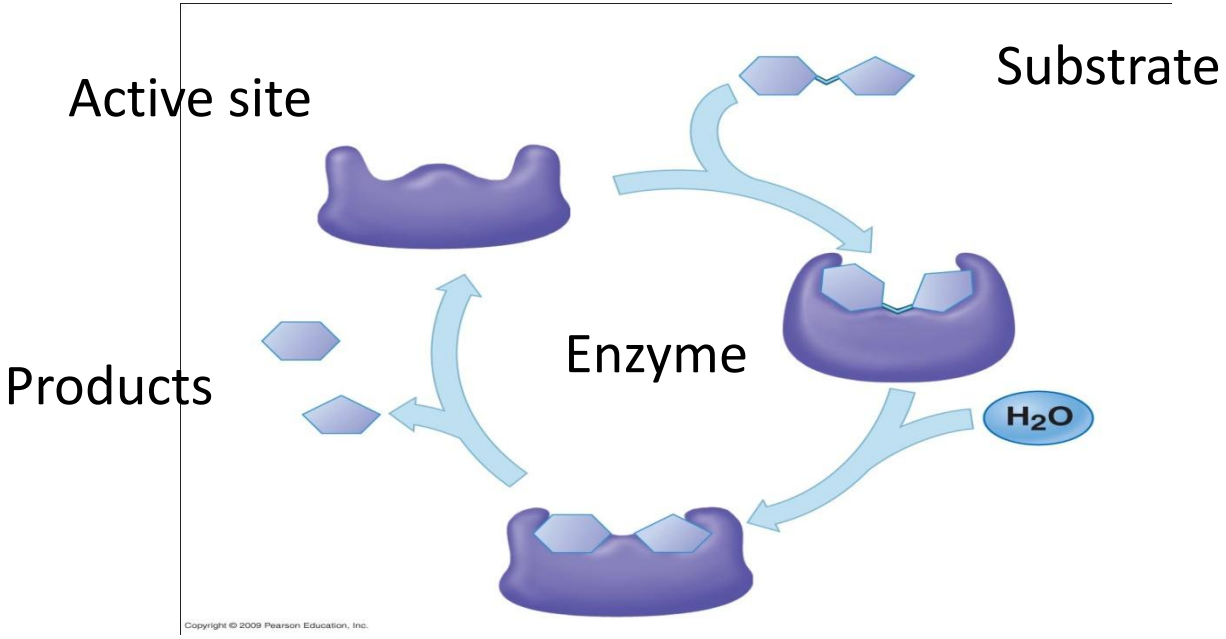
ENZYMES

- Even though not all proteins are enzymes, all enzymes are proteins.
- Enzymes are biological catalysts that are specific to the reaction they catalyze.



Structure and Function
Principle of Complementarily

- Enzymes have unique three-dimensional shapes and specific active sites
- Environmental conditions affect enzymatic activity by affecting enzymatic shape

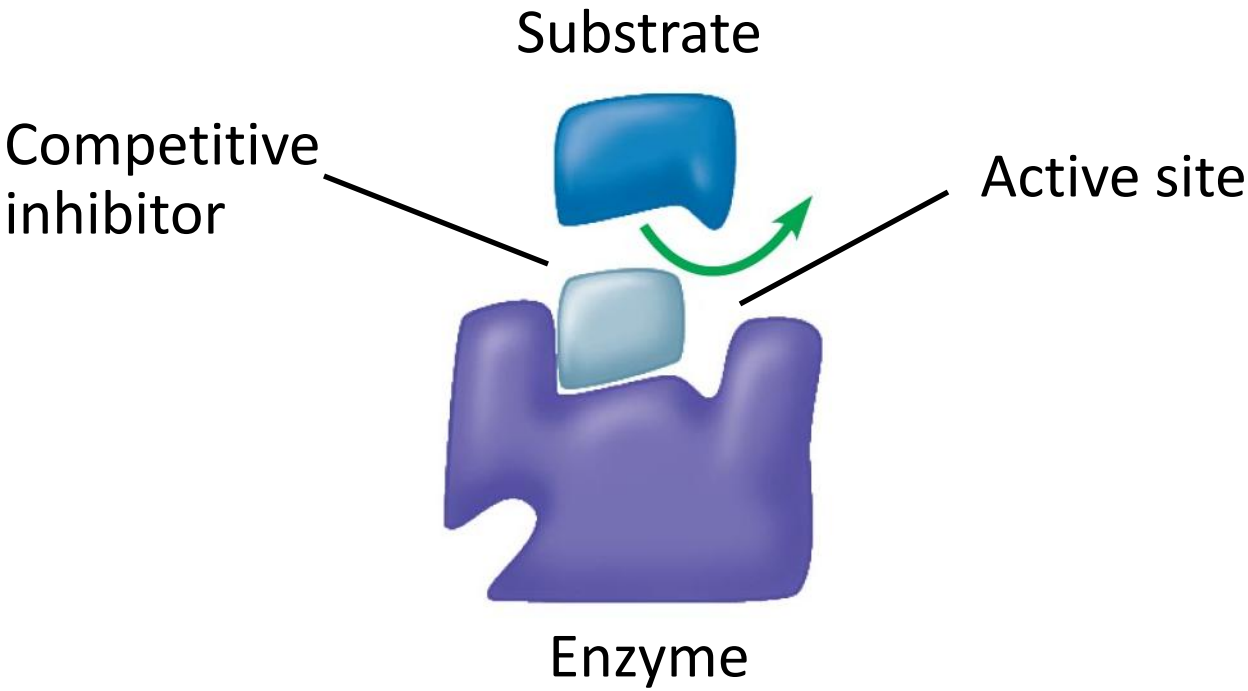


5.15 A specific enzyme catalyzes each cellular reaction

- Some enzymes require nonprotein helpers
  - **Cofactors** are **inorganic**, such as zinc, iron, or copper
  - **Coenzymes** are **organic** molecules and are often vitamins

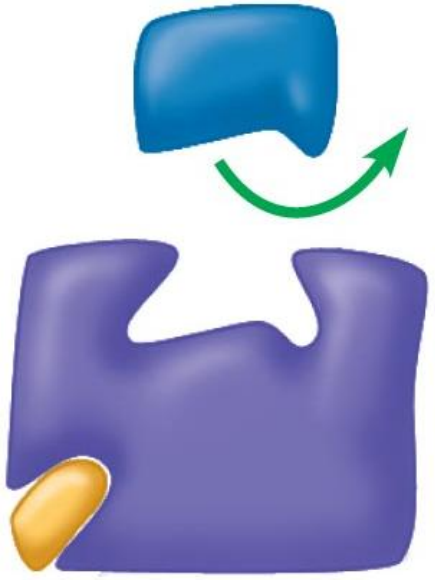
The Musical Chairs of Enzymatic Active Sites

- Inhibitors that compete with the substrate for the a place on the enzyme's active site are called **competitive inhibitors**



The incredible shrinking keyhole

- Some inhibitors affect the shape of the active site when they bind to the enzyme, these are called **noncompetitive inhibitors.**



Competitive inhibitor

You should now be able to

1. Describe the structure of the cell membrane
2. Describe the fluid mosaic model of the cell membrane
3. Describe the passage of materials across a membrane both passive (diffusion, facilitated diffusion, and osmosis) and active (active transport and vesicular transport).

You should now be able to

5. Explain how energy is transformed during life processes
6. Define the two laws of thermodynamics and explain how they relate to biological systems
7. Explain how a chemical reaction can either release energy or store energy
8. Describe ATP and explain why it is considered to be the energy currency of a cell

You should now be able to

9. Define enzyme and explain how enzymes cause a chemical reaction to speed up
10. Discuss the specificity of enzymes
11. Distinguish between competitive inhibitors and noncompetitive inhibitors

Molecules cross cell membranes

by

by

passive transport

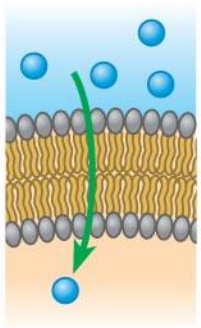
(a)

may be

moving down

moving against

requires



(b)

ATP

diffusion

(d)

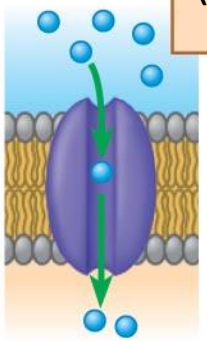
uses

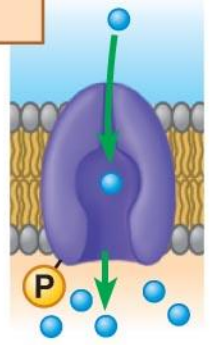
uses

(e)

of

of





(c)

polar molecules and ions

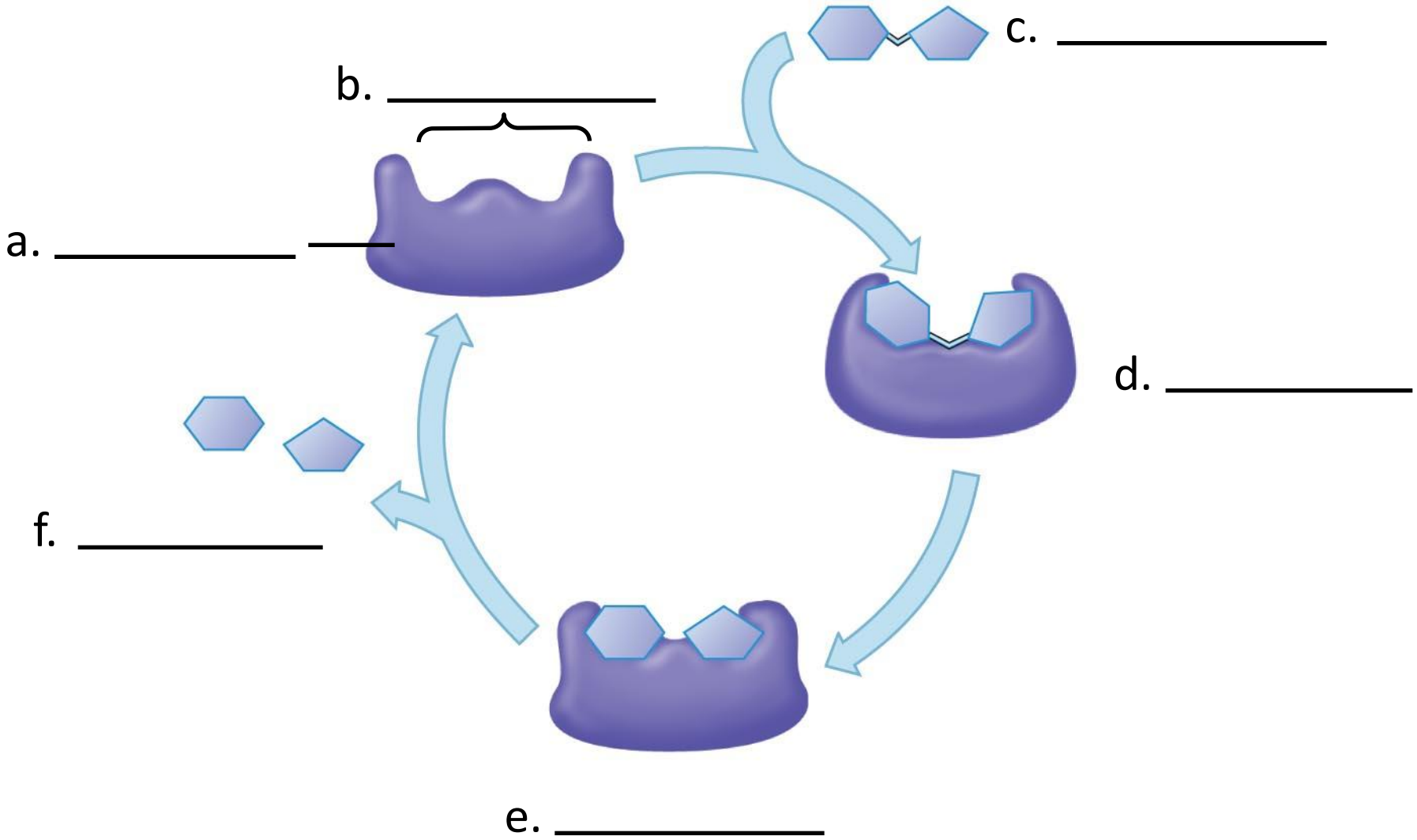


Table A: Rate and Enzyme Concentration

Lactose concentration	10%	10%	10%	10%	10%
Enzyme concentration	0%	1%	2%	4%	8%
Reaction rate	0	25	50	100	200

Table B: Rate and Substrate Concentration

Lactose concentration	0%	5%	10%	20%	30%
Enzyme concentration	2%	2%	2%	2%	2%
Reaction rate	0	25	50	65	65