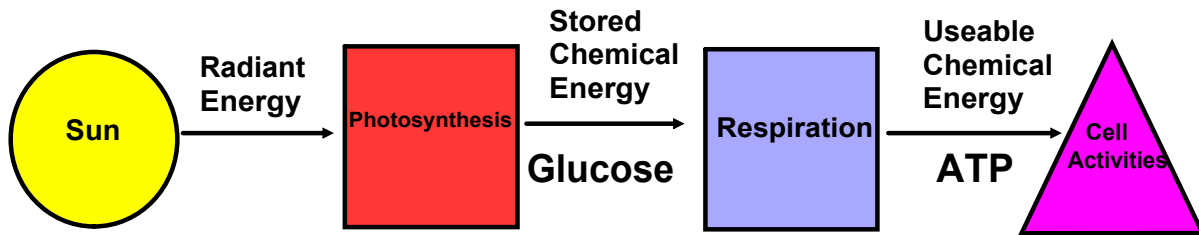


COPY DIAGRAM AT TOP OF NOTES**Chapter 4: Cells & Energy****Section 4.1 - Chemical Energy & ATP****I. Cell Energy**

- A.** Energy is essential to life; all living organisms must be able to *obtain energy from the environment*.
- B.** Plants are able to trap *light* energy and use it.
- C.** Other organisms must *eat food* to obtain energy.
- D.** Energy is the ability to cause matter to move; it cannot be *created or destroyed, but transformed*.

E. Energy comes in many forms

- a. Light
- b. Mechanical
- c. Sound
- d. Thermal
- e. Electrical
- f. Chemical
- g. Atomic/ Nuclear

F. Basic Types

- a. Kinetic = energy an object has because of its *motion*
- b. Potential = energy stored in an object because of its *position*

II. Energy Is Carried By Electrons

Carried by electrons in the **C-H** bonds of the molecules

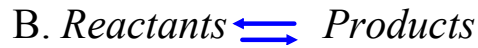
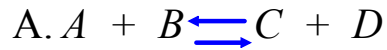
PreAP only

- A. Oxidation-Reduction Reactions (*Redox*)
Pass *electrons* to atoms or molecules
- B. Oxidation Rxns = *Loss of electrons (breaks bonds down)*
- C. Reduction Rxns = *Gain of electrons (puts bonds together)*

III. Energy and Chemical Reactions

Chemical reactions power *cellular activities*

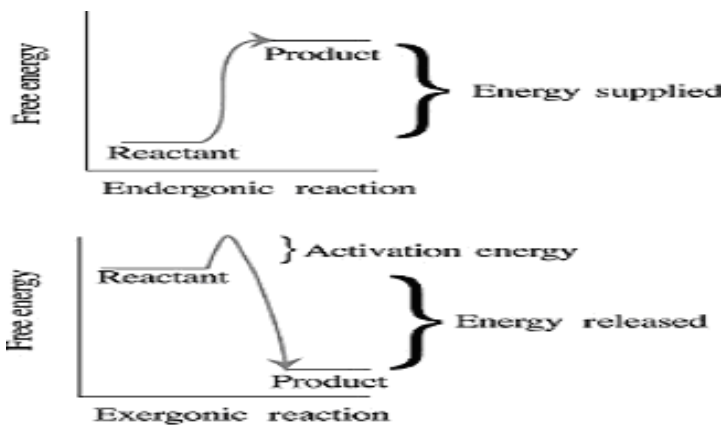
Chemical Reactions Absorb or Release Energy



C. Free Energy = **the energy from chemical reactions that drives cell activities**

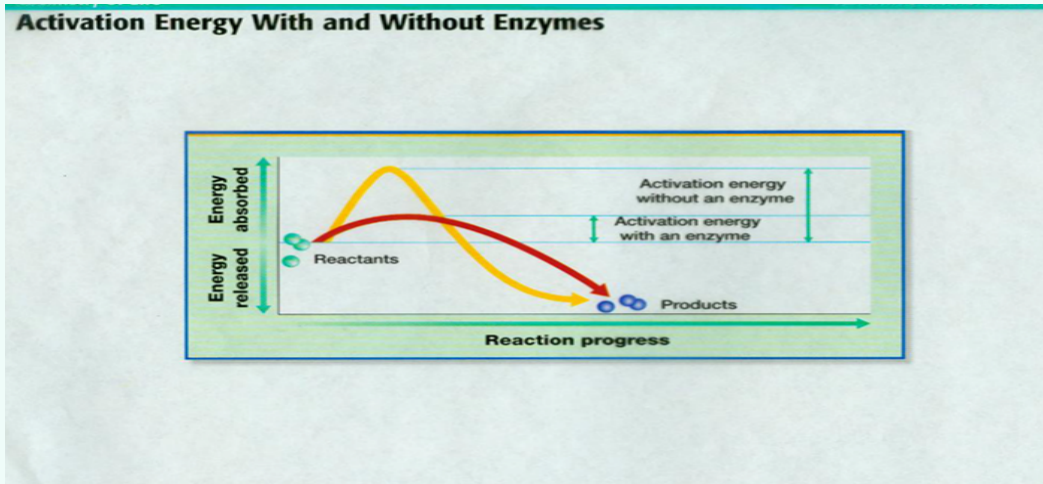
D. *Endergonic* reactions absorb free energy

E. *Exergonic* reactions release free energy



VI. Starting Chemical Reactions Requires Energy

Activation energy or a “kick in the pants” to get the reaction started.



V. Work and the need for energy

A. Many cellular processes require energy.

Ex: *Active transport, cell division, locomotion of cell*

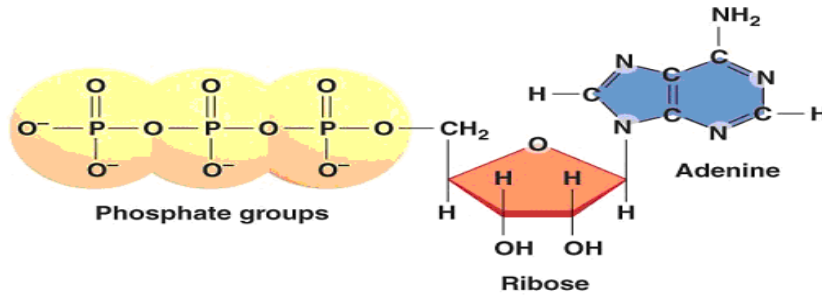
B. ATP (*adenosine triphosphate*) is a molecule in your cells that is the source of energy.

C. This energy is stored in the *chemical bonds* of ATP.

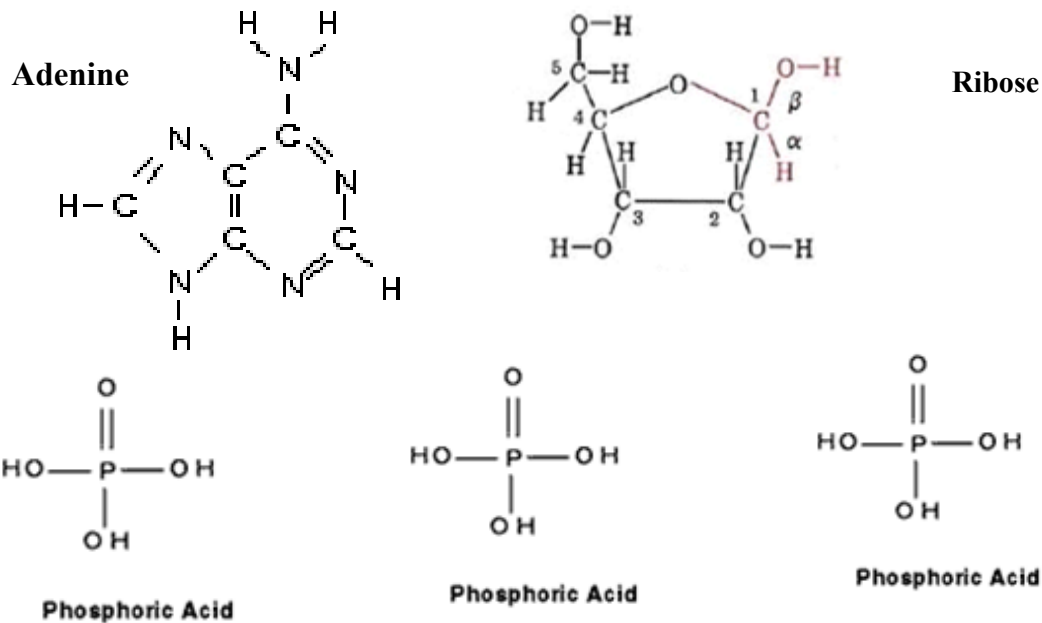
D. ATP is composed of:

1. one *adenosine* molecule (which is the sugar ribose connected to an adenine molecule)
2. three *phosphate* groups

(a) ATP consists of three phosphate groups, ribose, and adenine.

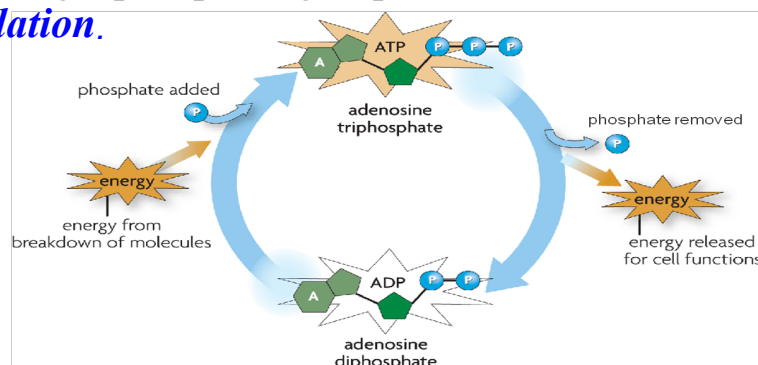


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VI. Forming and Breaking Down ATP

- A. The energy of ATP becomes available to a cell when *the molecule is broken down*.
- B. When ATP is broken down energy is released and the resulting molecule is *ADP (adenosine diphosphate)*.
- C. ATP is broken down into ADP when *the chemical bond between the second and third phosphate group in ATP is broken*.
- D. At this point ADP can form ATP again by bonding with *another phosphate group*.
- E. This process creates a *renewable* cycle
 * As long as phosphate groups are available, a cell can form ATP whenever it needs to.
- F. The process of adding a phosphate group on to a molecule is called *phosphorylation*.

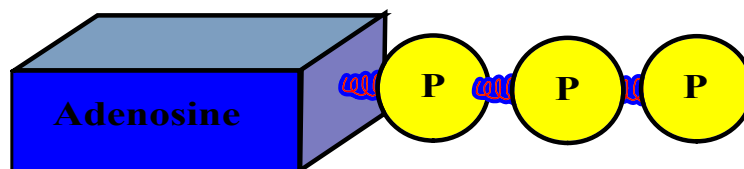


VII. How a cell taps into the energy of ATP

- A. When ATP is broken down and the energy is released, it must be *captured* and used or it is wasted and given off as *heat*.
- B. $ATP \rightleftharpoons ADP + P_i + \text{energy}$
- C. To access the energy locked up inside an ATP molecule it usually binds to an *enzyme* (protein). There is a specific *binding site* where ATP fits into and the protein will aid in the removal of the third phosphate group.

VIII. Uses of Cell Energy

- A. Making *new molecules*
- B. Maintaining *homeostasis*
- C. Eliminating *wastes*



IX. Energy Flows Through Living Systems

A. Organisms harvest energy by “*boosting*” electrons & use it to produce energy-storing macromolecules (*carbohydrates, lipids, proteins*)

B. Inorganic molecules → *Chemical energy*
Chemosynthesis done by certain bacteria (autotrophs)

C. Light energy → *Chemical energy*
Photosynthesis in plants (autotrophs)

| MOLECULE | ENERGY |
|--------------|-------------------|
| Carbohydrate | 4 calories per mg |
| Lipid | 9 calories per mg |
| Protein | 4 calories per mg |

