

Introduction

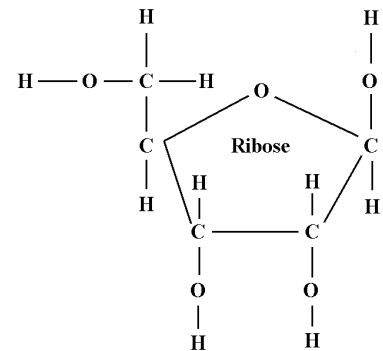
Is energy free to slosh around inside living cells? The answer is no. Energy exists in the form of chemical energy. This chemical energy is part of a compound called adenosine triphosphate (ATP). ATP produces chemical energy for biological work in all living cells. However, it is changed to a new chemical compound called adenosine diphosphate (ADP) when energy is produced. A change from ATP to ADP produces energy and uses up the original ATP. Does the cell have an endless supply of ATP? No, but ADP can change back to ATP. However, this requires energy. How is the cell able to solve its energy "budget" if it gives off energy during one change and then requires energy to change back to the original ATP?

Procedure**Part A. The Chemical Structure of Adenosine Triphosphate**

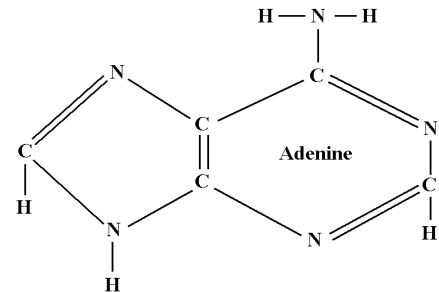
An ATP molecule is made up of subunits called *ribose*, *adenine*, and *phosphoric acid*, or *phosphate*. In Part A, you will learn about these three basic components. Let's start with the sugar ribose.

Ribose Molecule - Examine the structural formula of ribose.

1. What is the molecular formula of ribose? Fill in the appropriate subscripts. C H O
2. What is the ratio of hydrogen atoms to oxygen atoms in ribose?
3. Glucose is a six carbon monosaccharide or simple sugar. Ribose is also a carbohydrate but differs from glucose in having how many carbon atoms?

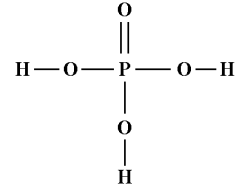
**Adenine Molecule - Examine the structural formula of adenine.**

4. What is the molecular formula of adenine? Fill in the appropriate subscripts. C H N
5. What element in adenine is not in carbohydrates? What element in carbohydrates is not in adenine?
6. What elements are found in both adenine and amino acids?



Phosphate - Examine the structural formula of phosphate.

7. Write the molecular formula of phosphate. Fill in the appropriate subscripts.
H P O



Constructing an ATP Molecule

An ATP molecule is made up of one ribose molecule, one adenine molecule, and three phosphate molecules joined together.

8. What does the prefix “tri” mean in the name of the compound adenosine triphosphate?

Cut out the models of adenine, ribose, and phosphate from the cutout page. Cut along **solid** lines only. Attempt to join the adenine and ribose molecules.

9. What parts must be lost from each molecule in order to join the cutouts? _____ Remember, the chemical process of building larger molecules by joining smaller units is called a condensation reaction.

Remove an H and an OH by cutting on the dotted lines. The adenine and ribose molecules can now be joined together to form adenosine. **Adenosine** is a combination of a sugar called ribose and a nitrogen base called adenine. By removing an H and an OH, new points of attachment have been created and atoms can chemically combine or bond.

10. What two molecules join together to form adenosine?
11. What molecule is formed when the H and OH combine?

Examine the phosphate cutout models on the last page.

12. Are all three cutout molecules exactly alike?
13. Only one of the three can attach to the ribose molecule. What atoms must be removed in order for the phosphate to join with ribose?

Attach this phosphate molecule to ribose. This bond is called a low energy bond. Attach the remaining phosphate molecules to each other and then to the phosphate already attached to ribose.

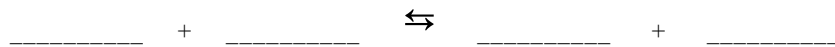
14. How many molecules of water are formed when a single ATP molecule is created?

ADP + P - Adenosine Diphosphate and a Phosphate

Review Questions:

19. How many high energy bonds are in one molecule of ATP?

20. Write a balanced equation for photosynthesis.



Cut Out Page for ATP and ADP Molecules

