Chapter 9 **Cellular Respiration** **Name _____**

Lab ATP - The Cell's Energy Molecule

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? The answer is **cellular respiration**.

Procedure

Part C. Regenerating ATP by Using the Energy in Foods

The amount of ATP in a cell is **limited**. However, the amount of energy needed by a cell is almost unlimited. The cell conserves its ATP by producing more from ADP. This appears to be simple. Just attach a phosphate molecule to an ADP and the resulting molecule ATP is formed. However, **energy** is required to reattach a phosphate molecule to ADP. The source of this energy is **not** another ATP molecule. The cell must find another source of chemical energy that it can use to convert ADP to ATP. The cell will turn to a process called **cellular respiration** and use as its source of energy. **Food** molecules, like carbohydrates, lipids, and even proteins, have plenty of energy to form many ATP molecules. This is why respiration is so important to life. For without respiration, there would not be enough energy to form ATP and the life processes within a cell would soon come to a halt and **death** would follow.

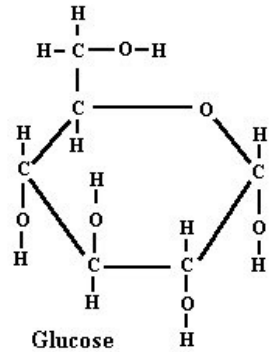
Part D. Glycolysis - The First Phase of Cellular Respiration

Where does the energy to form ATP come from? The energy source is the food that we consume and producers manufacture. Energy is released from food during cellular respiration. Energy is "stored" in the chemical bonds of all compounds. Food, such as glucose, contains many of these bonds. Glucose is the major source of energy for ATP formation.

Examine the structural formula of glucose.

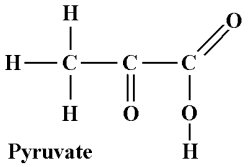
1. How many chemical bonds are there in glucose?

All organisms begin cellular respiration in the same way. It is called **glycolysis**. Glucose will be split into two smaller sugar-like molecules called or **pyruvic acid**. As this occurs, bonds in the glucose molecule are broken and energy is made available to form ATP.



Examine the structural formula of pyruvic acid.

2. How many chemical bonds are there in one molecule of pyruvic acid?



Pyruvate

3. The chemical change occurring during glycolysis can be represented by the following equation:

Glucose → Pyruvate + Pyruvate

_____ _____ _____

Write the number of chemical bonds below each chemical compound.

4. Does the total number of bonds in glucose equal the total number of bonds in both pyruvate molecules?

5. Write the molecular formula of one molecule of pyruvate. Fill in the appropriate subscripts. C H O

6. How many atoms of carbon, hydrogen, and oxygen are in two molecules of pyruvate?

The breaking of chemical bonds and loss of atoms results in the production of energy from the bonds of glucose. This energy can be used to convert ADP to ATP. A more complete equation for glycolysis would include the energy made available and the atoms removed from the glucose molecule:

Glucose → 2 Pyruvate + 4 ATP + 4 H

Complete the table below summarizing the total number of atoms in glucose and the two molecules of pyruvic acid.

Atoms	One Glucose	Two Pyruvic Acids
Carbon		
Hydrogen		
Oxygen		

Review Questions:

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

8. What does the term “glycolysis” mean?

9. What organisms on Earth are capable of doing glycolysis?

10. Write a balanced equation for cellular respiration.

_____ + _____ ⇆ _____ + _____

11. Write a balanced equation for photosynthesis.

_____ + _____ ⇆ _____ + _____

12. Which biochemical process is approximately 1 billion years older than the other, photosynthesis or cellular respiration?

13. Where in the cell does glycolysis take place, the mitochondria or the cytoplasm?

14. Name the three high energy products that were produced at the end of glycolysis;

a)

b)

c)