Name ______________________________ Teacher ________________ Date __________

4.1: Molecular Models for Cellular Respiration Worksheet

As you work to figure out the "unanswered questions" from your investigation, you will use molecular models to learn how cells get the energy they need for animals, plants, and decomposers to move and function.

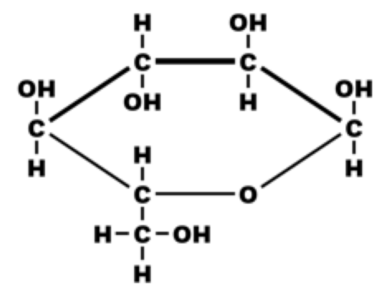
A. Introduction

The cells of animals, plants, and decomposers all use chemical energy stored in glucose and other organic molecules by combining them with oxygen (O_2). This chemical change, called cellular respiration, releases energy stored in the molecules' high-energy C-C and C-H bonds.

Think about the unanswered questions from your investigation and class discussions that you have had. *When the atoms in the glucose and oxygen molecules are rearranged during cellular respiration, what molecules are formed? What forms of energy does the chemical energy change into?*

B. Using molecular models to show the chemical change

Work with your partner to make models of the reactant molecules: glucose and oxygen. Glucose—a kind of sugar—is a carbohydrate. Using twist ties, show how chemical energy is stored in the high-energy bonds of glucose (and other organic molecules).



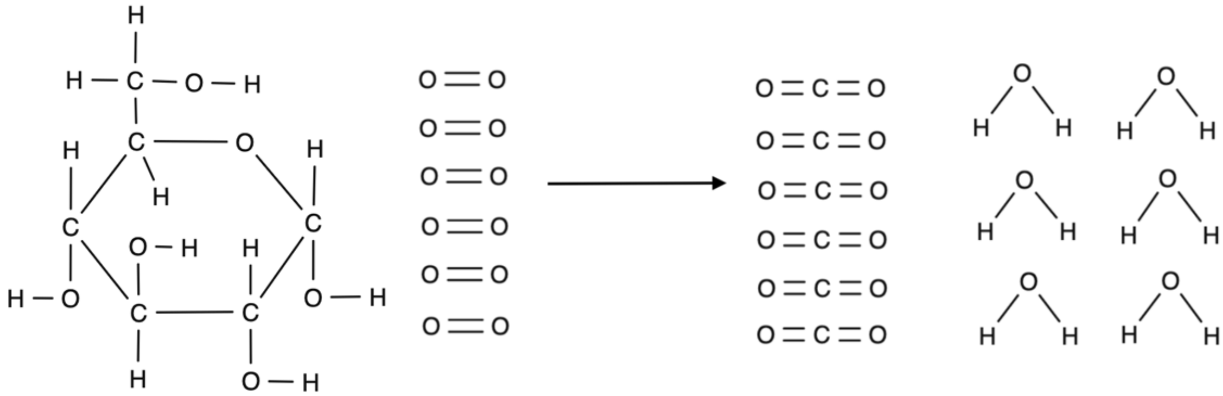
1. □ Make models of a glucose molecule ($C_6H_{12}O_6$) and oxygen molecules (O_2, with a double bond). Cells use oxygen during cellular respiration, so make 6 O_2 molecules. Put these molecules on the *reactant* side of the *Molecular Models Placemat*.
2. □ Use twist ties to represent chemical energy. Put a twist tie around each high-energy bond (C-C and C-H bonds) in the glucose molecule. Put the "Chemical Energy" card under the glucose molecule to label the energy in the C-C and C-H bonds. Note how many energy units (twist ties) there are in the glucose molecule.

Now, show how the atoms of the reactant molecules can recombine into product molecules—carbon dioxide and water—and show how chemical energy is released when this happens.

3. □ Take the glucose and oxygen molecules apart and recombine them into carbon dioxide (CO_2) and water (H_2O) molecules. Put these molecules on the *product* side of the *Molecular Models Placemat.* <u>Answer these questions</u>:
   a. How many oxygen molecules reacted with one glucose molecule? _______
   b. How many carbon dioxide molecules were produced? _______
   c. How many water molecules were produced? _______
4. □ Energy lasts forever, so move the twist ties to the *product* side of the *Molecular Models Placemat*. Carbon dioxide and water have only low-energy bonds (C-O and H-O), so what forms does the chemical energy change into? Put the correct energy card(s) under the twist ties.

C. Atoms last forever!

Account for all the atoms in your models.



(Reactants) (Products)

1. Circle all of the Carbon ATOMS in the reactants. How many are there? ___
2. Circle all of the Carbon ATOMS in the products. How many are there? ___

3. Underline all of the Hydrogen ATOMS in the reactants. How many are there? ___
4. Underline all of the Hydrogen ATOMS in the products. How many are there? ___

5. Put a square around all of the Oxygen ATOMS in the reactants. How many are there? ___
6. Put a square around all of the Oxygen ATOMS in the products. How many are there? ___

D. **Energy lasts forever!** Account for all the energy in your models.

1. How many twist ties are there before the chemical change? ________
2. What form of energy is there before the chemical change?____________________________
3. How many twist ties are there after the chemical change?__________
4. What forms of energy is there after the chemical change? ____________________________

E. Check Yourself!

1. Did the number and type of atoms stay the same at the beginning and end of the chemical change? ____

2. Did the number of twist ties (representing energy) stay the same at the beginning and end of the chemical change? ____

3. Why do the numbers of atoms and twist ties have to stay the same?

F. Writing the chemical equation

Use the molecular formulas ($C_6H_{12}O_6$, O_2, CO_2, H_2O) and the yield sign (→) to write a balanced chemical equation for the reaction:
