Name ______________________________ Teacher ________________ Date __________

4.1: Molecular Models for Potatoes Moving and Functioning Worksheet

You will use models to learn about how potatoes move and function at the atomic-molecular scale, as you continue to look for answers to “unanswered questions” from your investigation.

A. Introduction

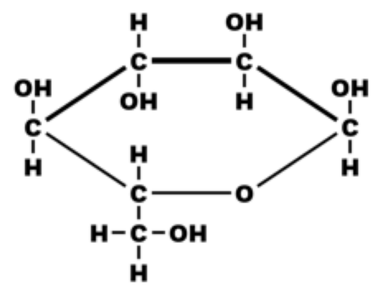
In order for plant cells to move and function, they need energy. Plant cells get energy from chemical energy stored in glucose and other sugar molecules that are made during photosynthesis. These molecules contain chemical energy stored in their high-energy bonds: C-C and C-H bond.

During cellular respiration, plant cells transform glucose and oxygen (O_2) into carbon dioxide (CO_2) and water (H_2O). Since carbon dioxide and water have only low-energy bonds (C-O and H-O), the chemical energy is released as motion and heat. Use the molecular models to show how this happens.

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 kinds of sugar.

1. □ Make models of a glucose molecule ($C_6H_{12}O_6$) and oxygen molecules (O_2, with a double bond). Plants use oxygen during respiration, so make at least 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.

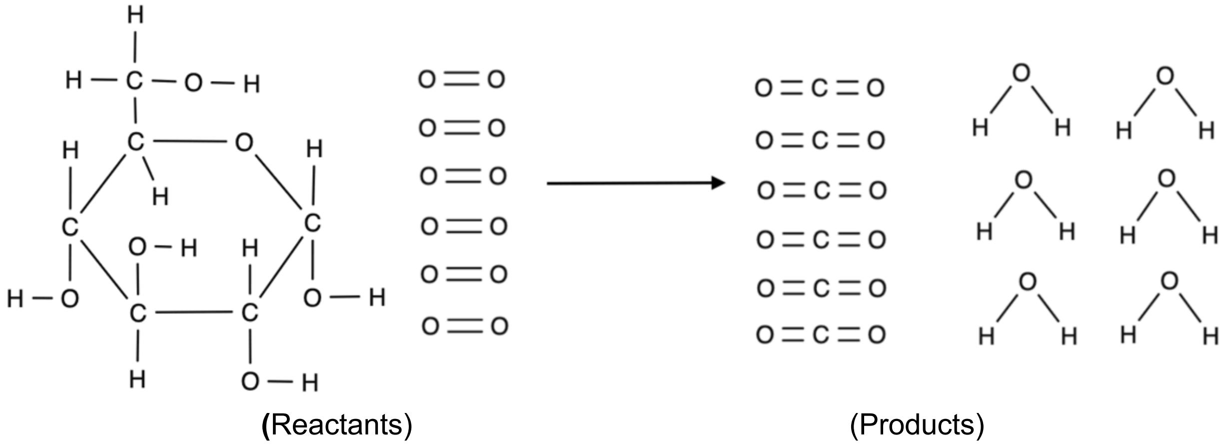
Show how the atoms of the reactant molecules can recombine into product molecules—carbon dioxide and water—and show how chemical energy is released when this happens.

3. □ Take the glucose and some of the 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.



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

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

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