Name _____ Teacher _____ Date _____

4.3: Molecular Models for Photosynthesis Worksheet

This worksheet has "grading" in the title because at this point, students can be held accountable for correct answers. Level 4 (correct) responses to the questions are in ***blue bold italics*** *below. There are also comments about common Level 2 and Level 3 responses to help you with grading and making decisions about what to emphasize in future lessons.*

Red italics suggest ways to grade student responses by giving them points for correct or partially correct answers. There are 14 points total on this worksheet.

As you work to figure out the "unanswered questions" from your plants investigations, you will use molecular models to learn how plant cells make food.

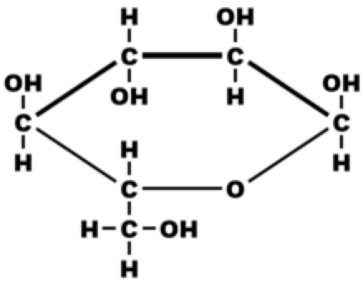
A. Introduction

When plants are in the light, photosynthesis (a chemical change) can occur in plant leaf cells. These cells transform light energy into chemical energy, which is stored in the high-energy bonds of glucose: C-C and C-H bonds.

Think about the unanswered questions from your investigations and class discussions that you have had. *In the light, what happens to the carbon dioxide (CO_2) that moves into the plant?*

B. Using molecular models to show the chemical change

1. *Work with your partner to make models of the reactant molecules: carbon dioxide and water.*
    a. □ Make models of 6 carbon dioxide (CO_2) molecules and 6 water (H_2O) molecules. Put these molecules on the *reactant* side of the *Molecular Models Placemat*.
    b. □ When you are finished creating the reactant molecules, carbon dioxide and water, put away all extra pieces that you didn't use from the molecule kit. <u>This is an important step!</u>
    c. □ Place 12 twist ties in the "reactants" square on your poster with a "Light Energy" card. These twist ties represent light energy coming from the Sun.
2. *Show how the atoms of the reactant molecules can recombine into product molecules—oxygen and glucose—and show how light energy is transformed into chemical energy when this happens*.
    a. □ Take the carbon dioxide and water molecules apart and recombine them into glucose ($C_6H_{12}O_6$) and oxygen (O_2) molecules. Put these molecules on the *product* side of the *Molecular Models Placemat.* <u>Answer these questions</u>:
        i. How many carbon dioxide molecules were used? ***6***
        ii. How many water molecules were used? ***6***
        iii. How many glucose molecules were produced? ***1***
        iv. How many oxygen molecules were produced? ***6***

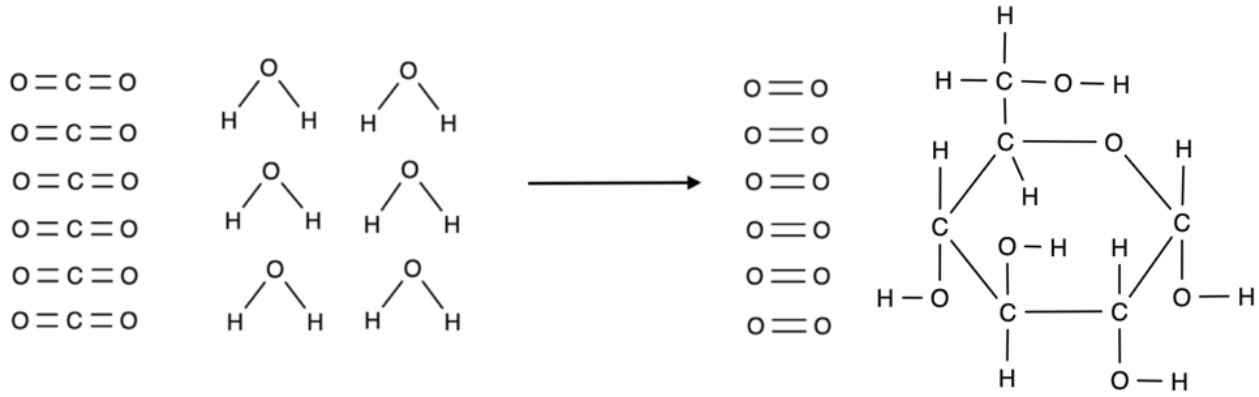


    a. □ Energy lasts forever, so move the twist ties to the *product* side of the *Molecular Models Placemat*. Glucose has high-energy bonds (C-C and C-H). Add a twist tie to

all the C-C and C-H bonds in the products. What form of energy did the light energy change into? (Re-read the introduction if you aren't sure.) 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? ***6***
2. Circle all of the Carbon ATOMS in the products. How many are there? ***6***

3. Underline all of the Hydrogen ATOMS in the reactants. How many are there? ***12***
4. Underline all of the Hydrogen ATOMS in the products. How many are there? ***12***

5. Put a square around all of the Oxygen ATOMS in the reactants. How many are there? ***18***
6. Put a square around all of the Oxygen ATOMS in the products. How many are there? ***18***

1 point for each correctly completed answer
6 points total

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

1. How many twist ties are there before the chemical change? ***12***
2. What form of energy is there before the chemical change? ***Light energy***
3. How many twist ties are there after the chemical change? ***12***
4. What forms of energy is there after the chemical change? ***Chemical energy***

1 point for each correctly answered question 4 points total

E. Check Yourself!

1. Did the number and type of atoms stay the same at the beginning and end of the chemical change? ***Yes*** *1 point for correct answer*

2. Did the number of twist ties (representing energy) stay the same at the beginning and end of the chemical change? ***Yes*** *1 point for correct answer*
3. Why do the numbers of atoms and twist ties have to stay the same?
   Matter/atoms and energy last forever. *1 point for correct answer*

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:

$$6H_2O + 6CO_2 \rightarrow C_6H_{12}O_6 + 6O_2$$

1 point for correctly written equation.