Name ______________________________ Teacher ________________ Date __________

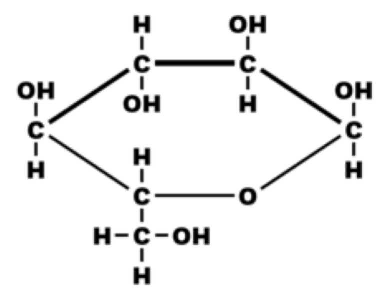
Activity 5.1: Molecular Models for Methane Burning Worksheet

A. Introduction

Methane is sometimes called natural gas. It is found under the ground and is extracted to use as a fuel. Methane is a good fuel because it has **chemical energy** stored in its high-energy C-H bonds. When methane burns, it reacts with oxygen (O_2) in the air to produce 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 heat and light. Use the molecular models to show how this happens.

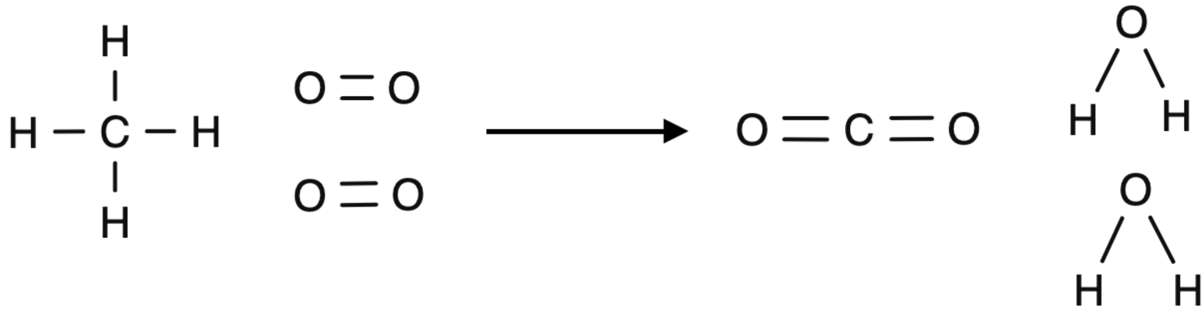
B. Using molecular models to show the chemical change

1. *Work with your partner to make models of the reactant molecules: ethanol and oxygen. Using the models, show how chemical energy is stored in the high-energy bonds of ethanol*.
    a. □ Make models of one methane molecule (CH_4) and two oxygen molecules (O_2, with a double bond). Put these molecules on the *reactant* side of the Molecular Models Placemat.
    b. □ When you are finished creating the reactant molecules (O_2 and methane), put away all extra pieces that you didn't use from the molecule kit. <u>This is an important step!</u>
    c. □ Use twist ties to represent chemical energy. Put a twist tie around each high-energy C-H bonds in the methane molecule. Put the "Chemical Energy" card under the methane molecule to label the energy in the C-H bonds.
2. *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*.
    a. □ Take the methane 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>:
        i. How many oxygen molecules reacted with 1 methane molecule? ____
        ii. How many carbon dioxide molecules were produced? _____
        iii. How many water molecules were produced? _____



    b. □ **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? (Re-read the introduction if you aren't sure.) Put the correct energy cards 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?

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F. Writing the chemical equation
Use the molecular formulas (CH_4, O_2, CO_2, H_2O) and the yield sign (→) to write a balanced chemical equation for the reaction:

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