**Modeling Cellular Respiration**

You will use models to learn about cellular respiration at the atomic-molecular scale. In our investigation, we saw the mealworms moving. Where did they get the energy to move?

Animals get energy from chemical energy stored either in their food (like carbohydrates) or in molecules (like fats) in their bodies. Carbohydrates and fats contain chemical energy stored in high-energy bonds: C-C and C-H bonds.

When animals use energy from carbohydrates or fats, they use oxygen (O2) in the air from breathing to produce carbon dioxide (CO2) and water (H2O). 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.

**Materials Required:**

* Molecular Model Placemat
* Bag with cereal (each color will represent a different type of atom)
* Highlighter to show high energy bonds

Use the table to record the color and/or description of the model component that represents each part of the molecules you are studying.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Carbon  (6 in bag) | Oxygen  (18 in bag) | Hydrogen  (12 in bag) | Chemical Bond | High Energy Bond | Low Energy Bond |
| Color/Description |  |  |  | Line between atoms | Highlight the bond in yellow | Keep the bond line black |

**Rules for Molecular Bonding**

1. Atoms in stable molecules always have a certain number of bonds to other atoms:
   1. Carbon: 4 bonds
   2. Oxygen: 2 bonds
   3. Hydrogen: 1 bond
2. Oxygen atoms do NOT bond to other oxygen atoms if they can bond to carbon or hydrogen instead.
3. Chemical energy is stored in bonds between atoms
   1. Some bonds (C-C and C-H) have high chemical energy
   2. Other bonds (C-O and O-H) have low chemical energy

**Procedure:**

1. Use a yellow highlighter to highlight every bond between a C-C and between a C-H.
2. Lay the cereal pieces out on the REACTANT (top) of the molecular placemat.
3. You should have placed the atoms on one molecule of sugar and 6 molecules of oxygen.
4. REARRANGE the SAME ATOMS (cereal pieces) from the REACTANTS and use them to make the produces. You should have placed the atoms on 6 water molecules and 6 carbon dioxide molecules.

**Analyzing the Model:**

Review the table below to account for all the atoms and types of energy in your models. Then answer the Check Yourself questions that follow.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **MATTER** | | | **ENERGY** | |
|  | # Carbon atoms | # Oxygen atoms | # Hydrogen atoms | # of high energy bonds | Forms of energy?  (chemical/ mechanical, heat, light) |
| **Reactants** | | | | | |
| Glucose (C6H12O6)  (1 molecule) |  |  |  |  |  |
| Oxygen (O2)  (6 molecules) |  |  |  |  |
| Total |  |  |  |  |
| **Products** | | | | | |
| Carbon Dioxide  (CO2)  (6 molecules) |  |  |  |  |  |
| Water  (H2O)  (6 molecules) |  |  |  |  |
| Total |  |  |  |  |

***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 high energy bonds stay the same at the beginning and end of the chemical change? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  3. Why do the numbers of atoms have to stay the same?

1. The Law of Conservation of Energy says that energy is not created or destroyed. Carbon dioxide and water have only low-energy bonds (C-O and H-O), so what happens to the energy that was stored in the high energy bonds of C-C and C-H in the glucose molecule? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# **Writing the chemical equation**

Use the molecular formulas (C6H12O6, O2, CO2, H2O) and the yield sign (→) to write a balanced chemical equation for the reaction:

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| --- |
|  |