Name: _____ Teacher: _____ Pd. ___ Date: _____

STAAR Science Tutorial 09
TEK 8.5F: Balanced Equations

TEK 8.5F: Recognize whether a chemical equation containing coefficients is balanced or not and how that relates to the law of conservation of mass.

Law of Conservation of Matter

- In a chemical reaction, matter is neither created nor destroyed. The atoms that existed before the reaction took place simply rearranged themselves into new substances.
- In a baking soda /vinegar reaction, the two ingredients: $NaHCO_3$ and $HC_2H_3O_2$, are rearranged into three different substances with the same number and kind of atoms: $NaC_2H_3O_2$, H_2O, and CO_2.
- For example, in the burning of methane reaction, the reactants methane (CH_4) and oxygen ($2O_2$) combine to make the products carbon dioxide (CO_2) and water ($2H_2O$). Notice that there are one carbon atom, four hydrogen atoms and four oxygen atoms both before and after the reaction.

Chemical Equations

- A **chemical equation** is a description of a chemical reaction, using the chemical formulas of each **reactant** (ingredient) on the left side of the equation and the chemical formulas of each **product** (the end result) on the right side of the equation. A right pointing arrow separates the reactants from the products.
- If there is more than one molecule of each reactant or product, a large **coefficient** number in placed in front of that substance's formula to show the number. The coefficient number should be multiplied by each subscript in the following formula to get the number of atoms.
- For the methane / oxygen burning reaction on the previous slide, the equation is: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$. There are one carbon, four hydrogen and four oxygen atoms on each side of the equation.

Recognizing Balanced Chemical Equations

- Because of the law of conservation of matter, there must be exactly the same number and kind of atoms on each side of a chemical equation. A correctly stated chemical equation is said to be **balanced** when the number and kind of atoms is the same on both sides.

- To test whether an equation is balanced, simply count the number and kind of atoms on the left side of the equation, and then check to see if there are the same number and kind on the right side. If so, it is balanced. If not, the equation is not balanced.
- The examples below show the process.

1. Is the equation: $H_2 + O_2 \rightarrow H_2O$ balanced?

   2 H = 2 H

   2 O ≠ 1 O **(not balanced)**

2. Is the equation: $2Fe + O_2 \rightarrow Fe_2O_3$ balanced?

   2 Fe = 2 Fe

   2 O ≠ 3 O **(not balanced)**

3. Is the equation: $6HCl + 2Al \rightarrow 2AlCl_3 + 3H_2$ balanced?

   6 H = 6 H

   6 Cl = 6 Cl

   2 Al = 2 Al **(balanced)**

4. Is the equation: $C_5H_7O_2(OH)_3 + 5O_2 \rightarrow 5H_2O + 5CO_2$ balanced?

   5 C = 5 C

   10 H = 10 H

   15 O = 15 O **(balanced)**

Practice Problems

1. Which of the following chemical equations are balanced?
   - A. $Al + CuCl_2 \rightarrow AlCl_3 + Cu$
   - B. $2Al + 3CuCl_2 \rightarrow 2AlCl_3 + 3Cu$
   - C. $3Al + 2CuCl_2 \rightarrow 3AlCl_3 + 2Cu$
   - D. $4Al + 3CuCl_2 \rightarrow 4AlCl_3 + 3Cu$

2. Which of the following chemical equations are balanced?
   - A. $K_3PO_4 + 2HCl \rightarrow 2KCl + 2H_3PO_4$
   - B. $K_3PO_4 + 3HCl \rightarrow KCl + H_3PO_4$
   - C. $K_3PO_4 + HCl \rightarrow KCl + H_3PO_4$
   - D. $K_3PO_4 + 3HCl \rightarrow 3KCl + H_3PO_4$