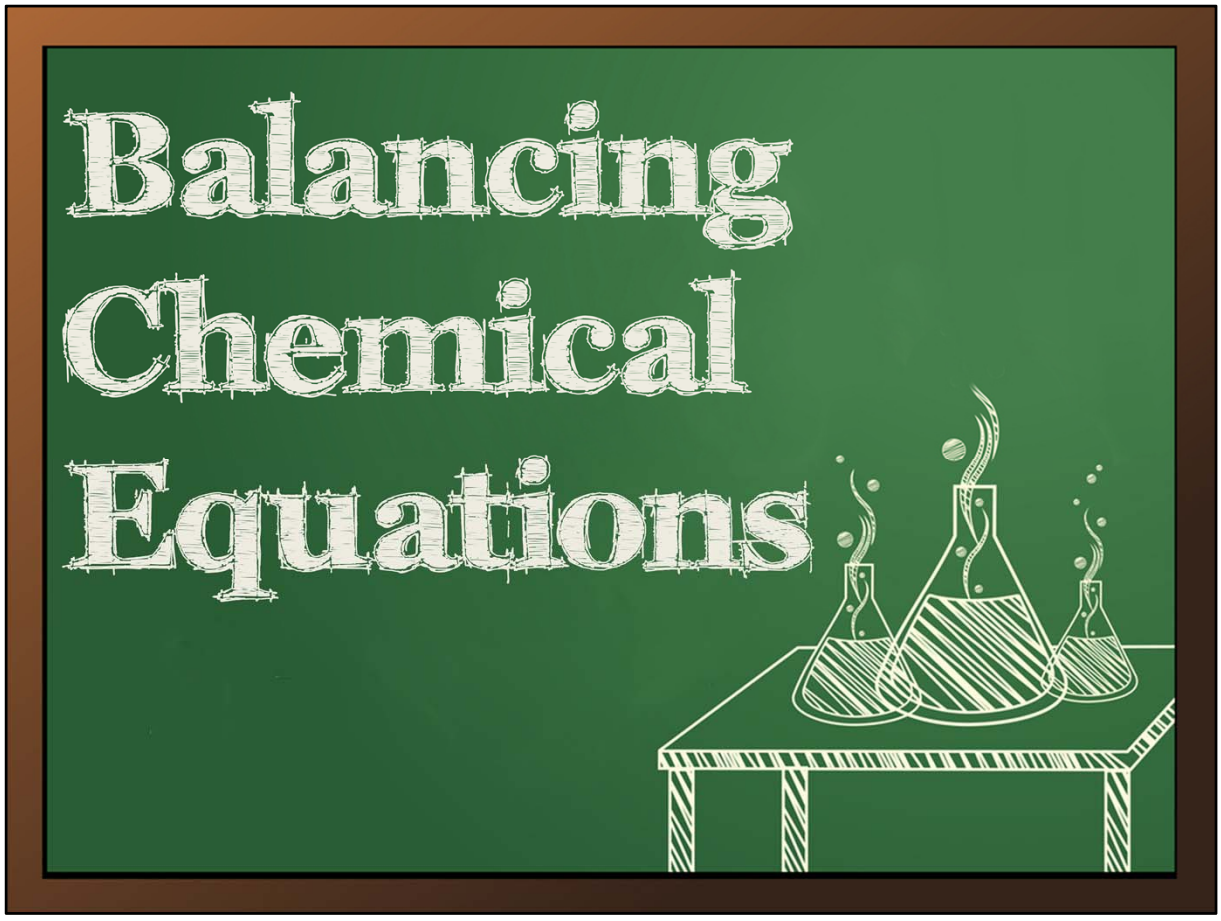
Module 6: Chemical Reactions

Topic 1 Content: Balancing Chemical Equations Presentation Notes



Balancing Chemical Equations

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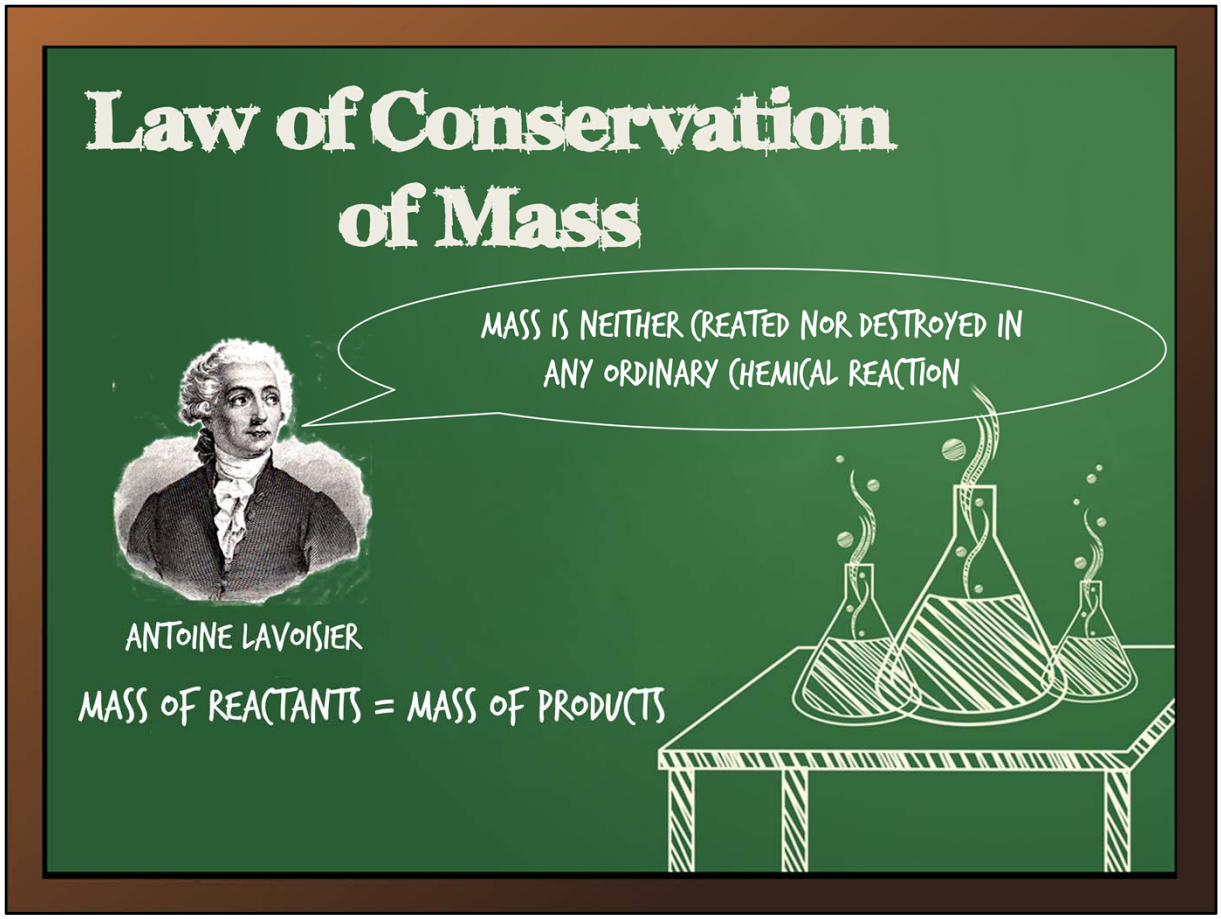

The Law of Conservation of Mass was established in 1789 by the French chemist Antoine Lavoisier. This law states that mass is neither created nor destroyed in any ordinary chemical reaction. A simpler way of stating that is to say that the mass of the substances produced, or the products, by a chemical reaction is equal to the mass of the reacting substances, or reactants.

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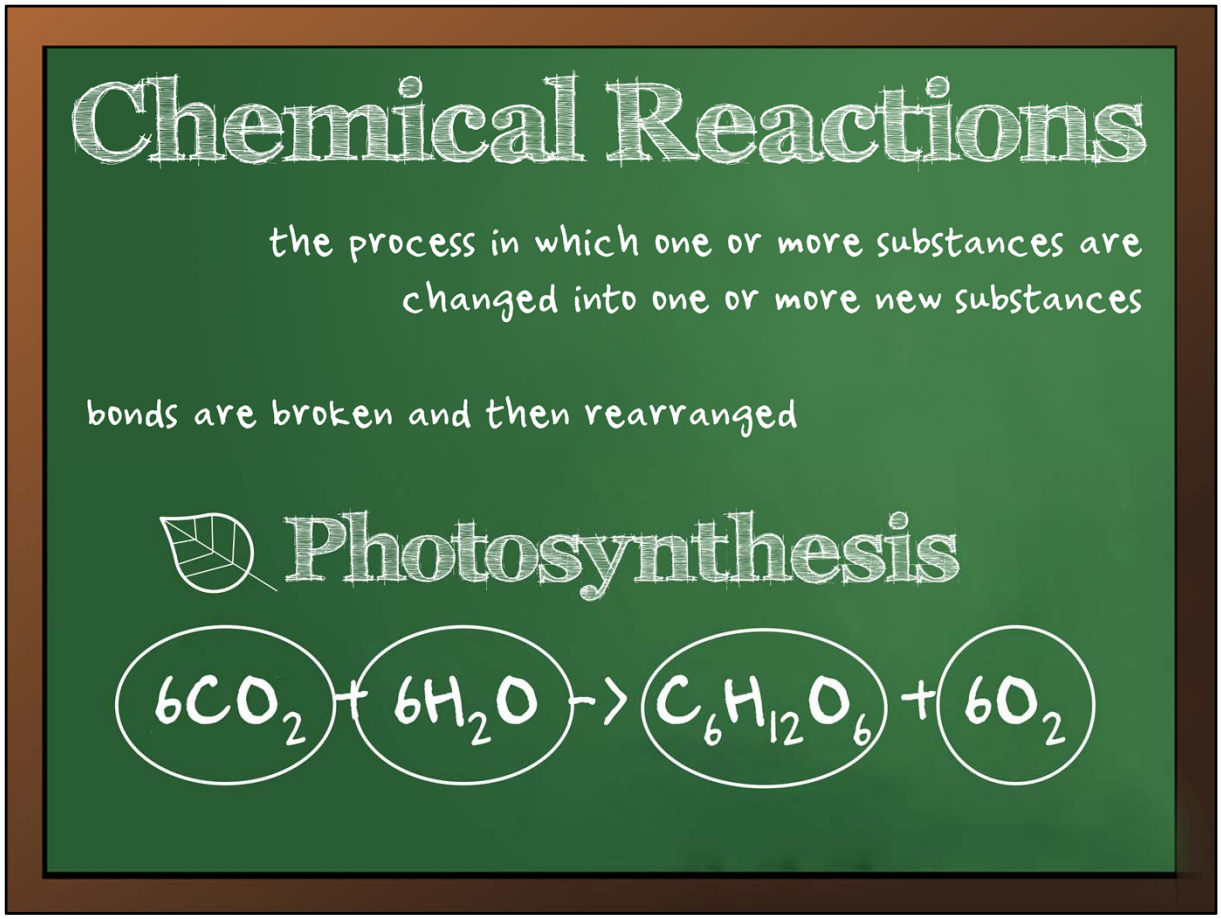

A chemical reaction is the process in which one or more substances are changed into one or more new substances. In a chemical reaction, the bonds are broken and then rearranged. This is the basis for what happens in all reactions. A new substance will be created that was not there before. Shown here is the balanced equation for the chemical reaction known as photosynthesis. All living plants go through the process of photosynthesis. This process takes the six carbon dioxide atoms combined with six atoms of water and creates the simple sugar glucose, as well as six oxygen atoms. As you may know, the oxygen generated through this reaction is very important to other forms of life on Earth. Instead of writing out a long, worded version, chemists use a shorthand equation like this to describe photosynthesis.

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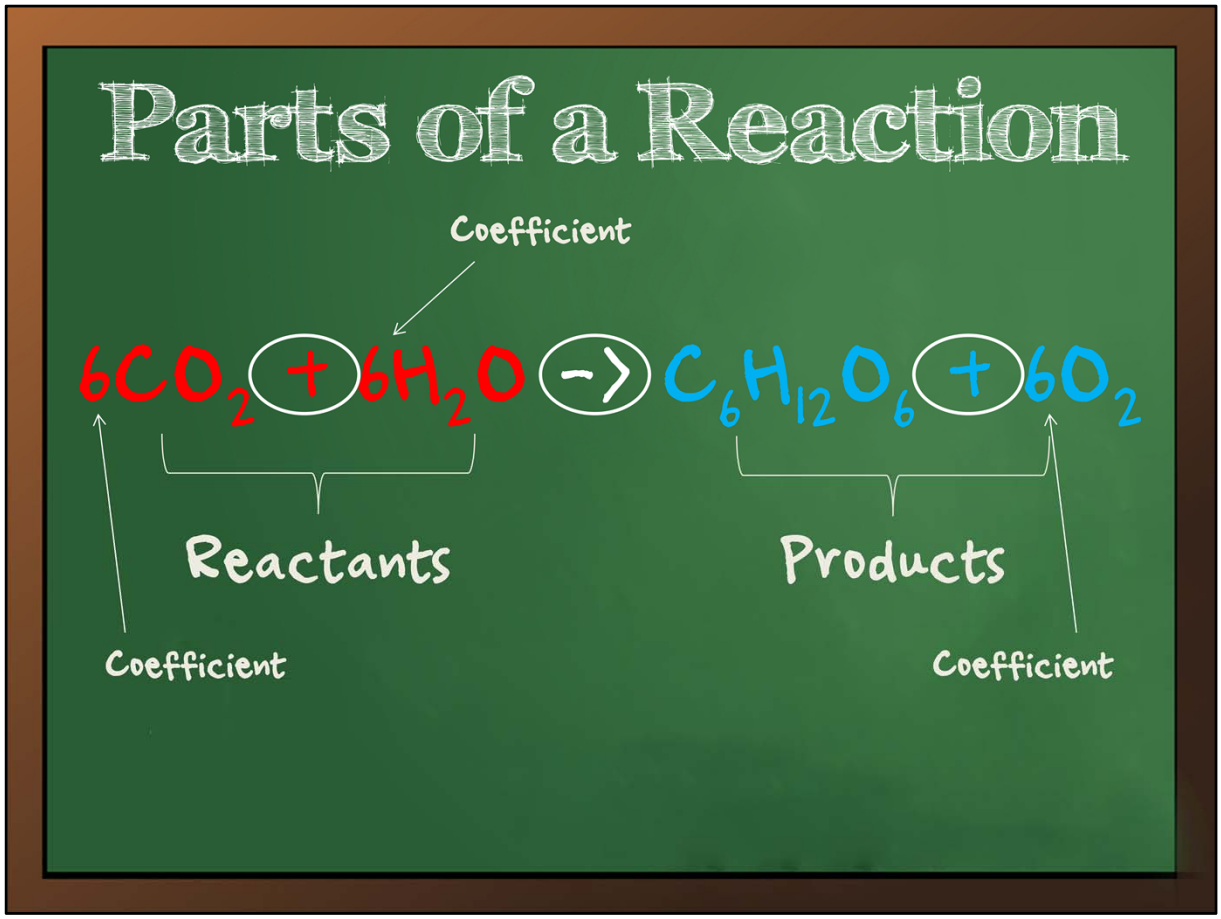

Chemical equations show the formulas for the substances that take part in the reaction. Before you learn how to balance equations, you must first understand the different parts of a reaction. The formulas on the left side of the arrow represent the **reactants**, or the substances that change in the reaction. The reactants are highlighted in red. The formulas on the right side of the arrow represent the **products**, or the substances that are formed in the reaction. The products are highlighted in blue. If there is more than one reactant or more than one product, they are separated by plus signs. The products and reactants are separated by an arrow. A coefficient is a number in front of chemical formulas which represents number of molecules. It can also represent number of moles of a substance. Take a moment to view the balanced chemical equation for photosynthesis with the reactants and products labeled. This reaction is balanced, meaning that the mass of the reactants is equal to the mass of the products.

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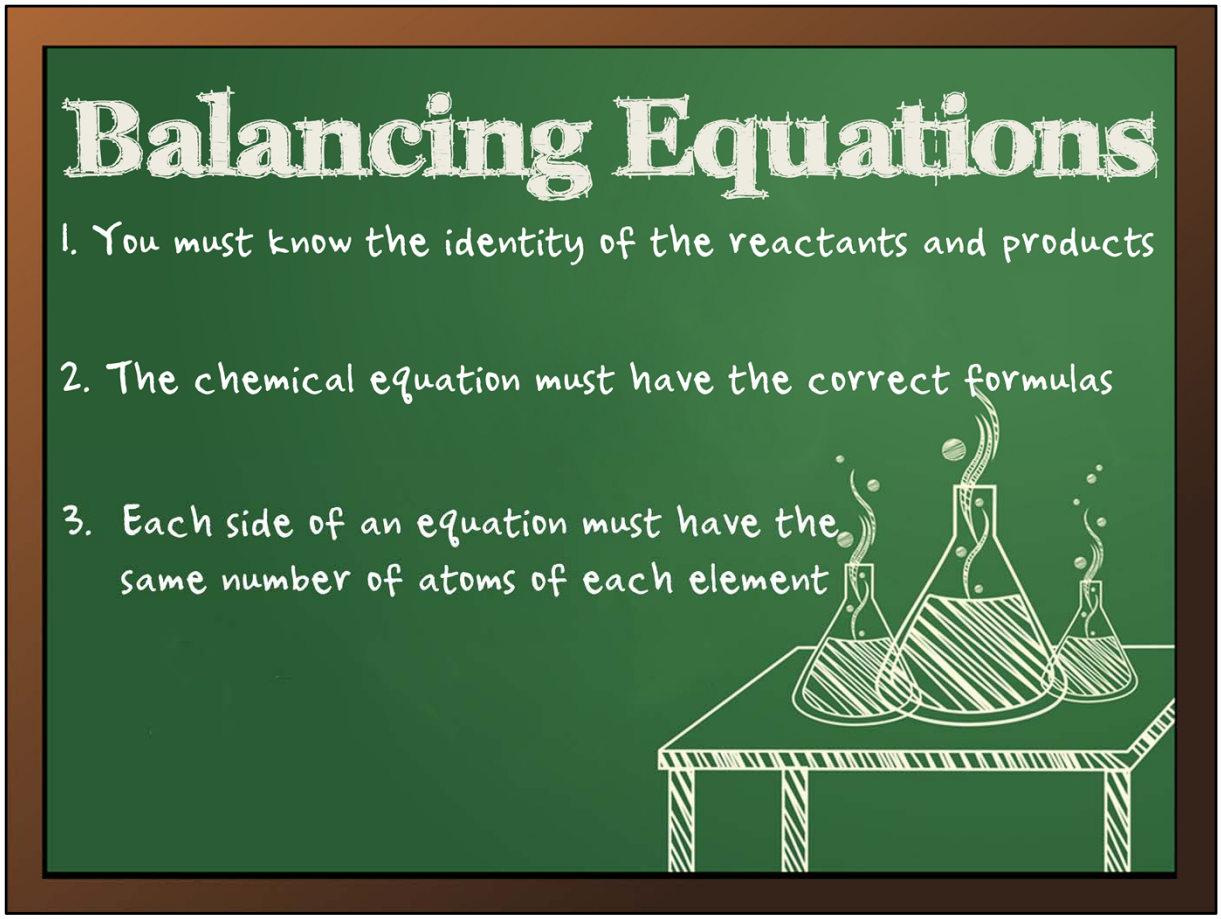

There are a few items to note when balancing chemical equations. First, you must know the identity of the reactants and products. You might be given this information, or you might have to obtain it experimentally. Second, the chemical equation must have the correct formulas. Pure elements have no ionic charge. Only ions in an ionic compound have a charge. It is helpful to remember the formulas for the diatomic molecules. Last, the Law of Conservation of Mass states that matter cannot be created or destroyed. This is true for chemical reactions. Therefore, each side of an equation must have the same number of atoms of each element.

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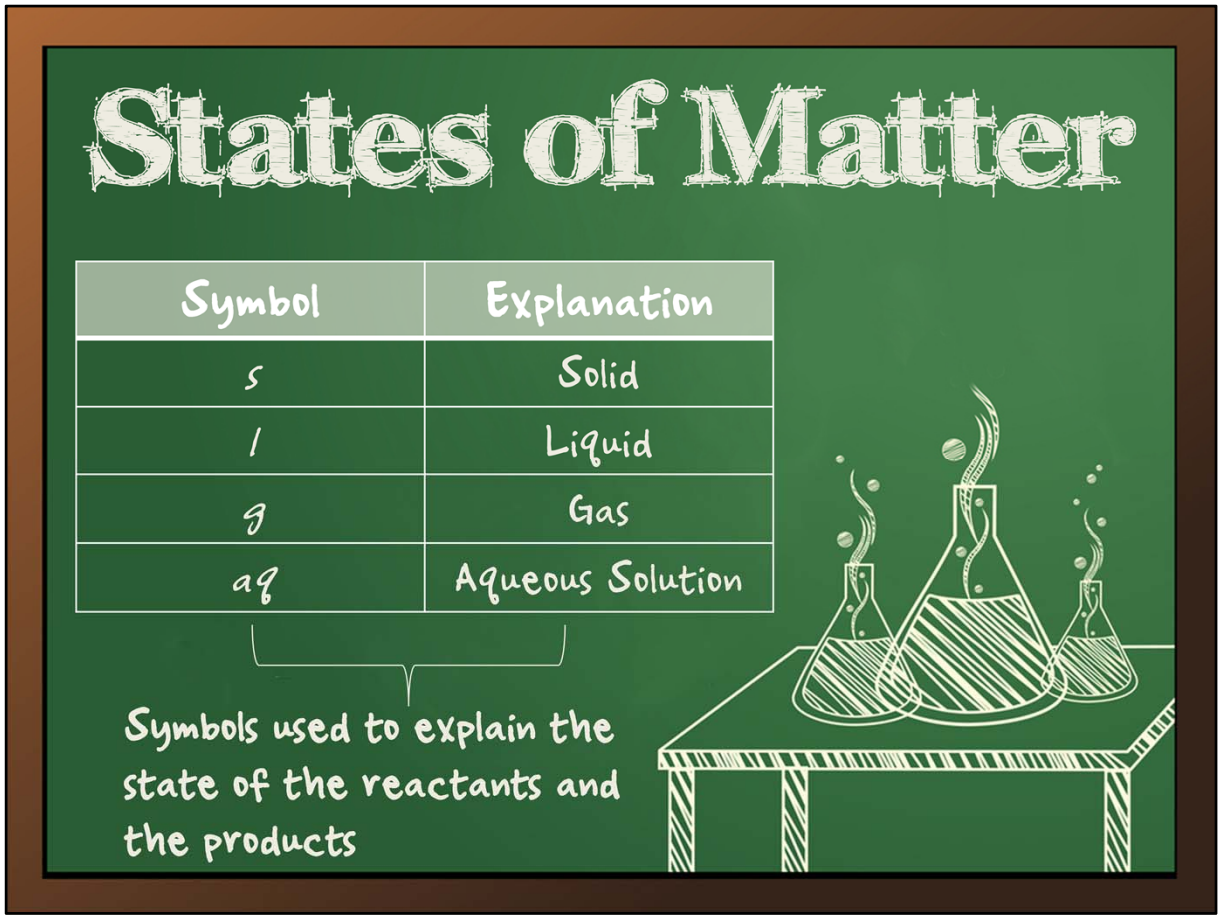
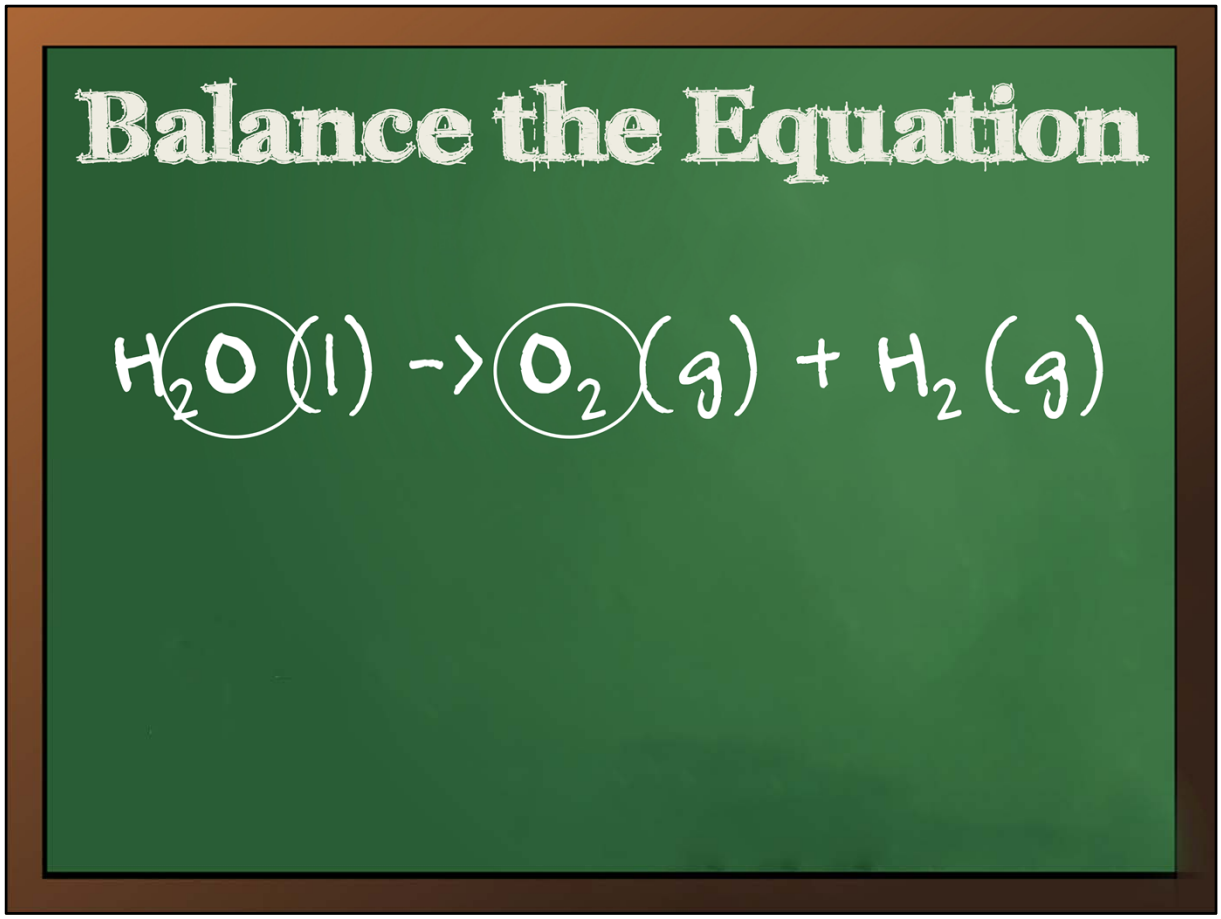
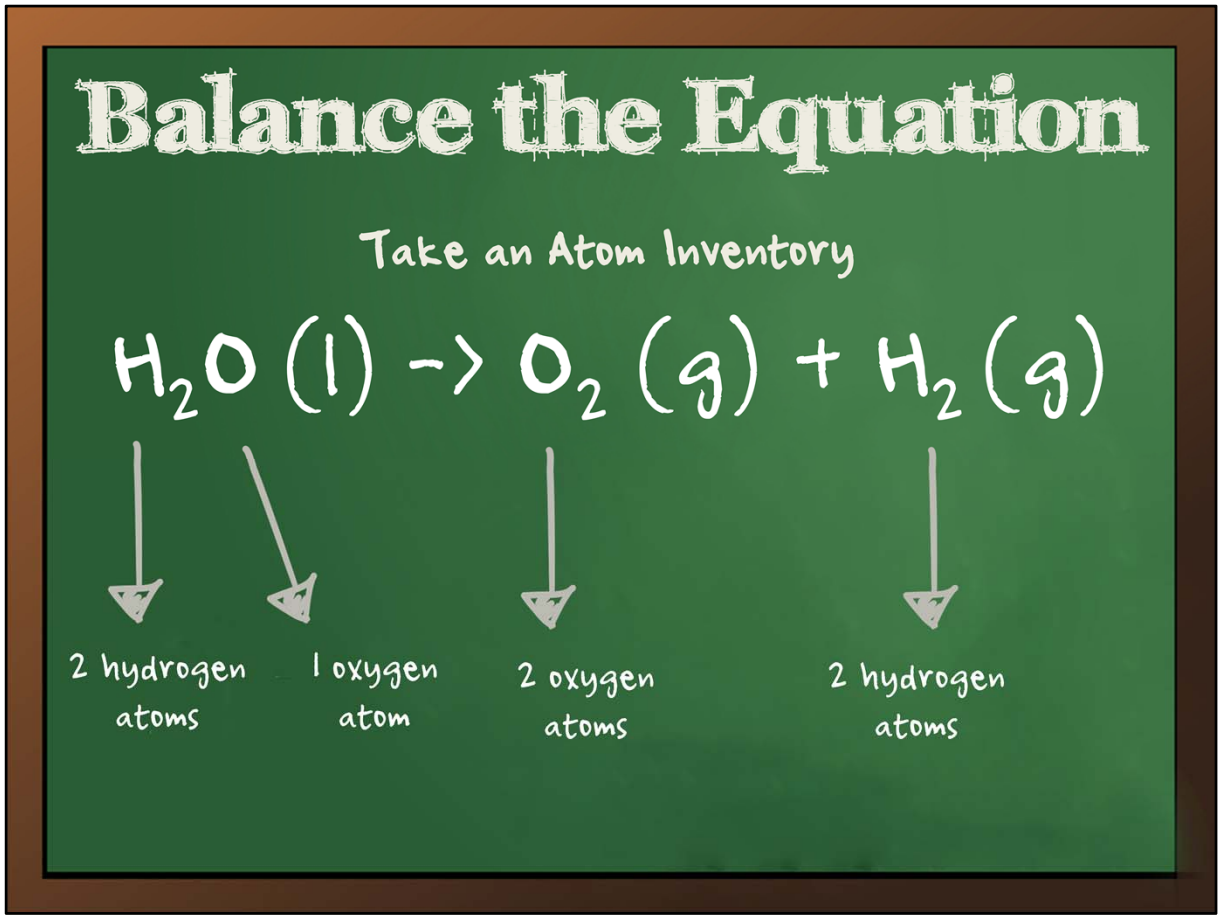


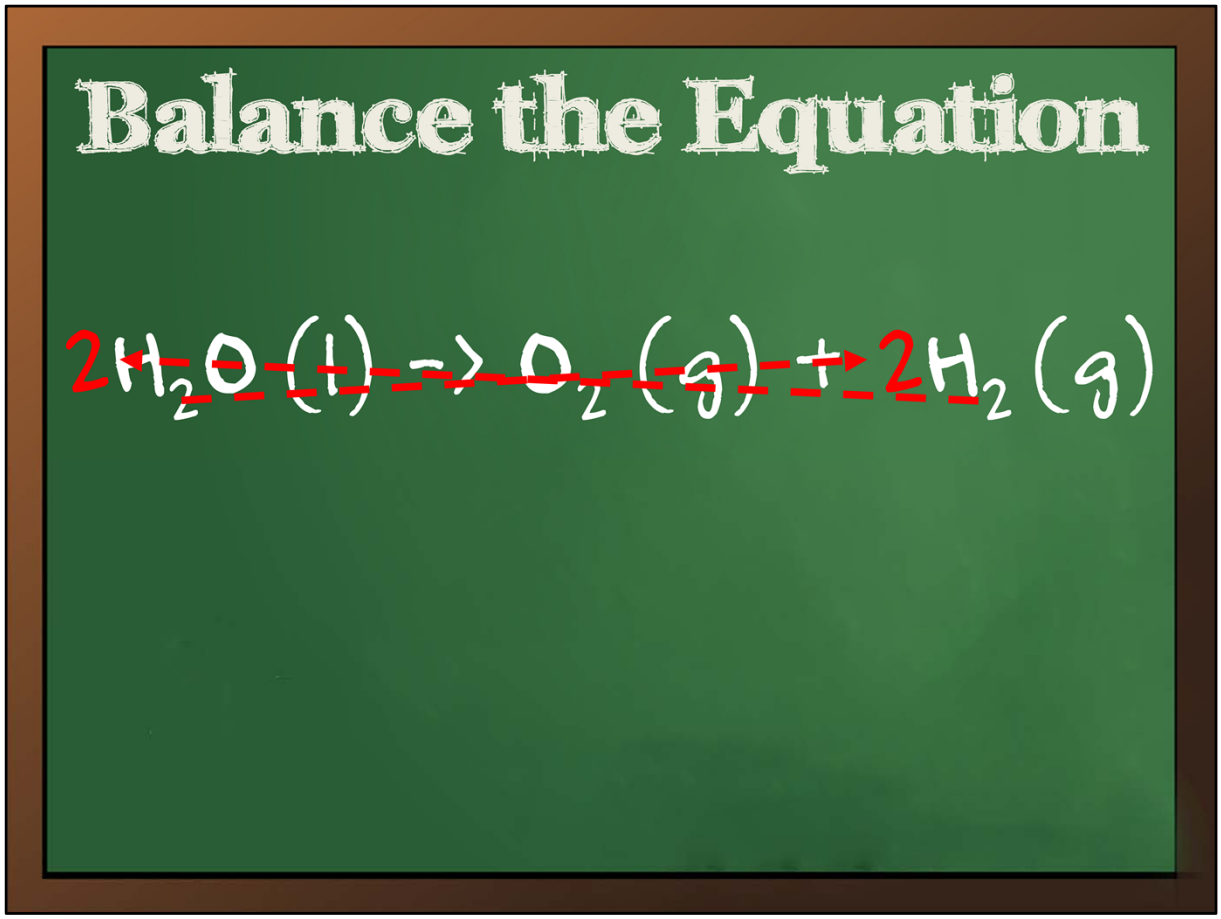
A chemical equation uses symbols and formulas to represent the identity and relative amounts of reactants and products in a chemical reaction. Equations also use symbols to identify the physical state of the reactants and product. You can view the table shown here to see the different symbols used for each state of matter. If the substance is dissolved in water, then it is identified with an *aq* for aqueous.



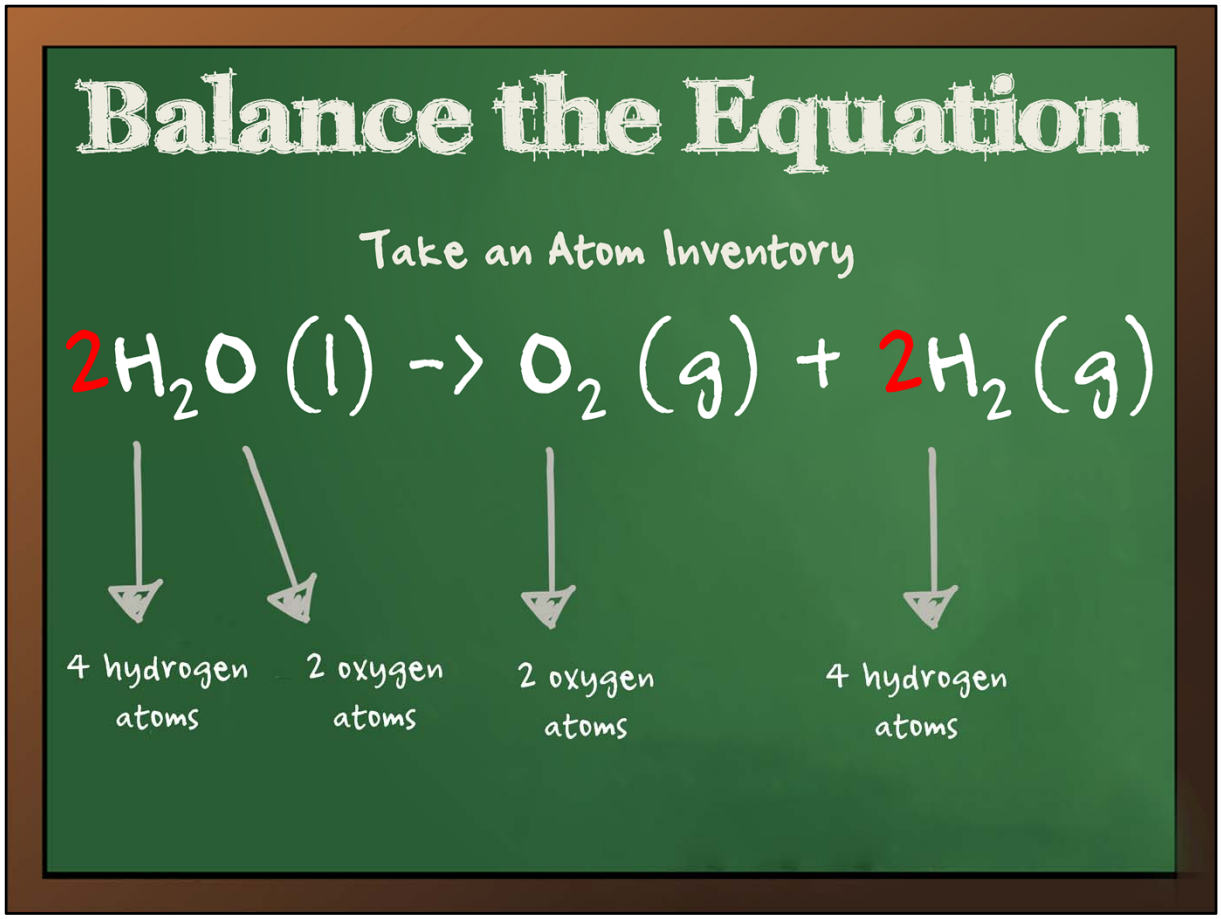
Now, try to balance a simple equation starting with the one shown here. Already, you may notice that there is a slight problem with this equation. Are there the same number of atoms of each element on both sides of the reaction? No, because there is one atom of oxygen in the reactant, but two in the product. You must balance the equation with coefficients in order to obey the Law of Conservation of Mass. That means you must take further steps to balance this equation.



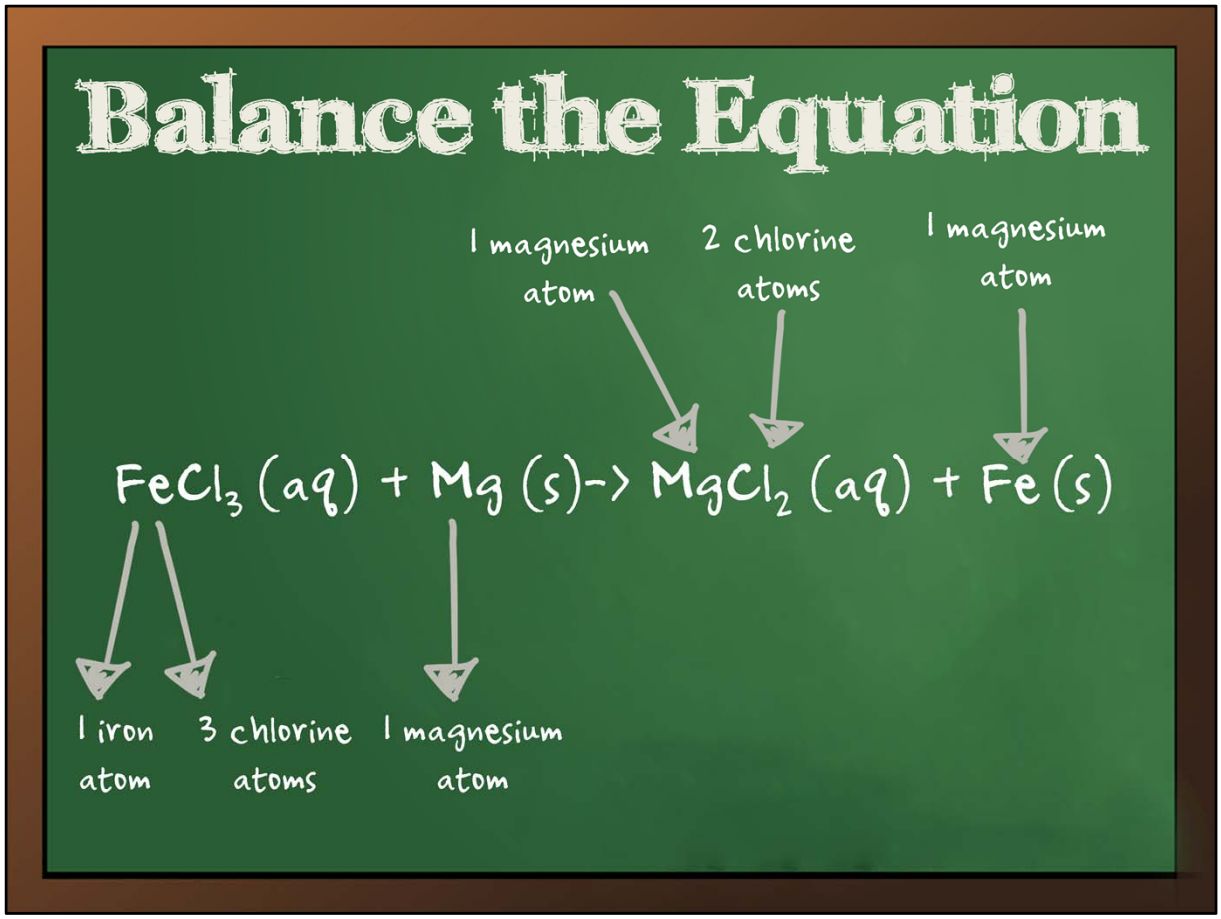
Since the numbers of oxygen atoms are not equal, you will need to complete a few steps in order to make sure the equation is balanced. As you balance the equation, it is helpful to keep track of how many atoms of each element are in the equation. This is called taking an atom inventory. Taking an atom inventory will show you exactly where you need to place the coefficient required to balance the equation.



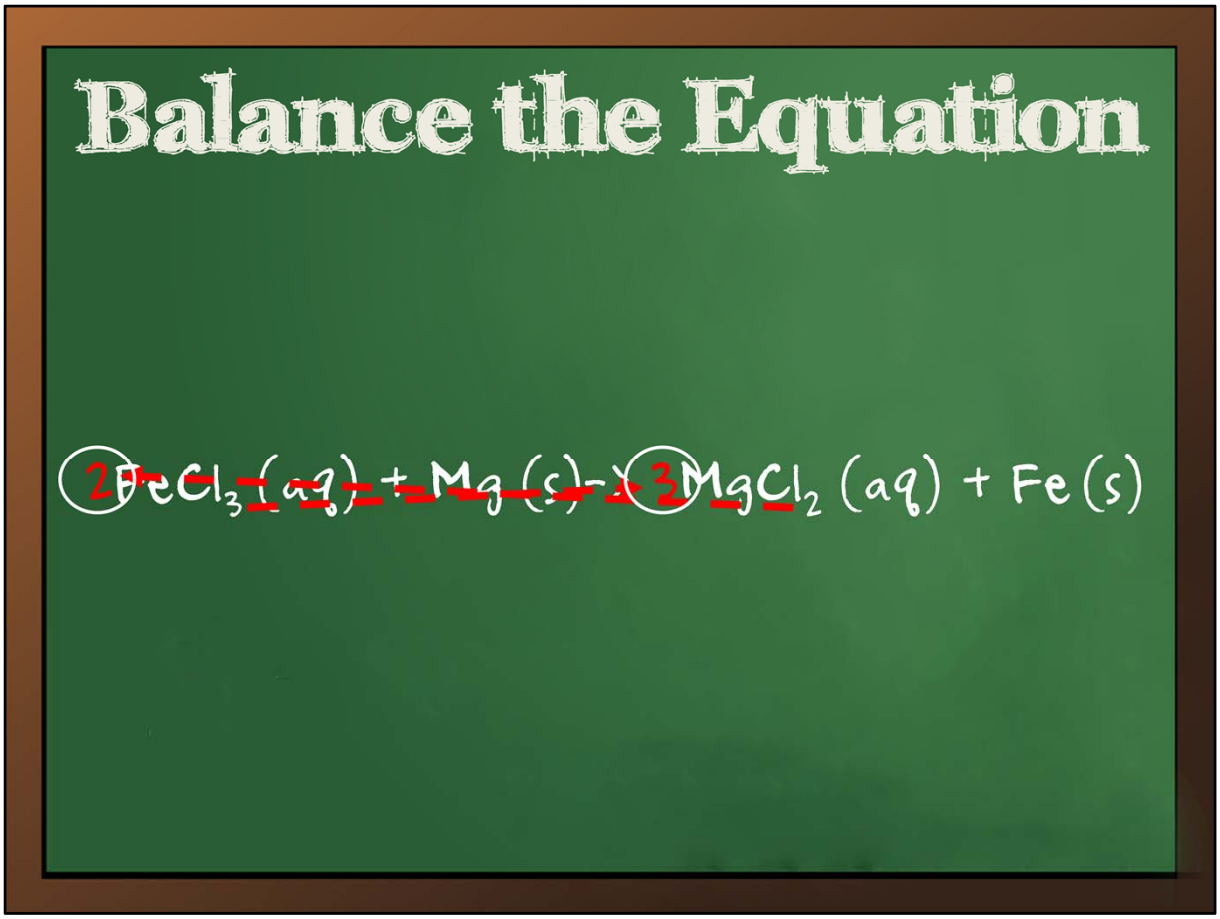
In order to balance the equation, the coefficient of two is placed in front of water and in front of hydrogen gas. Now, the equation has equal numbers of hydrogen and oxygen atoms. One strategy for balancing equations involves using the subscript for the element on the left side of the arrow as the coefficient in front of the formula containing the element on the right side of the arrow and vice versa.



Did placing the coefficient of two in front of the water and hydrogen gas balance the equation? To ensure that the equation is properly balanced, you will need to take another atom inventory. This time you will find that the amounts of products and reactants are equal. This equation is now balanced.



Here is another example of an unbalanced equation. This example shows the reaction of iron (III) chloride and magnesium producing magnesium chloride and iron. Look at this equation carefully; is it balanced? In order to answer this question, complete an atom inventory for this reaction.



After completing the atom inventory, you will see that there are an unequal number of chlorine atoms in the reactants and products. Further action is required to balance this equation according to the Law of Conservation of Mass. The same strategy from the previous equation can be used to balance this equation. The coefficient two is placed in front of iron (III) chloride on the left side of the reaction. The coefficient of three is placed in front of magnesium chloride on the right side of the equation. Why were the coefficients of two and three used? Remember, a good strategy for balancing equations involves using the subscript for the element on the left side of the arrow as the coefficient in front of the formula containing the element on the right side of the arrow. Once you believe you have balanced the equation, take another atom inventory. You can see from the atom inventory that this equation is now balanced.