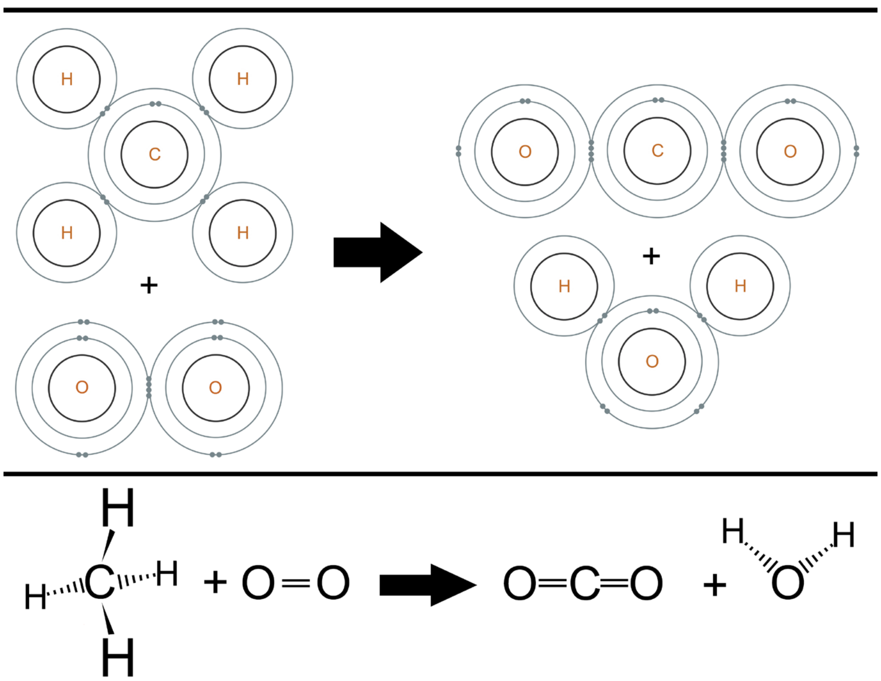
Figure 9.2.1

Chemical Reactions Change Compounds Chemically—Reactants Transform Into Products

This will be the last place where I emphasize that chemical reactions cause the reactants to change chemically. I've shown this below in two different ways, using Bohr diagrams and structural models for the methane combustion chemical reaction. You can see that the reactants—methane (CH_4) and oxygen (O_2)—have both changed chemically into entirely different chemicals—carbon dioxide (CO_2) and water (H_2O) after the reaction is completed. It might seem very obvious, but it is so important to realize that during a chemical reaction, bonds are broken and new ones are made. The bonds of the reactants are broken while new bonds are made in the products. Below, the bonds between the carbon and hydrogen in the methane are broken, as is the double bond between the oxygen atoms. As soon as those bonds are broken, the atoms no longer fulfill the octet rule (duet rule for hydrogen) and so they recombine instantaneously to form new molecules. Some of the oxygen atoms combine with hydrogen to form H_2O and some of them combine with carbon to form CO_2 and by doing that, the octet rule is again fulfilled. This pattern happens over and over again during chemical reactions. The bonds of the reactants are broken and as the atoms are freed from the reactants, they combine with other freed atoms to form new compounds—the products. Now, some of you might be wondering what the deal is with water being produced when something burns. The products of any combustion reaction—whenever anything burns—are always at least CO_2 and H_2O, but you never see water puddling around a burning campfire or dripping from a propane torch. This is where the importance of the phases of matter comes into consideration. Liquid water is one phase, and gas water—water vapor—is another. When something burns, the water is released in the form of gaseous water—water vapor—so you can't see it.

Basic reaction: $CH_4 + O_2 \longrightarrow CO_2 + H_2O$

methane | oxygen | carbon dioxide | water



New Graphic

9.3 CHEMICAL EQUATION—BALANCING THE EQUATION

However, there is something wrong with the chemical equation we have been using for methane combustion. While it is "good enough" to convey the idea of "methane combustion," there is still something seriously wrong with the equation—it is an **unbalanced chemical equation**, also called a **skeletal equation**. A skeletal equation is one in which the number of reactant atoms of each element does not equal the number of product atoms of each element (the stuff on the left side of the equation doesn't equal the stuff on the right). Let's look at that reaction and "count" the reactant and product atoms:

$$CH_4 + O_2 \longrightarrow CO_2 + H_2O$$

Reactants	Products
1 carbon	1 carbon
4 hydrogen	2 hydrogen
2 oxygen	3 oxygen