# Chemistry Lecture #11: Changes in Matter

Physical Change: Physical property of matter changes but the matter is still made of the same material.

For example, if I tear a piece of paper into tiny pieces, there is a change in the paper, but the material is still paper. The paper has physically changed, but we still have paper.

On the other hand, if I light the paper on fire, we see a change, but the paper is no longer paper. The paper has changed into another type of material, so it is not a physical change.

Changes in the physical state of matter is a physical change. For example, if an ice cube melts, it changes from a solid to a liquid. And if the liquid water is heated until it turns into steam, it has turned from a liquid to a gas. But in all 3 states of matter, the material is still $H_2O$.

Ice can be heated to turn into water, which can then be heated to turn into steam. This process can be reversed by removing heat. Thus, steam can be cooled and turned into water, and water can be cooled and turned into ice. Thus the conversion of ice all the way into steam is a *reversible physical change* since our end product can be converted back into the starting product.

On the other hand, if a piece of paper is torn into tiny pieces, the pieces won't reattach themselves. We could throw the pieces into a bag and shake the bag, but no matter how much we shake,

the pieces won't come back together. Thus, tearing a piece of paper is an *irreversible physical change.*

Chemical Change: Elements and or compounds react to form a new substance.

Chemical reaction: A chemical change where you start with one thing (reactant), and end up with another substance (product).

Iron + oxygen → rust
reactants product

water → hydrogen gas + oxygen gas
reactant products

*Signs of a chemical change*

How do we know when a chemical change has occurred? We can observe certain changes which sometimes indicate that a new substance has been made.

1. Generation of heat. Example: flames
2. Color change. Example: paper turns black after being lit.
3. Production of a gas. Example: you see smoke.
4. Precipitate forms Example: two clear liquids are mixed and a solid appears in the liquid.

The appearance of heat, color, gas or a precipitate is no guarantee that a chemical change has occurred. It could still be a physical change.

For example, suppose I have a glass of salt water. If I heat the water, it will disappear and leave behind a white salt residue. The appearance of a white solid could be considered a color change, but it doesn't mean that a new substance was made. The salt was still salt when it was in the water, and it was salt after the water was removed. Thus, no new substance was made. Dissolving salt into water is a physical change.

Sodium acetate is a solid that can also be dissolved in water. Under the right circumstances, the dissolved sodium acetate can be made to suddenly appear as a white solid if a tiny amount of energy is added to the dissolved solution. The sudden appearance of a white solid in a liquid may lead you to think that a new substance was being formed. But in actuality, it is simply sodium acetate changing from a dissolved form to a solid form. No new substance is made, and the change is physical, not chemical.