8th Grade Science Packet #3

**Chemical Reactions Change Substances**

This kind of change is a **chemical reaction**, a process in which one or more new substances are formed from one or more other substances. Substances that exist before a chemical reaction takes place and change as a result of the reaction are called **reactants**. New substances that form in chemical reactions are called **products**. In a chemical reaction, reactants react to produce products. Products are different substances than the reactants from which they came.

In the chemical reaction between vinegar and baking soda, there are two reactants: acetic acid (in vinegar) and sodium bicarbonate (in baking soda). The acetic acid and sodium bicarbonate react to form the products water, a substance called sodium acetate, and bubbles of carbon dioxide. Acetic acid and sodium bicarbonate are different substances than water, sodium acetate, and carbon dioxide. As a result, they have different properties that can be used to identify them.

The formation of a solid when two liquid mixtures combine is evidence that a chemical reaction is taking place.

Products have a different set of properties than the reactants. Scientists test whether a new substance has indeed formed by characterizing its properties, such as its density, odor, solubility, or flammability. If a substance is present that has properties distinctly different from those of the reactants, then a chemical reaction has taken place to form a product.

Some properties of matter are only noticeable during or after a chemical reaction. These properties are called chemical properties and other properties called physical properties. Flammability is a chemical property because you can only notice it when a substance is both undergoing a chemical reaction and burning. A substance's ability to react with another substance, or take part in a certain chemical reaction, is another chemical property.

Think back to the chemical reaction with baking soda and vinegar. If you keep adding vinegar, eventually the reaction will stop because all of the baking soda has been
consumed. When one of the reactants has been all used up, the chemical reaction will stop. The products that formed—water, sodium acetate, and carbon dioxide—do not react with vinegar. These products have different chemical properties from baking soda. This difference in chemical properties is evidence that they are different substances than baking soda.

Activity 1: Answer the following questions using the text above.

1. In a chemical reaction, substances existing before the reaction takes place are known as _________________.

2. Substances that are created after the reaction are known as _________________.

3. Properties that are only noticeable during or after a chemical reaction are known as _________________.

4. What is a chemical reaction? ____________________________________________

   ________________________________________________________________________

5. What is the difference between chemical properties and physical properties? ______

   ________________________________________________________________________

6. Scientists test whether a new substance has indeed formed by characterizing its properties, such as _________________.

   Conditions that Cause Chemical Reactions

   If you look around, there are countless substances in your surroundings. But not all of them are undergoing chemical reactions. Whether a reaction happens depends on the chemical properties of the reactants and on the specific conditions they are under. Different conditions can cause different reactants to undergo chemical reactions.

   Heating In many chemical reactions, a little bit of energy is needed to get the reaction started. All of the reactants are present on the head of a strike-anywhere match, but they do not react without help. A little bit of energy is needed for the
reactants to react. When the match head rubs against a rough surface, the friction provides energy for the reaction to start.

**Cooling** Chemical reactions also happen when one or more reactants are cooled. For example, nitrogen dioxide is a dark, orange-brown gas found in smog. When cooled, the dark brown gas goes through a chemical reaction and forms dinitrogen tetroxide—a colorless gas. If heated again, the dinitrogen tetroxide goes through the reverse chemical reaction, forming the dark brown gas again. In this way, chemical reactions depend on both the chemical properties of the mixed reactants and on their surrounding conditions.

**Mixing** Some substances will undergo a chemical reaction immediately when they are mixed. For instance, when lead nitrate and potassium iodide mix, they react almost as soon as they meet. Similarly, when baking soda and vinegar mix, a reaction begins the moment acetic acid and sodium bicarbonate meet.

**Activity 2:** Answer the following questions using the text above.

1. Why don’t matches catch on fire while they are in the box? _____________________
   __________________________________________________________________________

2. What are three conditions that can cause chemical reactions to occur? ______________
   __________________________________________________________________________
   __________________________________________________________________________

3. Give an example of a chemical reaction that is caused when reactants cool. _________
   __________________________________________________________________________
   __________________________________________________________________________

4. Give an example of a chemical reaction that is caused when reactants are mixed.
   __________________________________________________________________________
**Medicines in Clinical Trials**

For many centuries, people chewed willow bark or used it in teas to treat their headaches and fevers. Modern scientists were interested in finding the substances in willow bark that actually affected the human body so that they could develop better medicines.

Evaluating Salicin and Salicylic Acid First, the scientists tested the urine of patients and discovered that salicin becomes salicylic acid in the body. They suspected that salicylic acid was the drug that affected fevers and was a more effective medicine than salicin. Doctors then tested salicylic acid's effectiveness on their patients with fever or pain through clinical trials. Clinical trials are a type of test that medical scientists perform to assess a medicine's effectiveness. They would give each patient salicylic acid. They took notes on changes in body temperature and how the patient was feeling to determine how effective salicylic acid was in reducing fever and pain. They wanted to determine how well the drug accomplished their criteria—to reduce fevers and headaches while causing minimal negative side effects.

Salicylic acid did not perfectly meet their criteria for a successful drug. While it did reduce fever and headaches, it caused several unpleasant side effects. It caused nausea, dizziness, and breathing problems. Still, it was one of the best available drugs at the time, so it gained widespread use.

Evaluating Aspirin Chemical scientists and engineers tried to come up with new methods that would not just reduce pain and fever, but also not cause side effects. In 1853, a French scientist utilized chemical reactions to make acetylsalicylic acid, which we now know as aspirin, from salicylic acid. However, it wasn't used as a drug until 1897. In 1897, a scientist named Felix Hoffmann devised and patented a method for making aspirin for medicine. He developed chemical reactions that used salicylic acid as a reactant and made aspirin as a product. The aspirin was given to patients with fevers and headaches in a series of clinical trials. Doctors measured how much the aspirin reduced fever and how effective it was. There were also no reports of dizziness or breathing problems. The clinical trials showed that aspirin was a better solution for reducing fever and pain than salicylic acid. By 1918, about 20 years later, aspirin was widely used as one of the most powerful and effective medicines.
**Activity 3**: Answer the following questions using the text regarding clinical trials.

1. What is the relationship between salicin and salicylic acid? ____________________
   ________________________________________________________________________
   ________________________________________________________________________

2. What did early doctors think salicylic acid could treat? _________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________

3. What is a clinical trial? __________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________

4. What is the relationship between salicylic acid and aspirin? _____________________
   ________________________________________________________________________
   ________________________________________________________________________
   ________________________________________________________________________

5. Why is aspirin a better medicine than salicylic acid? __________________________
   ________________________________________________________________________
   ________________________________________________________________________