COMPLETE INTRODUCTION TO CHEMISTRY (GRADES 6-8)

KT-CHEMINT

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Science Foundations Series

TABLE OF CONTENTS:

Science Skills

As you move through this and other Science Foundations Series kits, you will have opportunities to develop each of these science skills.

- Develop testable questions about nature.
- Create, evaluate, and use models.
- Design and conduct investigations.
- Organize and reflect on data.
- Use computational thinking to show patterns and relationships.
- Use evidence to explain and argue.
- Synthesize ideas and communicate to others.

ATOMS AND MOLECULES

"What is everything made of?" Questions like this have been asked for centuries and scientists are continually trying to find the answer. **Matter** is the word used in science to describe everything that takes up space and has form. Simply put, matter is the stuff that makes up everything around us!

Elements are the simplest type of matter; they can't be broken down further through ordinary chemical means. You may have heard of some common elements like hydrogen, oxygen, carbon, or sodium. Some metals like copper or gold are also elements.

The smallest unit of matter is called an **atom**. Atoms are like building blocks that fit together to make up everything around us. While an atom is the smallest unit with the chemical properties of an element, even atoms are comprised of smaller particles: protons, electrons, and neutrons.

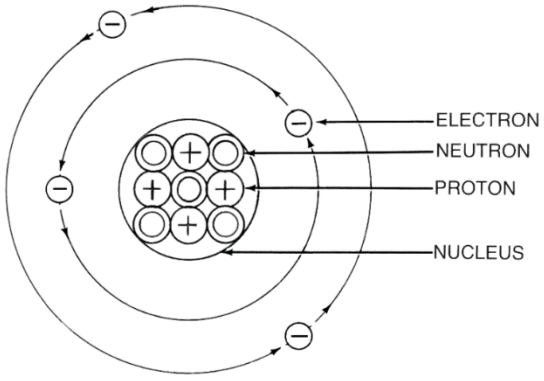

Figure 1. Diagram of an atom.

You may wonder how larger substances, like water, sugar, or iron, can exist if all matter is made of tiny atoms. Atoms can bond together into bigger compounds called **molecules**. For example, each water molecule contains two hydrogen atoms and one oxygen atom (H_2O). Molecules have different shapes, depending on the types of atoms bonded together. While molecules are larger than the atoms that make them up, they're still too tiny to see with the naked eye.

What happened?

Inside each kernel is a bit of water, about 13–15% of the total mass of the kernel. As the popcorn heats up, the water inside the kernel changes to steam, exerting great pressure on the outer covering, called the hull. Unlike the balloon, the hull doesn't expand with the steam inside it. The pressure builds until the kernel explodes, shattering the hull and allowing the steam to escape. Then, the starchy inner parts of the kernel puff out with steam and expand into the fluffy popcorn we eat. When the kernel pops, you should have seen steam condense on the sides of the test tube.

ACIDS AND BASES

Remember in Activity #2 when you mixed vinegar and baking soda? The foam was produced because an **acid** (vinegar) and a base, or **alkaline** (baking soda), were mixed and reacted rapidly.

Acids and bases have different properties. Acidic foods (like tomatoes or lemons) taste sour and bases taste bitter. But, in a chemistry lab, you never find out if a substance is acidic or basic by tasting it! Instead, you would use pH tests.

The **pH** scale is used to measure the amount of H+ ions in a solution (pH stands for positive hydrogen). When dissolved in water, acids donate hydrogen **ions** (H^+). Hydrogen ions are **hydrogen** atoms that have lost an electron and now have just a proton, giving them a positive electrical charge. Bases, on the other hand, when mixed with water yield hydroxide ions (OH^-). If a solution has a high concentration of H^+ ions, it is acidic. If a solution has a high concentration of OH^- ions, it's basic.

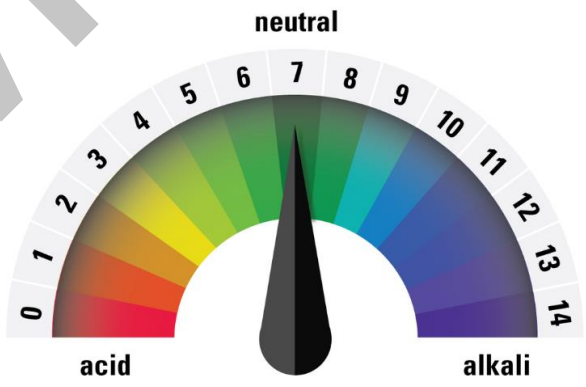

Figure 5. pH scale

Acids have a pH below 7; bases have a pH above 7. Strong acids have the lowest pH levels (0–4), and strong bases have the highest pH levels (10–14). Neutral solutions have a pH of 7 and are neither acidic nor basic. Distilled water (H_2O) is neutral because the H+ and OH^- ions are balanced.

Using the science of pH, you can change the color of a clear liquid. Find out how in the next activity.

9. Take the ball out of the beaker and roll it between your hands. It will be sticky at first but will become more solid as you work with it.
10. You now have a bouncy ball. Try bouncing it and answer the following questions.
11. Store your ball in an airtight container or zip-close bag so it doesn't try out and crumble.

How high does the ball go?

Does the ball bounce better on hard or soft surfaces? Why do you think this is?

What happened?

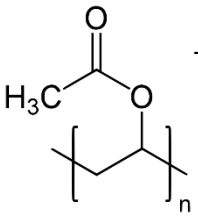

Figure 8. Polyvinyl acetate diagram.

The white glue, as you know, contains polyvinyl acetate, which gives the ball strength. Polyvinyl acetate is a polymer that is arranged in long, thin strands.

Cornstarch contains amylopectin, a polymer with a shape best described as "branched" — it sticks out like the branches of a tree. This gives the ball the property of elasticity. Elasticity allows the ball to return to its original shape after being compressed or stretched, like when it hits the floor. Instead of splattering everywhere, the ball bounces back up.

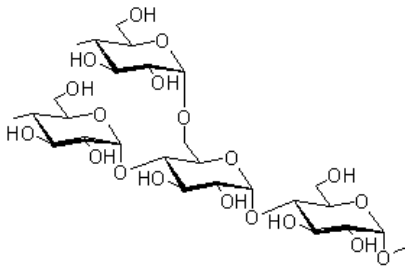

Figure 9. Amylopectin polymer diagram.

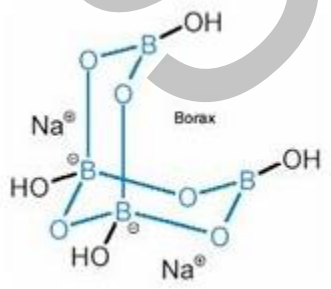

Figure 10. Sodium tetraborate diagram.

The sodium tetraborate (also referred to as borax) helps the glue and the starch molecules stick together. This connects the two polymers into a netlike formation, keeping the ball from crumbling or becoming slime when bounced.