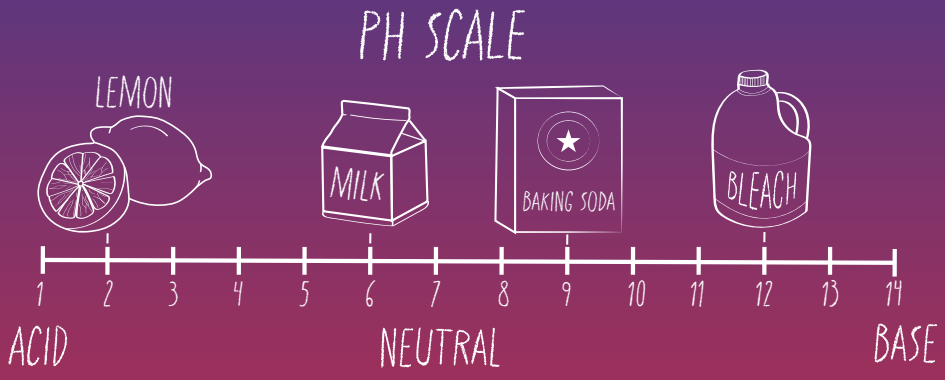
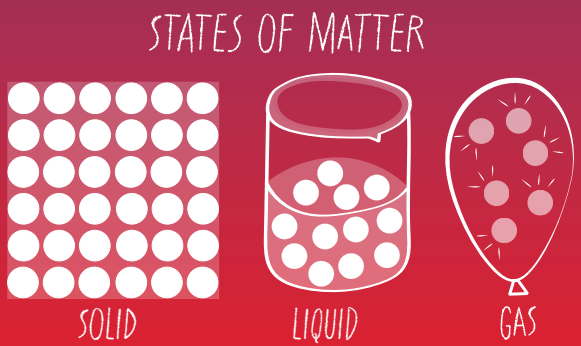
DREAM. BUILD. BECOME.

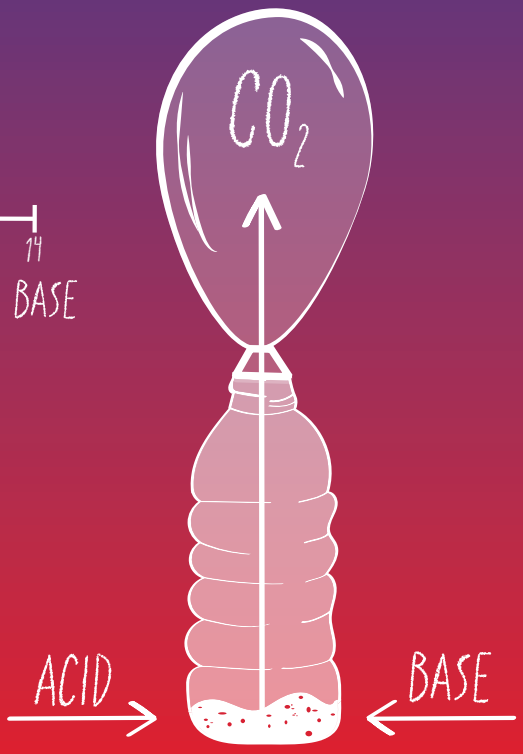
ACE METAL FOUNDATIONS

By IACMI

Chemical Changes







Chemical Changes

Prior Knowledge

Students should be able to follow simple, multistep directions and safely handle classroom materials such as balloons, funnels or paper cones, and plastic bottles under teacher supervision.

Chemical Changes

Lesson Overview

In this lesson, students investigate chemical changes by mixing two everyday substances and carefully observing what happens. As the materials interact, students notice bubbling, fizzing, and the inflation of a balloon, clear evidence that a new substance has formed.

Through hands-on exploration, students learn how to identify chemical changes using their senses and compare them to physical changes, such as changes in shape or size. Rather than focusing on scientific formulas or advanced chemistry terms, the lesson emphasizes observable evidence, cause-and-effect relationships, and clear explanations based on what students see, hear, and feel.

This activity also connects classroom learning to the real world. Scientists and engineers must recognize when materials change and design systems that safely manage those changes. By observing and describing evidence of change, students practice the same thinking skills used in manufacturing, product design, and problem-solving across many careers.

Vocabulary

Physical Change: A change in how something looks, feels, or is shaped that does not create a new substance, such as changing size, shape, or state

Chemical Change: A change that makes a new substance with different properties

Gas: Matter that spreads out to fill the space around it. It does not have its own shape or volume

Evidence of a Chemical Change: Signs that show a new substance has formed, such as bubbling, fizzing, gas forming, sound, or a change that cannot easily be reversed

Figure 1: A close-up of the periodic table, a key tool for scientists and engineers.

Figure 2: Erlenmeyer flasks, commonly used to mix, heat, and store liquids in laboratory experiments.

Chemical Changes

The Foundations of Understanding Changes in Matter

When you work with materials, they can change in different ways. Some changes are physical changes, and some are chemical changes.

A **physical change** happens when something changes in size, shape, or form, but it is still the same material. For example, stretching a balloon, bending a paperclip, or pouring water into a new container are physical changes. No new material is made.

A **chemical change** happens when materials are mixed or used in a way that creates something new. Chemical changes are often harder to reverse. Scientists look for evidence to tell when a chemical change has happened.

Evidence of a chemical change may include fizzing, bubbling, a new smell or sound, changes in temperature, such as heat being released or absorbed, the formation of a gas, the production of light, or a change that cannot easily be undone.

Composites can also involve chemical changes. A composite is made when two or more materials work together to make something stronger, lighter, or more useful than one material by itself. In some composites, strong fibers are placed inside a liquid resin. The fibers give the part strength, and then the resin goes through a chemical change as it hardens. Once it hardens, the resin holds the fibers in place and helps turn the materials into one strong part.

In this activity, you will mix two materials and observe what happens. As you watch carefully, you will see signs that a chemical change is taking place. You will also notice physical changes, such as a balloon changing shape as it fills.

By observing, describing, and explaining these changes, you are practicing how scientists and engineers study materials. Understanding how and why materials change helps people design products, improve safety, and solve real-world problems.

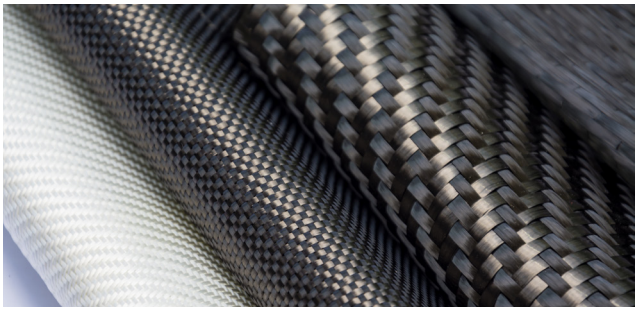


Figure 3: A close-up of carbon fiber, a composite material used in aerospace, automotive, and sporting equipment.

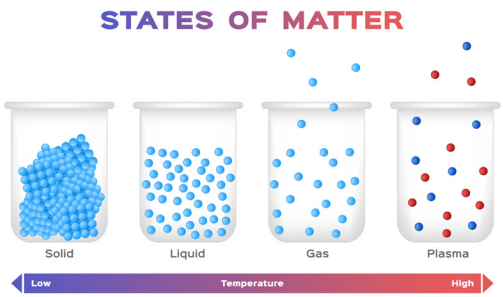


Figure 4: A diagram of the states of matter.

Chemical Changes

Materials

Materials Supplied in Kit

Per Student
- 1 Balloon

Shared
- Baking Soda

Materials Supplied by Teacher

- Vinegar
- Recycled: Bottles (20 oz. Soda bottles)
- Workspace protection (paper towels, trays, or table coverings)

Activity Directions

Step 1: Pour vinegar into the plastic water bottle until it is about one-third full

Step 2: Roll a piece of paper into a funnel-like cone and insert it into the opening of the balloon.
Step 3: Pour a small amount of baking soda into the paperfunnel to partially fill the balloon.

Step 4: Carefully stretch the open end of the balloon over the mouth of the bottle, keeping the baking soda inside the balloon.
Step 5: Lift the balloon so the baking soda falls into the vinegar.
Step 6: Observe.

Step 3

Step 5

Chemical Changes

Discussion Prompts or Reflection

- What did you notice when the baking soda and vinegar mixed together?
- Which observations show that a chemical change occurred?
- What physical changes did you notice during the activity, and how do you know they were physical changes?
- Why is it important for scientists and engineers to recognize when materials are changing in different ways?

Variations and Enrichment

- Variation can be introduced to this activity by changing the amounts of vinegar or baking soda, allowing students to observe how changing one material affects the results and the evidence of chemical change
- Enrichment can be introduced by challenging students to edit only one variable at a time in a measurably different way. This can help students quantify how a change to the inputs can impact the outputs
- Enrichment can also be introduced with the addition of a scale. By measuring the weight of the completed reaction bottle with the attached baking soda-filled balloon, students can observe that once the baking soda reacts with the vinegar, matter isn't created nor destroyed. Students can compare the measurements and discuss what stayed the same, even though the materials changed
- **Density Extension: Why Does the Carbon Dioxide Balloon Fall?**
    - Teacher Background: During the reaction between baking soda and vinegar, a gas (carbon dioxide, CO_2) is produced. The balloon traps this gas and inflates. Students often notice a balloon filled with CO_2 is behaves differently than a balloon filled with room air. This happens because carbon dioxide is more dense than the mixture of gases that make up room air.
    - Density describes how much matter is packed into a given space. Even though the balloons may be the same size, the carbon dioxide balloon contains heavier gas particles packed into the same volume.
    - To demonstrate this concept more clearly to students, you might tie one balloon containing carbon dioxide and blow up one balloon (room air) and drop them at the same time to watch them fall and note the differences.

Chemical Changes

Foundation Exploration

- **Chemists** study how different materials mix and change. They test chemicals to learn what happens when they are combined
- **Product Testers** check materials and products to make sure they work the right way, and are safe to use
- **Factory Workers and Manufacturers** use chemicals and materials to make products like plastics, fabrics, and coatings
- **Safety Specialists** make sure that chemicals are used carefully to people and the environment are protected
- **Future materials scientists** may design new materials that change color, clean water, store energy, protect people, or even help astronauts live and work in space. To do that, they'll need to understand how materials mix, react, and change.

Figure 5: Researchers analyzing samples and conducting experiments in a laboratory.

Figure 6: Worker wearing protective gear opening a storage tank at a chemical processing facility.