

# Lab 23. Classification of Changes in Matter: Which Changes Are Examples of a Chemical Change, and Which Are Examples of a Physical Change?

## Introduction

Matter, the “stuff” of which the universe is composed, has two characteristics: it has mass and it occupies space. Physical properties of matter, such as density, odor, color, melting point, boiling point, state at room temperature (liquid, gas or solid), and magnetism, are often useful for identifying different substances. Matter, however, can also go through changes in both its physical and chemical properties. During *physical changes* the composition of matter does not change; for example, freezing a sample of water results in a change of state (i.e., going from liquid to solid), but the substance is still water ( $\text{H}_2\text{O}$ )—its chemical composition did not change. During *chemical changes* the chemical composition of a substance does change; for example, burning a piece of wood in a fireplace is a chemical change. In this example, the original wood is transformed into ashes and smoke, which both have different chemical properties than the original piece of wood.

## Your Task

Create and observe the five scenarios listed below. Using your data and observations, determine if a physical or chemical change has occurred when

- 100 ml of water ( $\text{H}_2\text{O}$ ) is mixed with 5 g of table salt ( $\text{NaCl}$ ),
- a 2 cm magnesium strip is placed in a crucible and heated,
- 10 drops of sodium hydroxide ( $\text{NaOH}$ ) and 10 drops of copper(II) nitrate ( $\text{CuNO}_3$ ) are mixed,
- 5 drops of hydrochloric acid ( $\text{HCl}$ ) are added to 2 g of sodium bicarbonate ( $\text{NaHCO}_3$ ), and
- paraffin wax is subjected to heat in a hot-water bath.

The guiding question of this investigation is, **Which changes are examples of a chemical change, and which are examples of a physical change?**

## Materials

You may use any of the following materials during your investigation:

Consumables	Equipment
<ul style="list-style-type: none"><li>• <math>\text{NaCl}</math></li><li>• <math>\text{NaOH}</math> solution</li><li>• <math>\text{CuNO}_3</math> solution</li><li>• <math>\text{HCl}</math> solution</li><li>• <math>\text{NaHCO}_3</math></li><li>• Magnesium strip, 2 cm</li><li>• Paraffin wax</li><li>• pH paper</li><li>• Distilled water (in squirt bottles)</li></ul>	<ul style="list-style-type: none"><li>• Spot (reaction) plate</li><li>• Graduated cylinder (50 ml)</li><li>• Beaker (150 ml)</li><li>• Beaker (500 ml)</li><li>• Hot plate</li><li>• Bunsen burner</li><li>• Ring stand with metal ring</li><li>• Clay triangle</li><li>• Wire gauze square</li><li>• Crucible with lid</li><li>• Crucible tongs</li><li>• Test tube tongs</li><li>• Spatula</li><li>• Thermometer</li><li>• Electronic or triple beam balance</li></ul>

## Safety Precautions

Follow all normal lab safety rules. Your teacher will explain relevant and important information about working with the chemicals associated with this investigation. In addition, take the following safety precautions:

- Wear indirectly vented chemical-splash goggles and chemical-resistant gloves and apron while in the laboratory.
- Wipe up any water spilled on the floor from water baths.
- When investigating the odor associated with chemicals, never inhale with your nose directly over a tube, beaker or bottle; your instructor will demonstrate wafting the fumes toward your nose with your hand.
- Use caution when working with Bunsen burners. They can burn skin, and combustibles and flammables must be kept away from the open flame. If you have long hair, tie it back behind your head.
- Inspect the crucible for cracks. If it is cracked, exchange it for a new one. Clean the crucible and lid thoroughly before using them.
- Be careful with a crucible after removing it from a flame because it will still be hot.
- Use caution when working with hot plates, hot water, and melted wax because they can burn skin. Hot plates also need to be kept away from water and other liquids.
- Handle test tubes placed in the hot-water bath ONLY with test tube tongs.
- Handle all glassware (including thermometers) with care.
- Wash your hands with soap and water before leaving the laboratory.

**Investigation Proposal Required?**     Yes             No

### Getting Started

Create each of the scenarios listed on the previous page and record what happens. Then conduct additional tests as needed to determine if a chemical or physical change took place.

### Connections to Crosscutting Concepts, the Nature of Science, and the Nature of Scientific Inquiry

As you work through your investigation, be sure to think about

- the importance of patterns within science,
- the flow of energy and matter within a system,
- the difference between observations and inferences in science, and
- the difference between data and evidence in science.

### Initial Argument

Once your group has finished collecting and analyzing your data, you will need to develop an initial argument. Your argument must include a *claim*, which is your answer to the guiding question. Your argument must also include *evidence* in support of your claim. The evidence is your analysis of the data and your interpretation of what the analysis means. Finally, you must include a *justification* of the evidence in your argument. You will therefore need to use a scientific concept or principle to explain why the evidence that you decided to use is relevant and important. You will create your initial argument on a whiteboard. Your whiteboard must include all the information shown in Figure L23.1.

**FIGURE L23.1** \_\_\_\_\_

**Argument presentation on a whiteboard**

The Guiding Question:	
Our Claim:	
Our Evidence:	Our Justification of the Evidence:

### Argumentation Session

The argumentation session allows all of the groups to share their arguments. One member of each group stays at the lab station to share that group's argument, while the other members of the group go to the other lab stations one at a time to listen to and critique the arguments developed by their classmates. The goal of the argumentation session is not to convince others that your argument is the best one; rather, the goal is to identify errors or instances of faulty reasoning in the initial arguments so these mistakes can be

fixed. You will therefore need to evaluate the content of the claim, the quality of the evidence used to support the claim, and the strength of the justification of the evidence included in each argument that you see. To critique an argument, you might need more information than what is included on the whiteboard. You might, therefore, need to ask the presenter one or more follow-up questions, such as:

- What did your group do to analyze the data, and why did you decide to do it that way?
- Is that the only way to interpret the results of your group's analysis? How do you know that your interpretation of the analysis is appropriate?
- Why did your group decide to present your evidence in that manner?
- What other claims did your group discuss before deciding on that one? Why did you abandon those alternative ideas?
- How confident are you that your group's claim is valid? What could you do to increase your confidence?

Once the argumentation session is complete, you will have a chance to meet with your group and revise your original argument. Your group might need to gather more data or design a way to test one or more alternative claims as part of this process. Remember, your goal at this stage of the investigation is to develop the most valid or acceptable answer to the research question!

## **Report**

Once you have completed your research, you will need to prepare an *investigation report* that consists of three sections that provide answers to the following questions:

1. What question were you trying to answer and why?
2. What did you do during your investigation and why did you conduct your investigation in this way?
3. What is your argument?

Your report should answer these questions in two pages or less. The report must be typed and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your claim is acceptable or valid!