

## Chemical and Physical Changes (Guided Inquiry)

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Changes are so much a part of our lives that we may hardly think about them. Paints are mixed, ingredients become meals, tools rust, fuels are consumed, and rain and snow, form, fall, and then disappear. Some of these changes are physical, and some are chemical.

A physical change may be a change in the appearance but not in the actual substance of a material—the molecules originally present have not been changed to different molecules. For example, a change in state is a physical change—ice and liquid water are the same chemical substance but are physically different.

Chemical changes result from the formation, breaking, or rearrangement of chemical bonds. Atoms of compounds are rearranged to form different substances from the original ones. A chemical change can be depicted by an equation showing the rearrangement of atoms.

You will be given the materials to conduct various procedures. You will need to construct a procedure for each change, have your procedures approved by your instructor, and then carry out the procedures. The data you collect will be used to develop a set of criteria for determining whether a given change is chemical or physical.

### Safety

- Hydrochloric acid (HCl) and sodium hydroxide (NaOH) are corrosive to skins and eyes.
- $\text{CuSO}_4$ ,  $\text{Na}_2\text{CO}_3$ , ethanol, and sodium polyacrylate are irritants to skin and eyes.
- Ethanol is flammable.
- Ice is cold.
- Avoid inhaling any fumes produced during the chemical reaction.
- Spills should be neutralized and cleaned up immediately. Any solutions that contact skin should be rinsed off with plenty of water.
- Goggles and aprons must be worn.

**Chemical and Physical Changes (Guided Inquiry)****I. PURPOSE**

To practice developing lab procedures, creating data tables and to observe and explain the properties of various chemical and physical changes.

**II. MATERIALS**

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|--|-------------------------|------------------------|
| 1. 1.0 M NaOH                            | 8. Salt                 | 15. 100 mL Beakers     |
| 2. 1.0 M HCl                             | 9. Carbonated soda      | 16. Glass petri dishes |
| 3. 0.5 M CuSO <sub>4</sub>               | 10. Ice                 | 17. Sealable container |
| 4. 0.5 M Na <sub>2</sub> CO <sub>3</sub> | 11. Small test tubes    | 18. Test tube racks    |
| 5. Mg ribbon                             | 12. Graduated cylinders | 19. Balance            |
| 6. Ethanol                               | 13. Scissors            |                        |
| 7. Sodium polyacrylate                   | 14. Matches             |                        |

**III. PROCEDURES**

- For each of the lettered tasks listed below, write a brief procedure describing the materials needed and steps required to carry it out. Give special consideration to the safety of your procedures.

Tasks

- Combine 2 mL 1 M NaOH and 2 mL 0.5 M CuSO<sub>4</sub>.
- Touch a lit match to 1 mL ethanol.
- Combine 0.5 cm Mg ribbon and 3 mL 1 M HCl.
- Place 25 mL carbonated soda in a sealable container and shake. Open the sealable container.
- Combine 0.25 g sodium polyacrylate and 10 mL H<sub>2</sub>O.
- Combine 2 mL 1 M HCl and 2 mL 0.5 M Na<sub>2</sub>CO<sub>3</sub>.
- Combine 1 small ice cube and 5 g salt.
- Combine 2 mL 0.5 M Na<sub>2</sub>CO<sub>3</sub> and 2 mL CuSO<sub>4</sub>.

The following may be used as a template in writing procedures for each of the 8 tasks:

Part X

- Place 2 mL of NaOH solution in a test tube.
- Add 2 mL of HCl solution to the test tube.
- Monitor (qualitatively) any temperature changes.
- Observe for 1 minute and record your observations.
- Indicate whether a chemical or physical change has occurred and explain why.
- Clean up the lab station, disposing of used chemicals according to your instructor's directions.

- Construct a data table to record your observations for each task (remember to include columns to indicate whether each change is physical or chemical and an explanation of each physical/chemical classification as well as for all observations).

**IV. PRE-LAB QUESTIONS**

- Explain the differences between a chemical change and a physical change.
- List three examples of a physical change and three examples of a chemical change. Explain why you think each example is chemical or physical.
- What are the indicators of a chemical change? Include an example of each indicator.

**V. DATA & CALCULATIONS**

- DATA  
Data table goes here.
- CALCULATIONS  
None

**VI. QUESTIONS & DISCUSSION OF ERROR**

- QUESTIONS
  - Draw a picture depicting what happens to the molecules when water boils (changes from liquid state to gaseous state). Describe what is happening.

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2. Draw a picture depicting what happens to the elements and molecules when solid Mg ribbon reacts with hydrochloric acid. Describe what is happening.
3. While there are some outward signs of chemical changes, many of these can be mimicked in physical changes as well (for example, a change in color). What are some more reliable ways in which you might be able to determine with certainty that a chemical change has occurred?

**B. DISCUSSION OF ERROR****VII. CONCLUSION**