

## Chemical Families and Compounds

The Periodic Table groups elements by common properties. Can you use the Periodic Table to predict how elements will react? Can you use the properties of elements to predict the properties of the compounds they form? Do elements in the same family form similar compounds?

### Question

Write a question for this Investigation.

### Prediction

Read the Procedure, and then write a prediction about the behaviour of the elements and compounds.

### Experimental Design

In this Investigation, you will compare the elements in Groups 1 and 2 directly by examining their physical appearance and reaction with water. Then you will compare the elements in Groups 1 and 2 and Groups 16 and 17 by examining the solubility of the compounds formed by these elements.

### Materials

- microtrays or watchglasses
- toothpicks
- safety goggles
- apron
- water
- small samples of: calcium carbonate, magnesium carbonate, sodium carbonate, potassium carbonate, copper(II) chloride, copper(II) bromide, copper(II) oxide, copper(II) sulfide



Always assume that all chemicals are toxic. If any of these chemicals are spilled on skin, in eyes, or on clothing, wash the area immediately with plenty of cold water and inform your teacher.

### INQUIRY SKILLS

- |                 |              |                 |
|-----------------|--------------|-----------------|
| ● Questioning   | ● Conducting | ● Evaluating    |
| ○ Hypothesizing | ● Recording  | ● Synthesizing  |
| ● Predicting    | ● Analyzing  | ● Communicating |
| ○ Planning      |              |                 |

### Procedure

#### Part 1: Comparing Elements in Groups 1 and 2 (Teacher Demonstration)

1. Read through the Procedure and make a table to record your observations.
2. Your teacher will demonstrate the reactions of calcium and lithium with water. Note the colour of the indicator and determine whether the contents of the beaker are cloudy or clear after each reaction. Record your observations.
3. Sodium is in the same chemical group as lithium. Write a prediction for how sodium should appear and how it should behave in water.
4. Your teacher will next demonstrate the reaction of sodium with water. Record your observations.

#### Part 2: Comparing Group 1 and Group 2 Compounds (Student Activity)

5. Obtain a microtray and 10 toothpicks. Put on your safety goggles and apron.
6. Fill a cell of the microtray halfway with water. Obtain a small amount of calcium carbonate, just enough to fit on the flat end of the toothpick (Figure 1). Record your observations of the physical appearance of the compound.



Figure 1 Step 6

- Place the compound into the water in the cell, and stir gently with the toothpick (Figure 2). Does the compound dissolve in water? Record your observations of the compound's solubility (high or low).



**Figure 2** Step 7

- Repeat steps 6 and 7 with a small amount of sodium carbonate.
- Potassium is an alkali metal (as is sodium), and magnesium is an alkaline earth metal (as is calcium). Write a prediction for the appearance and solubility of potassium carbonate and magnesium carbonate.
- Test your prediction by repeating steps 6 and 7 with small amounts of potassium carbonate and magnesium carbonate.

### Part 3: Comparing Group 16 and 17 Compounds (Student Activity)

- Repeat steps 6 and 7 with small samples of copper(II) chloride and copper(II) oxide.
- Bromine is a halogen (as is chlorine) and sulfur is a Group 16 element (as is oxygen). Write a prediction for the appearance and solubility of copper(II) bromide and copper(II) sulfide.
- Test your prediction by repeating steps 6 and 7 with small samples of copper(II) bromide and copper(II) sulfide.

### Analysis

- In Part 1, did the two elements from of Group 1, sodium and lithium, appear and behave similarly? Was one reaction with water more vigorous than the other?
- How was the element from Group 2, calcium, similar to and different from the Group 1 elements? What is your evidence?
- In Part 2, which Group 1 and Group 2 carbonates had a similar appearance and a similar solubility?
- Are your observations consistent with the positions of the elements in the Periodic Table? Explain.
- In Part 3, which Group 16 and Group 17 copper compounds had a similar appearance and a similar solubility?
- Are your observations consistent with the positions of the elements in the Periodic Table? Explain.

### Evaluation

- Evaluate the three predictions that you made. Were they supported by your observations? Why or why not?
- Briefly describe how the Periodic Table can be used to predict the behaviour of elements and their compounds.

### Synthesis

- Predict what you would expect if potassium metal were added to water.
- Predict the solubility of copper(II) iodide and barium carbonate in water.
- Zinc oxide is a white solid and zinc sulfide is a black solid. Both are insoluble. Do these properties agree with your observations? Explain.