Comparing Family Behaviour

SKILLS MENU

- Questioning
- Hypothesizing
- Predicting
- Planning
- Controlling Variables
- Performing
- Observing
- Analyzing
- Evaluating
- Communicating

When Mendeleev designed his periodic table, he arranged the elements according to their similarities in physical and chemical properties. He placed lithium (Li), sodium (Na), and potassium (K) in the first column—the alkali metal family. He placed magnesium (Mg) and calcium (Ca) in the second column—the alkaline earth metal family. It is now your turn to determine why Mendeleev grouped these elements together. What common behaviour do they exhibit? Why are they placed in that particular sequence?

Testable Question

What patterns of chemical reactivity do elements of the alkali metals and alkaline earth metals exhibit?

Hypothesis/Prediction

Write a hypothesis for the Testable Question. Your hypothesis should include a prediction as well as a reason for the prediction.

Experimental Design

You will compare the appearance and reactivity of three alkali metals and two alkaline earth metals in water. You will then use your experimental evidence to explain why these metals are grouped together on the periodic table.

Equipment and Materials

- eye protection
- lab apron
- 3 small beakers
- plastic Petri dish cover
- scoopula
- magnesium metal (turnings)
- calcium metal (turnings)
- lithium metal
- sodium metal
- potassium metal
- cold water
- hot water

Lithium, sodium, and potassium are highly corrosive and flammable. Do not handle these substances. Your teacher will demonstrate their properties to you.

Procedure

SKILLS HANDBOOK 3.B.6.

1. Prepare a table in your notebook similar to Table 1.

Table 1 Observations

Metal	Appearance of metal	Reactant	Observations of reaction
Mg		cold water	
Mg		hot water	
Ca		cold water	
Li		cold water	
Na		cold water	
K		cold water	

Part A: Alkaline Earth Metals

2. Put on your lab apron and eye protection.
3. Use a scoopula to place a small amount of magnesium into each of two beakers. Fill only the tip of a scoopula with your metal sample before adding it to the beaker (Figure 1).

Figure 1 Only a small amount of each metal is required.

4. Record the appearance of the magnesium.
5. Add about 10 mL of cold water to the first beaker and 10 mL of hot water to the second beaker. Allow the mixtures to sit for a minute and record your observations.
6. Add about 30 mL of cold water to a third beaker.
7. Add a small amount of calcium to the beaker.

The mixture that is produced in step 7 is an irritant. Avoid skin contact. Dispose of this mixture as directed by your teacher.

Part B: Alkali Metals

(TO BE DEMONSTRATED BY THE TEACHER USING AN OVERHEAD PROJECTOR)

8. Your teacher will obtain a clean beaker, fill it halfway with cold water, and place a plastic Petri dish cover beside the beaker.
9. Your teacher will obtain a tiny piece of lithium (enough to fit on the flat end of a toothpick).
10. Record the appearance of the lithium.
11. Your teacher will carefully drop the lithium into the beaker of water and cover the beaker with the plastic Petri dish cover. Record your observations.
12. Your teacher will repeat steps 8–11 using a tiny piece of sodium and then a tiny piece of potassium instead of lithium.

Analyze and Evaluate

SKILLS HANDBOOK 3.B.7., 3.B.8.

(a) Compare the appearance of the three alkali metals that you observed. In what ways are they similar? In what ways are they different? T/I

(b) Compare the appearance of the two alkaline earth metals that you observed. In what ways are they similar? In what ways are they different? T/I

(c) Compare the behaviour of the two alkaline earth metals in water. Which metal was more reactive? Support your answer with your experimental evidence. T/I

(d) Compare the behaviour of the three alkali metals in water. List the metals in order of increasing reactivity. Support your answer with your experimental evidence. T/I

(e) Did these observations agree with your hypothesis? Explain. T/I C

(f) Which conditions must be kept the same in each test in order to accurately compare the reactivity of different elements? T/I

(g) Compare the reactivity of Na and Mg, elements in the same row of the periodic table. Which element is more reactive? Support your answer with your experimental evidence. T/I

(h) Compare the reactivity of K and Ca, elements in the same row of the periodic table. Which element is more reactive? Support your answer with your experimental evidence. T/I

(i) What unavoidable sources of error, if any, did you encounter in this activity? Explain your answer and suggest improvements that can be made to the procedure. T/I C

Apply and Extend

(j) Use all your observations in this activity to summarize patterns that are evident within each family, and across each row, of the periodic table. T/I

(k) Use the observed patterns to predict the physical properties and the relative reactivity of Rb, Cs, and Fr. T/I

(l) Use the observed patterns to predict the physical properties and the relative reactivity of Sr and Ba. T/I

(m) Use the observed patterns to predict the relative reactivity of Cs and Ba. T/I

(n) Alkali metals are not often found in pure form in nature. Why not? Explain using your experimental evidence. T/I