BLOCKLY EXTENSION: TYPES OF BONDING

How can you use Blockly coding to determine whether a solid compound is ionic or covalent?

Objectives

- Create code that classifies compounds as ionic or covalent based on their conductivity in an aqueous solution or dispersion.
- Incorporate existing code to determine the ionic nature of a variety of unknown solids in an aqueous solution or dispersion.

Materials and Equipment

- Data collection system
- Conductivity sensor
- Small cup or beaker, 50-mL (1 per compound)
- Scoopula (1 per compound)
- Stirring rod
- Graduated cylinder, 25-mL
- Sucrose (table sugar)
- Sodium bicarbonate (baking soda)
- Sodium chloride (table salt)
- Potassium bitartrate (cream of tartar)
- Unknown solid compounds
- Wash bottle with distilled water
- Waste container

Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- Wear safety goggles at all times.
- Dispose of all solutions according to your instructor's directions.

Procedure

Part 1 — Create Conductivity Code

1. Select **Sensor Data** in SPARKvue.
2. Connect the conductivity sensor. Select only the conductivity measurement and choose the **Digits** display.
3. Start collecting data. Record the conductivity of the solvent (distilled water) in Table 1.
4. Place a pea-sized sample (~ ¼ teaspoon) of each known compound in individual beakers or cups. Add 25 mL of distilled water to each. Stir each sample for 30-45 seconds to mix. Remember to rinse the stirring rod between samples.
5. Solubility refers to the ability of one substance to dissolve in another; in this case, the ability of the solid to dissolve in the water. Record your observations of solubility in Table 1.
6. Measure the conductivity of each solution and record results in Table 1. Rinse the conductivity probe thoroughly between measurements. Stop collecting data when you have measured all solutions.

   NOTE: *The conductivity sensor has a maximum reading of ~21,000 µS/cm. Any readings above this value could be well above 21,000 µS/cm.*

7. Look for trends in the data to help you classify each compound as either ionic or covalent. Record your answers in Table 1.
8. Add a new page with two displays.

9. Set both displays to **Digits** 1.23. On the left side, choose the **Select Measurement** button to set the display to **Conductivity (µS/cm)**. You will set the right side once you are ready to test code.
10. Select the **Code** icon .
11. Based on the conductivity data from Table 1, use the blocks on the left to create code that identifies a solution as either ionic or covalent when its conductivity is measured. When you are ready to test your code, click the **Code** icon again to return to the digits displays.
12. Choose the **Select Measurement** button on the right-side Digits display and the select the **User Entered** tab. Set the measurement to the text output you created in your code.
13. Start collecting data to test your code. Revise your code as needed to accomplish the coding goal before moving on to Part 2.
14. Stop collecting data and save your work in SPARKvue. Attach a copy of the code created for this investigation.

Part 2 — Bonding in Unknown Solutions

1. Your instructor will provide you with several unknown solids to test. Each unknown is identified with a letter. Apply the same method used in Part 1 to produce solutions for each solid. Record solubility observations in Table 2.
2. Use your code to classify each unknown solid as ionic or covalent. Record the results in Table 2. Test as many substances as indicated by your instructor.
3. Fill out all the remainder of Table 2 except for the last column.
4. Once all groups have completed data collection, your instructor will share the identity of each substance. Complete Table 2 with this information.

Data Collection

Table 1. Conductivity of known ionic and covalent compounds

Name of Substance	Solubility Observations	Conductivity (µS/cm)	Classification
Solvent: Distilled water	N/A		
Sucrose (table sugar)			
Sodium bicarbonate (baking soda)			
Sodium chloride (table salt)			
Potassium bitartrate (cream of tartar)			

Table 2. Properties of Unknown Solutions

Name of substance	Solubility observations	Conductivity (µS/cm)	Classification	Compound identity
A				
B				
C				
D				
E				
F				
G				

Questions and Analysis

1. Is the ability of each solute to dissolve in water a reliable predictor of bond type? Support your answer with observations from this investigation.

2. Compare the original classification of each substance made based on conductivity value. Circle any substances that show a discrepancy in classification based on the substance identity. Which substances showed discrepancies? What could have caused the discrepancy? If you saw no discrepancies, in what circumstance would you expect to see a discrepancy?

3. Calcium carbonate is an ionic compound. When a sample of calcium carbonate is added to 20 mL water and conductivity measured, it is determined to be only 13.3 µS/cm. Explain this observation.

4. Strong acids and bases ionize in solution. Would you expect them to have high conductivities? Why or why not? Why do you think strong acids and bases are not part of this investigation?