

Playing the Ionic Compounds Card Game

Background Information

Ionic compounds are composed of charged particles called **ions**. Positively charged ions are called **cations**, and negatively charged ions are called **anions**. Although ionic compounds are composed of ions, they are electrically neutral. The sum of the positive charges of the cations and the negative charges of the anions is zero. The formula of an ionic compound can be determined from the ratio of cations and anions needed to produce a total charge equal to zero. The symbol for the cation always appears first in the formula.

The names of ionic compounds are based on the names of their ions. For most cations, the name of the cation is the same name as the element name. However, many transition metals form more than one ion. For these ions, a Roman numeral is used to show the charge. For example, Fe^{2+} is iron(II) and Fe^{3+} is iron(III). Anions are named by combining part of the name of the element and the ending *-ide*. For example, the name for O^{2-} is oxide. A covalently bonded group of atoms that has a positive or negative charge is called a **polyatomic ion**. These ions have names that reflect their composition.

In this investigation, you will practice naming ionic compounds and writing their formulas by playing a card game.

Problem

How are the names and formulas of ionic compounds determined?

Pre-Lab Discussion

Read the entire investigation. Then, work with a partner to answer the following questions.

1. **Inferring** What is the object of the game?

2. **Classifying** How many cation symbol cards, cation name cards, anion symbol cards, and anion name cards are required for this card game?

3. **Inferring** How many cards of each type does each player receive at the beginning of a round?

4. **Inferring** What happens after a player makes a correct match?

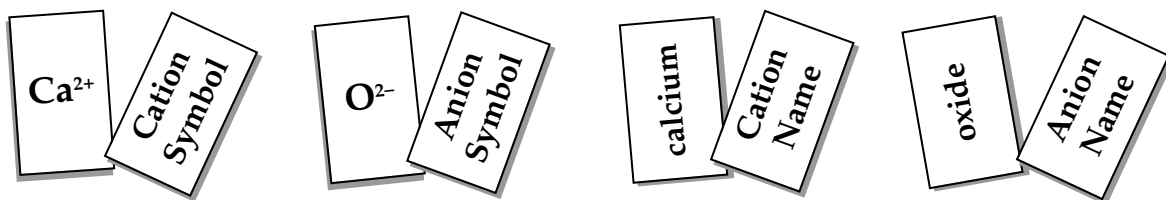
5. **Making Judgments** When does the game end?

Materials *(per group)*

100 unlined index cards

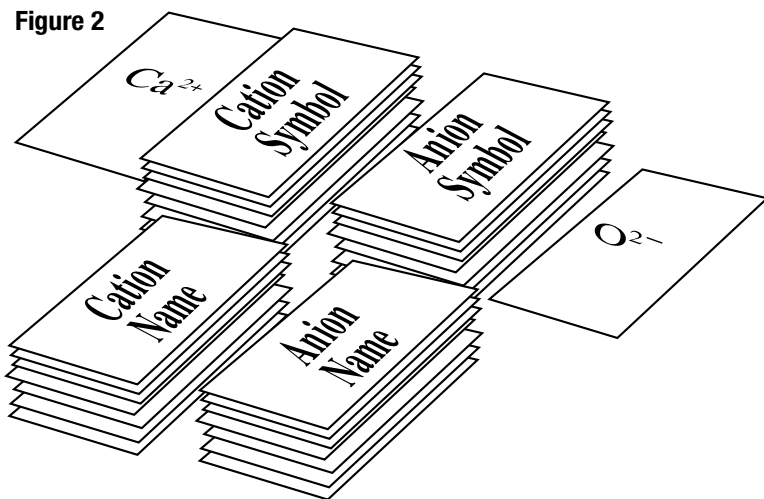
Procedure

1. Work in groups of four. Use the index cards to prepare four decks of playing cards. Examples of cards are shown in Figure 1.
 - a. **Cation symbol cards.** Prepare four cation symbol cards for each of the following cations. Write the symbol for each cation on the front of an index card. On the back of each card, write "Cation Symbol."
 Na^+ K^+ Mg^{2+} Ca^{2+} Al^{3+} Fe^{2+} Fe^{3+} Cu^+ Cu^{2+} Zn^{2+}
 - b. **Cation name cards.** Prepare one cation name card for each of the following cations. Write the name of each cation on the front of an index card. On the back of each card, write "Cation Name."
sodium potassium magnesium calcium aluminum
iron(II) iron(III) copper(I) copper(II) zinc
 - c. **Anion symbol cards.** Prepare four anion symbol cards for each of the following anions. Write the symbol for each anion on the front of an index card. On the back of each card, write "Anion Symbol."
 F^- Cl^- O^{2-} S^{2-} PO_4^{3-} CO_3^{2-} NO_3^- N^{3-} Br^- OH^-
 - d. **Anion name cards.** Prepare one anion name card for each of the following anions. Write the name for each anion on the front of an index card. On the back of each card, write "Anion Name."
fluoride chloride oxide sulfide phosphate
carbonate nitrate nitride bromide hydroxide

**Figure 1**

2. After you finish preparing the cards, shuffle each deck of cards separately and place the decks facedown on the table.
3. To determine who goes first, have each player draw a cation symbol card. The player who draws the ion with the highest charge goes first. If players draw the same charge, they should draw another card. Replace the cards and shuffle the cation symbol deck. Play continues clockwise.

4. To start the game, each player draws three cation symbol cards, three anion symbol cards, one cation name card, and one anion name card. Then, turn over one card from each deck of symbol cards to start a discard pile, as shown in Figure 2.

Figure 2

5. The object of the game is to gather the correct number and type of symbol cards to match the formula of the compound represented by the selected cation and anion name cards. As soon as you think you have a match, declare it and show your cards. If you are correct, you will receive one point for each ion in the compound. For example, you would receive three points for the ions in MgCl_2 .
6. When you show your cards, any other player can challenge your match by providing the correct formula. If your formula is incorrect (the charges do not add up to zero) or if your formula does not match your name cards, the challenger gets the points.
7. During a player's turn, the player may do one of the following:
 - a. Draw a card from either the cation symbol deck or discard pile, or from the anion symbol deck or discard pile, and discard a cation or anion symbol card to the appropriate discard pile; or
 - b. Draw a new cation name card, anion name card, or both, and place the old name cards at the bottom of the appropriate decks.

If you can make a match after drawing a card, you must declare it before discarding any cards. Once cards are discarded, the turn is over, and play continues.

8. If there is no challenge after you declare a match, record the formula, the name, and the number of points in the data table. If there is a challenge, the group must determine who is correct and who gets the points. If you challenge another player and receive the points, record "Challenge" in the data table instead of the name of the compound.
9. After you declare a match and the group determines who gets the points, draw new ion symbol cards and ion name cards to replace the ones you showed to make a match. Put the used ion symbol cards in the appropriate discard pile. Set the used name cards aside and out of play. At that point, your turn is over, and play continues.
10. If either the cation symbol cards or the anion symbol cards are all used, mix the appropriate discard pile, turn it over, and continue play. When either the cation name cards or the anion name cards are all used, the game is over. The winner is the player with the most points.

Observations

DATA TABLE

Match	Compound Name	Compound Formula	Points
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
		Total	

Analysis and Conclusions

1. **Calculating** Describe how to determine the correct ratio of ions in a compound.

2. **Inferring** Explain why it is not possible to write a formula for a compound of sodium and calcium.

3. **Applying Concepts** Each of the chemical names below contains an error. Describe the nature of the error in each name.

a. Potassium sulfur

b. Oxide potassium

c. Copper oxide

4. **Relating Cause and Effect** How many anions are required to balance one aluminum ion? Explain your answer.

5. **Drawing Conclusions** How are the name and formula of an ionic compound determined?

Go Further

In this investigation, you used the charges on ions to determine the formulas of compounds. How could you change this game so you could play it with covalent compounds? Design a card game that you could use to practice writing formulas and naming covalent compounds containing two elements.