Name _____ Class _____ Date _____

Core Skill Lab

Reactivity of Halide Ions

The four halide salts used in this experiment are found in your body. Although sodium fluoride is poisonous, trace amounts seem to be beneficial to humans in the prevention of tooth decay. Sodium chloride is added to most of our food to increase flavor while masking sourness and bitterness. Sodium chloride is essential for many life processes, but excessive intake appears to be linked to high blood pressure. Sodium bromide is distributed throughout body tissues, and in the past it has been used as a sedative. Sodium iodide is necessary for the proper operation of the thyroid gland, which controls cell growth. The concentration of sodium iodide is almost 20 times greater in the thyroid than in blood. The need for this halide salt is the reason that about 10 ppm of NaI is added to packages of table salt labeled "iodized."

The principal oxidation number of the halogens is −1. However, all halogens except fluorine may have other oxidation numbers. The specific tests you will develop in this experiment involve the production of recognizable precipitates and complex ions. You will use your observations to determine the halide ion present in an unknown solution.

MATERIALS

- 24-well microplate
- $AgNO_3$, 0.1 M
- $Ca(NO_3)_2$, 0.5 M
- gloves
- KBr, 0.2 M
- KI, 0.2 M
- lab apron
- $Na_2S_2O_3$, 0.2 M
- NaCl, 0.1 M
- NaF, 0.1 M
- NaOCl (commercial bleach), 5%
- $NH_3(aq)$, 4 M
- safety goggles
- starch solution, 3%
- thin-stemmed pipettes (12)

 **Always wear safety goggles and a lab apron to protect your eyes and clothing.** If you get a chemical in your eyes, immediately flush the chemical out at the eyewash station while calling to your teacher. Know the location of the emergency lab shower and eyewash station and the procedures for using them.

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 **Do not touch any chemicals.** If you get a chemical on your skin or clothing, wash the chemical off at the sink while calling to your teacher. Make sure you carefully read the labels and follow the precautions on all containers of chemicals that you use. If there are no precautions stated on the label, ask your teacher what precautions to follow. Do not taste any chemicals or items used in the laboratory. Never return leftovers to their original container; take only small amounts to avoid wasting supplies.

 **Call your teacher in the event of a spill.** Spills should be cleaned up promptly, according to your teacher's directions.

Acids and bases are corrosive. If an acid or base spills onto your skin or clothing, wash the area immediately with running water. Call your teacher in the event of an acid spill. Acid or base spills should be cleaned up promptly.

Never put broken glass in a regular waste container. Broken glass should be disposed of separately according to your teacher's instructions.

Never stir with a thermometer because the glass around the bulb is fragile and might break.

OBJECTIVES

Observe the reactions of the halide ions with different reagents.

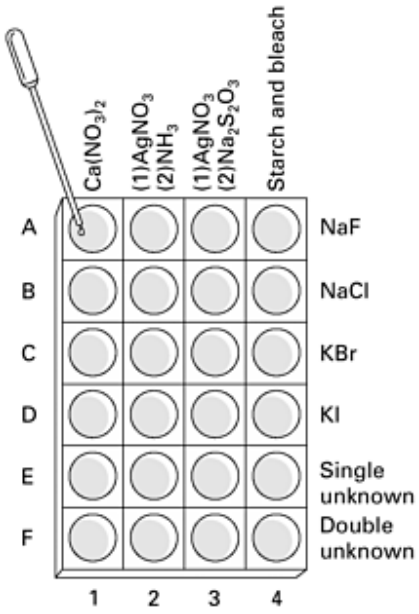
Analyze data to determine characteristic reactions of each halide ion.

Infer the identity of unknown solutions.

Procedure

1. Put on safety goggles, gloves, and a lab apron.
2. Put 5 drops of 0.1 M NaF into each of four wells in row A, as shown in **Figure 1.** Put 5 drops of 0.1 M NaCl into each of the wells in row B. Put 5 drops of 0.2 M KBr into each of the wells in row C and 5 drops of 0.2 M KI into each of the wells in Row D. Reserve rows E and F for unknown solutions.

Figure 1



3. Add 5 drops of 0.5 M $Ca(NO_3)_2$ solution to each of the four halide solutions in column 1. Record your observations in the **Table 1.**
4. Add 2 drops of 0.1 M $AgNO_3$ solution to each of the halides in columns 2 and 3. Record in **Table 1** the colors of the precipitates formed.
5. Add 5 drops of 4 M $NH_3(aq)$ to the precipitates in column 2. Record your observations in the **Table 1.**
6. Add 5 drops of 0.2 M $Na_2S_2O_3$ solution to the precipitates in column 3. Record your observations in **Table 1.**
7. To the halides in column 4, add 5 drops of starch solution and 1 drop of 5% bleach solution. Record your observations. Save the results of testing the known halide solutions for comparison with the tests of the unknown solutions.
8. Obtain an unknown solution. Put 5 drops of the unknown in each of the four wells in row E. Add the reagents to each well as you did in steps 3–6. Compare the results with those of the known halides in rows A–D. Record your findings in **Table 1,** and identify the unknown.
9. Obtain an unknown solution containing a mixture of two halide ions. Place 5 drops of the unknown mixture in each of the four wells in row F. Add the reagents to each well as you did in steps 3–6. Record your results. Compare the results with those of the known halides in rows A–D. Identify the halides in the double unknown solution.
10. Rinse the microplate into a trough or dishpan provided by your teacher. Clean all apparatus and your lab station. Return equipment to its proper place. Dispose of chemicals and solutions in the containers designated by your teacher. Do not pour any chemicals down the drain or in the trash unless your teacher directs you to do so. Wash your hands thoroughly before you leave the lab and after all work is finished.

TABLE 1: RESULTS OF THE REACTIONS OF HALIDE SALTS

Halide Salts	$Ca(NO_3)_2$	$AgNO_3$	$AgNO_3 + NH_3$	$AgNO_3 + Na_2S_2O_3$	NaOCl + starch
NaF					
NaCl					
KBr					
KI					
Single unknown					
Double unknown					

Analysis

1. **Analyzing Data** Which procedure(s) confirm(s) the presence of (a) F^- ions, (b) Cl^- ions, (c) Br^- ions, (d) I^- ions?

Conclusions

1. **Drawing Conclusions** What generalizations can be made about silver halides?

2. **Applying Conclusions** In nuclear explosions or accidents, iodine-131, a radioactive fission product, can become dispersed in the atmosphere. Eventually, the iodine isotope will fall onto the ground and be absorbed by plants. Explain how radiation from iodine-131 could become concentrated in the human body and cause a growth disorder.

3. **Defending Conclusions** Identify your unknown(s) and use your experimental evidence to support your identifications.