



Identification of Unknown Substances I

Forensics Investigation Kit

Introduction

Is the white powder on the floor aspirin, flour, cocaine, or sugar? How do authorities distinguish between substances that might look alike? To the criminalist the answers may be critical to solving a case or getting a conviction.

Concepts

- Standards/controls
- Chemical reactions
- Precipitation
- Solubility

Background

Substance identification is very important in many real-life situations. An unconscious victim has ingested some drug—it is critical to identify the substance as quickly as possible. A child has swallowed some pills from a medicine cabinet—identification could be a matter of life or death. Someone is seen selling bags of white powder—it must be identified for a criminal conviction to occur. A person has died from someone tampering with drug bottles at a local pharmacy—what was added to the antacid tablets?

The basis for identification of unknown substances always hinges upon using known standards for comparison. Without knowing exactly how a known substance reacts to all tests, it would be impossible to make a positive identification of an unknown substance. As new drugs and substances are created, standards for testing for these substances must also be developed. The FBI Crime Laboratory, for example, works very closely with pharmaceutical companies to produce tests for all new drugs as they are developed. The "standards," which are kept on file, are critical for proper identification of "unknowns."

In the first part of this laboratory, a set of standards will be established for the simulated drugs Scogaine, Davlate, Bradlin, Irenin, and Markopan. Once the standards have been established, tests will be run to identify an unknown. Though this simulation is clearly an oversimplification and cannot actually be used to test unknowns, the principles are the same as those utilized by a crime laboratory. In the criminal laboratory, the simple chemical reactions would be replaced by complex chemical analyses utilizing very expensive and sophisticated equipment.

Materials

Hand lens	Plastic graduated test tubes with screw tops, 5
Scogaine, teaspoonful	Water, distilled, 60-mL
Davlate, teaspoonful	Sodium carbonate solution, Na_2CO_3 , 1.0 M, 18 mL
Bradlin, teaspoonful	Iodine solution, 30 drops
Irenin, teaspoonful	Silver nitrate solution, AgNO_3 , 0.3 M, 30 drops
Markopan, teaspoonful	Small cups, 5
Unknown drug, teaspoonful	Plastic spoon
Hydrochloric acid solution, HCl, 0.1 M, 30 drops	Paper towel
Aluminum foil, $1\frac{1}{2}'' \times 1\frac{1}{2}''$, 5	Tongs or forceps

Safety Precautions

Hydrochloric acid, silver nitrate, and iodine solutions are toxic by ingestion or inhalation and severely corrosive to skin and eyes. Sodium carbonate is also a skin irritant. Iodine and silver nitrate solutions will stain the skin and clothing. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wash hands thoroughly upon completion of laboratory work.

Procedure

1. Use a plastic spoon to obtain approximately one level teaspoonful of each drug in separate, labeled small cups. Clean the spoon after each sample is taken to avoid any cross contamination.
2. Using a separate graduated test tube for each drug, fill each tube to the 0.5-mL line with one of the drugs. Clean the spoon in between each drug to avoid any cross contamination. Label each tube carefully.
3. Examine each drug with a hand lens. Describe the appearance of each substance on the Unknown Substance Worksheet.
4. Make a small, flat cup from a piece of aluminum foil ($1\frac{1}{2}'' \times 1\frac{1}{2}''$). Label the cup and pour the contents of one of the test tubes into the aluminum cup. Repeat this procedure using a separate aluminum foil cup for each drug. Use tongs or forceps to place the cups on a hot plate at the setting indicated by your instructor. Observe the substances for 3–4 minutes after the hot plate is hot. Which ones melt? Remove the cups from the hot plate. Record the results on the Unknown Substances Worksheet. Write NR for no reaction.
5. Refill each test tube to the 0.5-mL mark again with a new supply of drug.
6. Use a Beral-type pipet to add 5 drops of 0.1 M hydrochloric acid (HCl) to each tube. As the acid is added, note any reaction that occurs and record the results for the HCl test on the Unknown Substances Worksheet for each drug.
7. Thoroughly wash and dry the test tubes.
8. Relabel the test tubes, if necessary, and add fresh samples of each substance to the 0.5-mL line in the appropriate test tubes.
9. Using a clean Beral-type pipet, add about 5 mL of distilled water to each test tube. Place a screw cap on each tube and shake each tube for about a minute. Note which substances dissolve in water and which do not. Record the results for the solubility test on the Unknown Substances Worksheet. Save the test tubes and solutions for the next step.
10. Use a clean Beral-type pipet to add 2–3 mL of 1.0 M sodium carbonate solution to each test tube from step 9. Observe each carefully as the test solution is added and note any reactions on the Unknown Substances Worksheet.
11. Thoroughly wash and dry the test tubes.
12. Relabel the test tubes, if necessary, and add a fresh 0.5-mL sample of each substance to the test tubes.
13. Use a clean Beral-type pipet to add 5 drops of iodine solution to each sample. Iodine solution is an orange/brown color and will stain skin and clothing. Record any color changes when iodine reacts with each of the five samples on the Unknown Substances Worksheet.
14. Thoroughly wash and dry the test tubes.
15. Relabel the test tubes, if necessary, and add a fresh 0.5-mL sample of each substance to the test tubes.
16. Use a clean Beral-type pipet to add 5 mL of distilled water to each test tube. Place a screw cap on each test tube and invert the tube several times. Allow each tube to sit for 30 seconds. Use a clean Beral-type pipet to add 5 drops of silver nitrate solution to each test tube. *Warning:* Silver nitrate will stain skin and clothing. If a precipitate forms as a result of the addition of silver nitrate, record this result on the Unknown Substances Worksheet.
17. Thoroughly wash and dry all of the test tubes.
18. Secure a sample of an unknown substance from your instructor. Run all of the tests from steps 3–16 on the unknown substance. Record the results from all of the tests on the Unknown Substances Worksheet in the column for the unknown.
19. Compare the test results for the unknown substance against the “Standards” for each known drug and then determine which drug the unknown most closely resembles.

Disposal

Consult your instructor for appropriate disposal procedures.

Name: _____

Unknown Substances Worksheet

	Scogaine	Davlate	Bradlin	Irenin	Markopan	Unknown
General Appearance						
HCl Test						
Heat Test						
Solubility in Water						
Sodium Carbonate Test						
Iodine Test						
Silver Nitrate Test						

Unknown most closely resembles: _____

Teacher's Notes

Identification of Unknown Substances

Materials Included in Kit

Scogaine, 100 g	Plastic spoons, 15
Davlate, 100 g	Hydrochloric acid solution, HCl, 0.1 M, 25 mL
Bradlin, 100 g	Plastic test tubes with screw tops, 75
Irenin, 100 g	Sodium carbonate solution, Na ₂ CO ₃ , 1.0 M, 250 mL
Markopan, 100 g	Iodine solution, 0.05 M, 25 mL
Unknown, 100g	Silver nitrate solution, AgNO ₃ , 0.3 M, 25 mL
Cups, 75	

Additional Materials Needed (for each lab group)

Hand lens	Water, distilled, 30–40 mL
Aluminum foil, 1½" × 7½"	Paper towels

Pre-Lab Preparation

The simulated drug samples may be dispensed into the plastic cups and labeled prior to class in order to save class time and to avoid congestion at a central dispensing area. Follow usual chemical dispensing procedures that work well with your students and your unique classroom setup.

Safety Precautions

Hydrochloric acid solution, silver nitrate solution, and iodine solution are toxic by ingestion or inhalation and severely corrosive to skin and eyes. Sodium carbonate is also a skin irritant. Iodine and silver nitrate solutions will stain the skin and clothing. Please consult current Material Safety Data Sheets for additional safety information. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Remind students to wash hands thoroughly upon completion of laboratory work.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Hydrochloric acid may be disposed of according to Flinn Suggested Disposal Method #24b, sodium carbonate #26a, iodine solution #12a, and silver nitrate #11.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12

- Evidence, models, and explanation
- Constancy, change, and measurement

Content Standards: Grades 5–8

- Content Standard B: Physical Science, properties and changes of properties in matter
- Content Standard E: Science and Technology

Content Standards: Grades 9–12

- Content Standard B: Physical Science, structure and properties of matter, chemical reactions
- Content Standard E: Science and Technology

