



WHAT COULD IT BE?

QUICK PEEK

In this lesson, students learn more about forensic scientists as they analyze powders to determine the identity of an “unknown”.

SUGGESTED GRADE LEVELS: 9–12

ILLINOIS STATE LEARNING GOALS

SCIENCE

11.A, 13.A

MATH

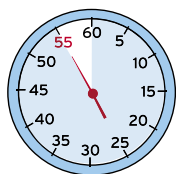
6.A, 7.A, 10.A, 10.B

LANGUAGE ARTS

1.C, 3.A, 4.A

OBJECTIVES

- ★ Students will perform a series of tests to compare and contrast the physical and chemical characteristics of several unknown powders.
- ★ Students will analyze the data that they collect to identify an unknown substance.



PACE YOURSELF:
55 MINUTES



PREPARE YOURSELF

1. Prepare small zip-lock bags with about $\frac{1}{4}$ cup of each of the six substances. Label the bags with the proper letters. Prepare enough bags so each lab group will have six different bags.
 - A: Baking soda
 - B: Calcium chloride
 - C: Corn starch
 - D: Plaster of Paris
 - E: Table sugar
 - F: Table salt
2. Prepare 1M sodium carbonate by adding 53 grams of sodium carbonate powder to 500ml of distilled water. When sodium carbonate combines with calcium chloride solution, a precipitate of calcium carbonate will form.
3. For Part 2, select a different substance for each lab group and place it in a small plastic bag. Write a number on each bag that represents the locker number in which the substance was found. Keep records of what numbers match which substances.
4. (*optional*) Make a chart on the board of each drug and their affect.
5. Make copies of the data table for each student.

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MATERIALS

Per Group:

- Samples of the six white powders (A, B, C, D, E, F) in individual resealable plastic bags:
 - A:** Escape **B:** Peppy **C:** Vavoom **D:** Droop **E:** Bang **F:** Table salt
- Teaspoon
- Safety glasses
- Gloves
- Hand lens
- Black construction paper
- Aluminum foil
- Hot plates
- Labels
- Lugol's solution
- Medicine dropper
- Diluted acetic acid
- Distilled water
- 1M sodium carbonate solution
- 7 test tubes and stoppers
- Stirring rod
- Unknown sample in zip-lock bag

Per Student:

- Copy of the *Powder Analysis Chart*

Lugol's iodine (Lugol's solution) is a solution of elemental iodine and potassium iodide in water. It is often used as an antiseptic and disinfectant, for emergency disinfection of drinking water, and as a reagent for starch detection in laboratory and medical tests.

WHAT COULD IT BE?



WHAT YOU NEED TO KNOW...

Remind students that the powders they are testing are actually safe materials that, in this experiment, represent illegal drugs.

The collection of evidence at a crime scene is very important to any criminal investigation. Once this evidence has been collected and packaged properly, it is transported to the crime lab.

Crime labs frequently receive unknown substances taken from a crime scene. Experts in the crime lab have the task of determining the physical and chemical identity of these substances. Some times these mysterious substances are illegal drugs. The findings of the crime lab are important in determining the guilt or innocence of a suspect.

When trying to determine the identity of an unknown substance, crime lab experts must use testing procedures that give characteristic, distinguishable results. These tests and their results must be established prior to the examination of the unknown substance. For example, if you want to determine if an unknown white powder is cocaine, you must have a previously established, positive test for cocaine. Then you can conduct this established test on an unknown white powder.

It is also important to perform more than one positive test on an unknown. Proper identification requires that you use enough different tests to rule out the possibility that the unknown may be any other substance.

The forensic scientist in the crime lab must carefully perform each test on the unknown so that the identification is correct beyond a reasonable doubt.



WARM UP!

Here is the story (this is a STORY and is not based on any known facts)

Hillsboro High School has a drug problem. Over the past year, illegal drugs have been seized from student lockers on five occasions. All of these illegal drugs are white powders that look remarkably like table salt. During a recent locker search, investigators collected several zip-lock bags filled with a white powder. Before charges can be pressed, the identity of the powders must be established.

You are a member of a forensic science lab team that has been sent to Hillsboro High School. A temporary lab facility has been set up at the high school. The unknown white powders are delivered to you in the lab so you can determine their identity.

Due to limitations in equipment at the school, you have been asked to use a simple series of tests to determine the identity of the powders. To enable you to do this, six KNOWN white powders have been provided. You will run tests on

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It is a good idea to model the different procedures that will be used in this lab.

each of the six known powders and record your results. Later you will compare results with those from tests of unknown powders collected during locker seizures. Your findings will determine the charges (if any) brought against the students in possession of drugs.

A brief overview of the white powders previously discovered at Hillsboro High School includes the following:

ESCAPE: a mild hallucinogen.

PEPPY: a mild stimulant; often results in psychological dependence.

VAVOOM: a strong stimulant; causes physical dependence.

DROOP: a moderate depressant; causes physical dependence.

BANG: a strong narcotic that causes physical and psychological dependence.

TABLE SALT: found in a student's locker as a joke.



THE HOW TO

PART 1: DEVELOPING A POSITIVE TEST FOR THE SIX UNKNOWN POWDERS

All students and teachers need to wear safety goggles and gloves during this lab.

You will need samples of each of the known powders, A through F. It is important to take accurate notes and record your results for tests conducted on the six known powders in Data Table 1. If nothing happens in a specific test on a known substance, record ND (no data) in the proper location on the data table. At the end of Part A, you should have written in each box on the chart.

1. Place a small amount of sample A on the black paper and observe its appearance with a hand lens. Record your results. Repeat this for sample B through F. Dispose of the sample and the paper in the trashcan.
2. Place 1/2 teaspoon of sample A in a test tube. Add 10 drops of vinegar to the test tube. Record your observations. Repeat this test with the remaining five powders in a separate test tube. Wash out each test tube.
3. Label the six pieces of aluminum foil A, B, C, D, E, and F. Place 1/2 teaspoon of each of the six samples on the appropriate piece of foil. Place the six squares on a hot plate set at a medium setting. Observe each for 3-5 minutes. Record your results. Dispose of the foil and its contents.
4. Place 1/2 teaspoon of sample A in a test tube. Add 10 ml of distilled water. Stopper the test tube and shake for a few seconds. Record your observations. Repeat this for the remaining samples in separate test tubes. Do not dispose of the samples. You will use them in the next step.

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5. Using the six test tubes from step 4, add 5 ml of sodium carbonate solution to each test tube. Observe and record what occurs in each test tube. Wash out the test tubes.
6. Place 1/2 teaspoon of each sample in a clean test tube. Add 10 drops of Lugol's solution to each test tube. Record your results. Wash out the test tubes.

PART 2: IDENTIFICATION OF AN UNKNOWN SUBSTANCE

You now have the test results for each white powder in Data Table 1. These results will help you to determine the identity of an unknown substance by comparison. Several unknown substances were discovered in student lockers today. Different forensic teams have been asked to identify some of the unknowns. In Data Table 2, write down the number of the zip-lock bag whose contents you will analyze. This number indicates the locker from which the baggie was taken. Compare your results with those in Data Table 1 to determine what substance the student had in his or her locker. Be careful; your results will determine whether or not charges should be pressed against the student.

1. Write down the locker number on the bag in Data Table 2.
2. Perform all the tests you performed in Part 1 on this unknown substance. Record your findings in Data Table 2.
3. Compare the results in Data Table 2 with the results in Data Table 1.



WHAT'S GOING ON HERE?

Students are learning more about the intricate, meticulous work that goes into forensic science. Forensic scientists need to practice accuracy and have keen observation skills to be successful in analyzing evidence.



DID THEY GET IT?

POSTLAB QUESTIONS (*can be answered in a whole group discussion or individually*)

1. Describe one positive test from Data Table 1 for each of the six powders.
2. Was the powder you examined in Part 2 one of the illegal drugs or was it table salt? Explain how you arrived at this conclusion.
3. Explain why forensic scientists must be very accurate when examining substances in the laboratory.
4. Explain why Part 1 was a vital part of this experiment.



ET CETERA

After the lab you may wish to discuss precipitates, positive Lugol's test for starch, and the reaction of sodium bicarbonate and vinegar to produce carbon dioxide bubbles.

WHAT COULD IT BE?

DATA TABLE 1
Observations of Tests Performed on Known Substances

Name of Known Substance	Observation with Hand Lens	Hot Plate Results	Addition of Water	Addition of Sodium Carbonate	Addition of Acetic Acid	Addition of Lugol's Solution
A: Escape						
B: Peppy						
C: Vavoom						
D: Droop						
E: Bang						
F: Table Salt						

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DATA TABLE 2
Reaction of Powders to Chemical Tests

	Hand Lens Observation	Hot Plate Results	Addition of Water	Addition of Sodium Carbonate	Addition of Acetic Acid	Addition of Lugol's Solution
Unknown Sample						
# _____						

SCORE

DATA TABLE 1	
All results thoroughly recorded	30
Every space has writing but it is not thorough or completely accurate	20
Missing observation data (some blanks)	15
Data table is only partially complete (half finished)	10
Less than half of the data is present	5
DATA TABLE 2	
Data table is complete and observations are well written	15
Data table missing 1 or 2 observations, observations lack detail	10
Data table missing 3 or 4 observations, observations lack detail	5
QUESTIONS	
Each questioned answered correctly, thoroughly and in a complete sentence	20
Each questioned answered correctly, lacks supporting details, may not be a complete sentence	15
One question not answered, not complete sentences, incorrect response	10
Two questions not answered, or incorrect	5
TOTAL :	65 points