Lab: Is it a Hoax

FOR THE TEACHER

Summary
In this lab, students will identify an unknown substance as the dangerous chemical X or a common household product. Students will perform tests on the physical and chemical properties of different substances to determine the identity of the unknown.

Resource Type: Lab
Grade Level: Middle school

Objectives
By the end of this lesson, students should be able to
- Identify and differentiate between physical and chemical properties of matter.

Chemistry Topics
This lesson supports students’ understanding of
- Physical change
- Chemical change

Time
Teacher Preparation: 1 hour
Lesson: 50 minutes

Materials
For each group:
- Unknown sample (see identities in teacher notes)
- Cabbage juice for pH test
- Biuret reagent (1% strong base followed by CuSO₄ (aq))
- Vinegar
- Iodine

Safety
- Always wear safety goggles when working in a chemistry lab.
- Students should wash their hands thoroughly before leaving the lab.
- When students complete the lab, instruct them how to clean up their materials and dispose of any chemicals.

Teacher Notes
- This activity is engaging, quick, inexpensive, and requires students to use deductive reasoning to solve a problem. I use it after a similar lab that uses only physical properties to identify an unknown. It’s a nice parallel to draw because in this lab students identify substances using physical and chemical properties.
Students should understand that reactivity and flammability are independent of the size of sample.

Unknown identities:
- A: Baking Soda
- B: Corn starch (Chemical X)
- C: Salt
- D: Gelatin
- E: Baking powder

Test results:

<table>
<thead>
<tr>
<th>Test</th>
<th>Baking Soda</th>
<th>Corn starch</th>
<th>Salt</th>
<th>Gelatin</th>
<th>Baking Powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>White</td>
<td>White</td>
<td>White</td>
<td>Ivory</td>
<td>White</td>
</tr>
<tr>
<td>Crystal or</td>
<td>Powder</td>
<td>Powder</td>
<td>Crystal</td>
<td>Crystal</td>
<td>Powder</td>
</tr>
<tr>
<td>pH</td>
<td>Base</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Can be slightly acidic</td>
<td>Neutral</td>
</tr>
<tr>
<td>Biuret</td>
<td>Blue</td>
<td>Blue</td>
<td>Blue</td>
<td>Purple</td>
<td>Blue</td>
</tr>
<tr>
<td>Vinegar</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Iodine</td>
<td>No</td>
<td>Black</td>
<td>No</td>
<td>No</td>
<td>Black</td>
</tr>
</tbody>
</table>

FOR THE STUDENT
Student Activity Sheet: Is This a Hoax Lab

Lesson

Engage
Ask students: List some examples of physical change. *Sample answers: tearing paper, crumbling cookies, melting ice*

Ask students: List some examples of chemical change. *Sample answers: sugar caramelizing, vinegar and baking soda reacting to produce a gas, iron rusting.*

Explore
Background
You are an FBI agent and a package was sent to an important political leader. The politician was exposed to a white powdery substance. For precautionary reasons, he was rushed to George Washington Hospital in Washington, D.C. The treating physician has requested that you identify the substance to determine his course of treatment. You must find out whether the package was a hoax and is actually a harmless household product, or if the substance is dangerous Chemical X that leads to death within two hours of inhalation. The clock is ticking...

Procedure
1. Make observations of your sample. Record the color and type of solid in your data table.
2. Test your sample and record your observations in the data table.
   a. pH test (acid/base properties)
b. biuret test (peptide bonds)
c. vinegar reactivity (confirms acid/base properties)
d. iodine test (detects starch)

3. For the pH test, use the chart below to help you determine the property.

<table>
<thead>
<tr>
<th>pH</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Red</td>
<td>Purple</td>
<td>Violet</td>
<td>Blue</td>
<td>Blue-Green</td>
<td>Greenish Yellow</td>
</tr>
</tbody>
</table>

Red Cabbage pH Indicator Colors

<table>
<thead>
<tr>
<th></th>
<th>Acid</th>
<th>Neutral</th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>purple</td>
<td>violet</td>
<td>blue</td>
</tr>
</tbody>
</table>

**Results**

<table>
<thead>
<tr>
<th>Test</th>
<th>Color</th>
<th>Crystal or powder</th>
<th>pH: acid, base, or neutral</th>
<th>Biuret: purple or blue</th>
<th>Vinegar: reaction or no reaction</th>
<th>Iodine: no change or turned black</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Analysis**

1. What is the identity of your unknown?
2. Why was it important to use different tests to determine which powder/crystal the unknown sample is?
3. This lab tested how your substance reacted with different liquids. Do you think the property of reactivity is dependent on the size of your sample, or would the tests come out the same even if you used more or less?
4. You previously completed a lab that used physical properties to identify a substance. Which properties do you think are MOST reliable to identify unknown substance, chemical or physical? Explain

**Conclusion**

Write 2–3 sentences explaining what you learned.

**Explain**

- Enforce the understanding that the cabbage juice reacts with acids and bases differently but does not react with neutral substances.
- The biuret solution will react with certain substances and turn purple. If it stays blue there was no reaction since color change is a sign of a chemical change.
- The vinegar produces bubbles when it reacts. The bubbles are a sign of a chemical reaction.
- The iodine turns black when it reacts with certain substances.
**Extend**

**Activity:** *Dalton’s Atomic Theory*

**Research:** In 1808, John Dalton proposed what is now known as the law of conservation of mass. Have students research Dalton and his career. Have them make a time line to highlight his achievements.

**Connections to Standards**

**Benchmarks:**
- SC.8.P.9.2: Differentiate between physical changes and chemical changes.
- SC.8.N.1.6: Understand that scientific investigations involve the collection of relevant empirical evidence, the use of logical reasoning, and the application of imagination in devising hypotheses, predictions, explanations and models to make sense of the collected evidence.

**Common Core Standards:**
- LACC.68.RST.1.3 Follow multistep procedure when carrying out experiments i.e. taking measurements, etc.
- MACC.K12.MP.1 Proficient students look for a starting point based upon given information, they analyze and look for similarities and differences.
- MACC.K12.MP.3 Students use deductive reasoning skills to be able to generate and clarify arguments based upon data, distinguish faulty from logical reasoning.
- MACC.K12.MP.5 Students are able to select and use tools appropriately to make measurements, analyze the data gathered using these tools including technology.
- MACC.K12.MP.6 Students are able to collect, calculate, interpret and communicate data accurately i.e. units, labeling graphs. To be able to examine claims and make explicit use of definitions.