Lab: Top Secret

FOR THE TEACHER

Summary
In this lab, students will learn about the history of invisible ink and will have the opportunity to compare two types of homemade invisible ink recipes.

Grade Level
Middle School

Objectives
By the end of this lab, students should be able to
- Discuss the history and original uses of invisible inks.
- Analyze and compare their experiment results to determine the best recipe for invisible ink.

Chemistry Topics
- History
- Chemical Properties
- Physical Properties

Time
Teacher Preparation: Depending on the materials on hand, 10–60 minutes to gather materials
Lesson: Three 55 minute periods

Materials
- Lemon juice
- 10ml graduated cylinder
- 50ml beaker
- Cotton swabs (Q-tips) or paint brush
- Hot plate
- Baking soda
- Water
- Stirring rod
- White computer paper

Safety
- Always wear safety goggles when handling chemicals in the 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.
- Exercise caution when using a heat source. Hot plates should be turned off and unplugged as soon as they are no longer needed.
Teacher Notes

- Students will need to access this Article on Invisible Ink in order to answer the pre-lab questions.
- This is a link to additional interesting background information: Article on the Historical Uses of Invisible Ink
- If hot plates are not available, they can be replaced with lamps/light bulbs in the procedures.
- Extension options include:
  - Allow students to research another recipe and make it (after teacher review/approval) for additional comparison.
  - Have student write disguised invisible notes to each other, and the student receiving the note has to determine what was written.

FOR THE STUDENT

Lesson  

Top Secret

Pre-lab
Visit ArtofManliness.com, and use The History of Invisible Ink article from September 9th, 2011, to answer the questions below.


1. What are the two categories of invisible ink?

2. Explain the difference between the categories of invisible ink and list examples for each category.

3. Find one interesting example of invisible ink from Ancient Times and briefly explain it:

4. Explain how iodine worked as a universal reagent for invisible ink during World War I?

5. How did the Germans get away with still using invisible ink after iodine had been discovered as a universal reagent?

6. When mail was intercepted during World War II and sent to the FBI labs for testing, what are the three conditions that the paper would be exposed to in attempt to reveal secret messages or codes?

Materials

- Lemon juice
- 10ml graduated cylinder
- 50ml beaker
- Cotton swabs (Q-tips) or paint brush
- Hot plate
- Baking soda
- Water
• Stirring rod
• White computer paper

**Safety**
- Always wear safety goggles when handling chemicals in the lab.
- Wash your hands thoroughly before leaving the lab.
- Follow the teacher’s instructions for cleanup of materials and disposal of chemicals.
- Exercise caution when using a heat source. Hot plates should be turned off and unplugged as soon as they are no longer needed.

**Procedure**

*Invisible Ink Recipe #1*
1. Measure ~5ml of lemon juice with the graduated cylinder and add it to a 50ml beaker (pour juice or squeeze lemon).
2. Write a message with the lemon juice on a plain white piece of paper. You can use a cotton swab or paintbrush as a pen.
3. Let the paper dry completely.
4. Heat the paper up by holding it over a hotplate or other heat source. Be careful to not hold the paper too close or it will burn.
5. Read the message which should appear in a pale tan or brown color.
6. Complete the data table.

*Invisible Ink Recipe #2*
1. Using the graduated cylinder measure ~5ml of baking soda and add it to the 50ml beaker. Measure ~5ml of water in the graduated cylinder and add it to the beaker with the baking soda.
2. Use the stirring rod to mix the baking soda and water until it is a uniform mixture.
3. Write a message with the baking soda mixture on a plain white piece of paper. You can use a cotton swab or paintbrush as a pen.
4. Let the paper dry completely.
5. Heat the paper up by holding it over a hotplate or other heat source. Be careful to not hold the paper to close or it will burn.
6. Read the message which should appear in a brown color.
7. Complete the data table.

<table>
<thead>
<tr>
<th>Comparison of Invisible Ink recipes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invisible Ink</td>
</tr>
<tr>
<td>Recipe #1</td>
</tr>
<tr>
<td>Recipe #2</td>
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</tbody>
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**Analysis**
1. Which recipe did you like the best? Explain your choice.
2. Suggest an idea for a different recipe – brainstorm ideas with your classmates!