



Chemist: Operation Espionage

Time: 45 Minutes

Skill Level: Elementary (age 6-11)

Background

What is Science Inquiry?

Children are natural scientists. From a very early age they explore the world, ask questions and seek answers. This journey of exploration and discovery is Science Inquiry. Science Inquiry helps young people understand their environment, solve problems and gain knowledge about scientific ideas and processes.

Next Generation Science Standards (NGSS)

Science and Engineering Practices

1. Asking questions
3. Planning and carrying out investigations

Disciplinary Core Ideas

PS1: Matter and its interactions

Crosscutting Concepts

2. Cause and effect: Mechanism and explanation

Objective

In this activity, students will create an invisible ink and determine a method for revealing the hidden message.

About the Scientist

Chemists are scientists that study the composition and properties of matter, and the way chemicals interact with each other. Some chemists study substances at the atomic and molecular levels. They often work in laboratories and use their knowledge to identify unknown substances, as well as develop new products or improve existing products.

The Science of Chemical Reactions

A chemical reaction occurs when a chemical substance changes into another substance with a different chemical identity. The key to identifying a chemical reaction is to make observations! A chemical reaction is usually accompanied by easily observed physical effects, such as the emission of heat and light, or a color change.

One type of chemical reaction occurs between chemicals with different *pH values*, namely *acids* and *bases*. This type of chemical reaction is called an acid-base reaction. Students may have observed such a reaction between vinegar and baking soda. How might this relate to invisible ink?

Materials List:

Baking soda
Cotton swabs
Cotton balls
Cups
Purple grape juice
Grape juice concentrate
Cranberry juice
Food coloring (red and blue)
Wet wipes for cleanup
Roll of paper towels
Plain white paper
Water

Prep ...For each group of students, fill three cups halfway with purple grape juice, grape juice concentrate, and cranberry juice, and label each accordingly. Then fill a fourth cup with water, add a drop of red and blue food coloring, and label this cup “colored water.”

Discuss ...What do students know about invisible ink? Why is it used? What’s the science behind invisible ink? Discuss chemical reactions and acid-base reactions. How can we make invisible ink from these everyday materials?

Predict ...Generate Ideas. Select a Solution.

Experience “What to Do”- What is the plan for the investigation?

To create the invisible ink, have students combine **1 teaspoon of baking soda** and **1 teaspoon water** in a cup and stir. Students will then fold a sheet of paper into four equal parts and write use a cotton swab to write a message in each section of the paper. Be sure to let the paper dry completely before proceeding. Students can make their prediction while the paper dries. Then students can test each of the four liquids using the cotton balls to see which one best reveals the hidden message.

Share ...Encourage students to discuss their observations as they test the liquids.

Reflect ...Analyze and interpret the data and results. Discuss among the group.

Why do some liquids work better at revealing the message than others? What is different about these liquids? How does the liquid reveal the hidden message?

Generalize ...to real world examples. Construct explanations.

Why do some chemicals react with each other whereas others do not?

Apply ...outside the classroom or club meeting.

Is this a good solution for keeping messages secret? Explain.

Additional resources:

- This experiment is based on an activity by Fetch! With Ruff Ruffman for PBS Kids:
<http://www.pbs.org/parents/fetch/activities/act/act-espionage.html>

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Agriculture Sciences & Natural Resources, Family & Community Health, 4-H Youth, Forestry & Natural Resources, and Extension Sea Grant programs. Oregon State University Extension Service offers its programs and materials equally to all people.