iSTEAM After School

LESSON 6: INVISIBLE INK

SUPPLIES

TEACHER BRINGS
- Water (if no sink)

MAIN BIN
- Frosted cups (15)
- Paintbrushes (15)
- White crayons (15)
- Watercolor Sets (3)

FOLDER
- Cardstock (30)

OBJECTIVES

- ☑ Understand the meaning of the term **hydrophobic** (hai·druh·fow·buhk).
- ☑ Explore how the properties of wax and water can be used to create invisible ink.

HOOK

3 min

- Ask students: have you ever wanted to send a secret message that only you and a friend could read?
- Have you ever heard of **invisible ink?** What do you think would happen if we drew with something that you can't see?

INTRODUCTION

3-5 min

Welcome back, agents. In today's experiment, we will learn all about hydrophobic materials and properties. In other words, we'll be learning how to write using invisible ink!

Instead of writing with a pencil or marker, today we will use a white crayon. The crayon is made of wax, which is hydrophobic—it repels water. When you color on white paper with a white crayon, you can't see it because it blends in. But when you paint over it with water-based watercolors, the paint doesn't stick to the wax, so the crayon marks "pop out" and become visible. This process demonstrates resistance, and material properties—basic but powerful scientific concepts that help secret agents on their missions.

MEET TODAY'S SECRET AGENT

INKJET

Specialty: Invisible ink production

Agent Inkjet possesses an extraordinary power to create invisible messages. With her unique ability, Inkjet can encrypt vital information using invisible ink, concealing it within documents or surfaces. Her toolbox of hydrophobic writing utensils allows her to develop hidden messages, ensuring that only those with the right knowledge can decipher their hidden messages.

INVISIBLE INK

DISCUSSION

3-5 min

Discuss the following questions with students:

- Have you ever made a secret message before? How did you do it?
- What do you think a secret message is? Why do people make secret messages?
- What colors do you like to use when you draw or write?
- How do you think crayons and watercolors are different? What can you do with them? What do you know about crayons and paint—are they made of the same stuff?

Using the ideas generated in this discussion, have students predict what will happen when they paint on the paper after drawing with the white crayon?

- When you draw with a white crayon on white paper, it's hard to see because both are the same color. That's why the message looks "invisible" at first.

FUN FACT!

Invisible ink was used during the American Revolutionary War to carry secret messages! Their notes could be heated over a candle to reveal the words. You can try this experiment at home--if you write on paper with milk or lemon juice, for example, and then heat it up, the message will appear!

ACTIVITY

25-30 min

1. Give each student a white crayon and one sheet of cardstock. Let them write a message or draw something (encourage big, bold shapes.)

2. After they're done drawing, give them watercolor paint, a brush, and a water cup. Instruct them to wet the brush, pick up some watercolor paint, and then dip the brush back into the water cup. Gently brush over their paper and watch the secret message appear.

3. Let them try again on a second sheet, either to improve or try something new. As students are working on their second invisible ink message or drawing, discuss what they observe!

4. Ask the students:
   - What did you notice when you painted over the white crayon?
   - Why do you think the crayon marks show up now?"
   - What happened when the paint hit the wax?

5. If time permits, students can send secret messages or drawings to one another to decode. See extension activity for ideas.

TIP

If students' crayon drawings aren't showing up, check how they're using their brushes. They might not be using enough water! Remind them to wet their brush well before dipping into the paint. The more watery the paint, the better their crayon designs will show through!

INVISIBLE INK

OBSERVE & EXPLAIN 10 min

Scientists always watch closely during experiments. Let's use our science eyes and describe what we see, notice, and wonder

- What parts stayed white or bright?
- How did the message appear—slowly, all at once, or in pieces?
- Did the paint go over the crayon or slide off it?

EXTENSION

If there is extra time and materials, the class can repeat the experiment with more or less of the following variables:

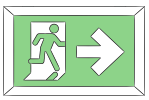
- Create a secret code alphabet and have students write messages to decode.
- Make a greeting card or invitation with a hidden message inside.
- Turn it into a mini comic or illustrated story where the hidden image reveals part of the plot.

White crayons are made from wax, which is a type of solid that water cannot mix with. This is because wax is **hydrophobic**, meaning it repels water. Hydrophobic actually means "scared of water"--that's why it stays away from water!

In this experiment, we used watercolor paint to reveal the hidden message. Watercolor paint is made with water, and when you brush it over the paper, the paint soaks into the paper, except where the wax crayon is. The wax blocks the paint, so those areas stay white, while the rest of the paper gets covered in color.

This is a scientific concept called resistance. The wax resists the watercolor because they are made of different materials that don't mix. That's why the message or drawing shows up—it never disappeared, it was just hiding in plain sight!

Writing in invisible ink is like coloring in reverse! The areas you want to see have no color, but the surrounding areas are colorful. Even though it looked like magic, it was actually science. You used your knowledge of materials—wax and water—to create a secret message, just like a scientist or spy!



Exit Ticket

Ask each student the following question as they walk out the door.

- Q: When we say something is hydrophobic, what does that mean?
  - A: Something that is hydrophobic repels water, which means the water stays away!