INVISIBLE INK

ELEMENTARY SCHOOL LEVEL 2

Invisible ink is a form of *steganography*, the practice of concealing a message inside of another file or format. There are many forms of invisible ink that have been utilized over the years, but one of the most basic is lemon juice. When applied to paper, lemon juice dries leaving no trace. By applying heat to the paper, you can make the lemon juice change color, becoming visible to the naked eye.

EDUCATIONAL STANDARDS:

NGSS CONNECTION:
2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

COMMON CORE CONNECTION:
ELA/Literacy

RI.2.1 Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text or the experience.

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures. When was invisible ink used in history?

RI.2.8 Describe how reasons support specific points the author makes in a text.

W.2.1 Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., *because, and, also*) to connect opinion and reasons, and provide a concluding statement or section.

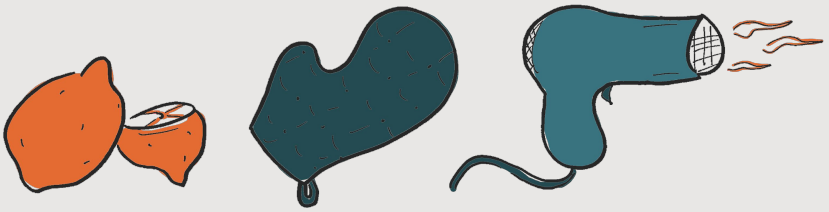
DOK:
Level 3: Strategic Thinking

MATERIALS NEEDED:

- ❏ Lemon juice
- ❏ Cotton swab
- ❏ Paper
- ❏ Cutting board
- ❏ Oven mitt
- ❏ Heat source (lamp, hairdryer, hot plate)

DIRECTIONS:

1. Lay your paper out on a table.
2. Dip the cotton swab into the lemon juice and use it to write your hidden message.
3. Let the lemon juice dry on the page.
4. Use a heat source to heat up the paper and the message should appear.
5. You may need to leave it for half an hour depending on your heat source. Your secret message will then be visible.



OBJECTIVE:

Students will be able to explore various thermal changes and argue from evidence that some are reversible while others are not.

ESSENTIAL QUESTION:

- How might things change under various heat conditions?

ENGAGE / EXPLORE:

1. Ask students to think about how heat affects water.
    a. Have students use language and visuals
    b. Share ideas with the class
2. Have students conduct an experiment to add heat to ice
    a. Students record what happens to the ice when it is heated
    b. Students might be asked if it is the same thing as before?
3. Have students conduct the reverse by putting the water in a freezer.
    a. Students record what happens to the ice when it is frozen
    b. Students might be asked if it is the same thing as before?
4. Repeat the above process to cook an egg.
    a. Students could determine if this process is irreversible

EXPLAIN:

1. Hold a discussion with students of physical vs chemical change
    a. Video on chemical vs physical change
    b. Students should practice identifying chemical vs. physical changes

ELABORATE:

1. Have students do the next assignment of your choice by writing with lemon juice
2. Once done, have students or you heat up the paper to reveal their answers
3. Evaluate
    a. Have students then construct an argument using evidence on whether this process is:
    b. Chemical or physical
    c. Reversible or irreversible.