Investigating Images in Invisible Inks – It's Incredible!

By David Heroux, Ph.D.

Introduction

Photography uses light to make a chemical change and create an image. The Anthotype/Sun Print activity in this issue of *Celebrating Chemistry* (located on pg. 11) is an example of a chemical change that uses sunlight.

In this activity, you will explore using heat, instead of light, to develop an image. Using heat to make invisible ink appear is an example of a chemical change. Another example of this kind of change is when food gets burnt.

Additionally, you will explore different materials that can be used as invisible inks on paper to make an image appear!

SAFETY SUGGESTIONS

- Safety goggles required
- Do not eat or drink any of the materials used in this activity
- Thoroughly wash hands after this activity
- You will need an adult to help you use the oven to develop your pictures. Only adults should handle items being heated, and they should wear oven mitts.

Question to Investigate

What makes the best material for invisible inks?

Materials

- Paper
- Paint brushes, cotton swabs, or similar item for drawing your invisible picture
- Materials to test as invisible inks:
  - Fruit juice (lemon, apple, or orange juice)
  - Onion blended in food processor
  - Vinegar
  - Clear soda
  - Diluted honey
  - Milk
  - Sheet pan (cookie sheet)
  - Oven

Procedure

1. Select several of the invisible ink materials to test. Make sure to use a new cotton swab or paint brush with each ink tested.
2. Make a data table that includes the name of the materials you use to make an image, the time it takes for the image to appear, and the darkness of the image. Draw a picture using your invisible ink. When your drawing is done, use a pencil to print the name of the material used.
3. While you are drawing your image, have an adult preheat the oven to 350 ˚F/177 ˚C.
4. Place your picture(s) on a cookie sheet and have your adult helper place it in the oven for 5 minutes.
5. Have the adult remove the cookie sheet from the oven and wait for it to cool before handling.
6. Observe your image and record your data in your table.
7. Explore which "ink" forms an image faster by making new pictures and heating them for shorter times.
8. Which of your "inks" was the most invisible before heating? Which "ink" made the darkest image after heating? Use a scale of 1 to 5 to indicate how dark each one is.

What did you observe?

If you were a spy and wanted to send a message in invisible ink, which one of the inks you tested, if any, would you use?

How does it work? / Where's the chemistry?

The material in this activity used to make the invisible inks all contain acids or sugars. These acids react with the paper to form sugars. When heated, the sugars oxidize and turn dark.

David Heroux, Ph.D. *is the Leavy Family Professor of Chemistry at Saint Michael's College.*