



Information for Students and Parents Last Date Updated: Fall 2018

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Invisible Ink

Materials

- Goldenrod paper
- Lemon Juice (Acidic Solution)
- Vinegar (Acidic Solution)
- Baking Soda (Basic Solution)
- Plastic cups
- Cotton swabs/toothbrush/paintbrush
- Grape Juice (pH indicator) or UV light lamp
- Wax crayons (optional)
- scissors

Methods

1. Equally mix water and baking soda into a plastic cup. This solution will be the “ink”.
2. Use a cotton swab, toothbrush, or paintbrush to decorate and write on the goldenrod paper.
3. Allow the ink to dry on the goldenrod paper.
4. Hold the paper up to a heat source or UV light lamp to view the decorations. The baking soda solution should cause the decorations on the paper to turn brown.
5. Cut the goldenrod paper into bookmark sized portions and repeat steps 2-4 to create an “invisible ink” or regular bookmark.

Hypothesis

The purpose of this experiment is to observe the pH of various chemicals in goldenrod paper. Students will observe the reaction of baking soda, ammonia, vinegar, ect on goldenrod paper and make note of the color change.

Sample Hypothesis: If a basic solution is used to write on the goldenrod paper, then it will leave a permanent message.



Observations

- If ammonia is added to the paper, the message will disappear as the ammonia evaporates.
- Basic solutions will provide a permanent message on the goldenrod paper.
- Color change will occur depending on whether a solution is acidic, basic, or neutral.
- Basic solutions will turn the goldenrod paper red.
- Acidic solutions will keep the paper yellow.

Scientific Principles

Ammonia is a base, thus it will cause the goldenrod paper to change to red. The goldenrod paper will not stay red, though. Carbon dioxide gas which is apart of the air we breathe mixes with water vapor and this makes a weak acid (carbonic acid). This reacts with ammonia (basic) on the goldenrod paper resulting in ammonium carbonate (a more neutral solution). This will result in a slow change of the pH which results in the dye changing from red (basic) back to yellow (neutral).

Using a stronger base like baking soda (sodium bicarbonate), the red message will not disappear as a result of just the carbon dioxide in the air. A stronger acid needs to be used, like lemon or lime juice, or vinegar to change the solution from red back to yellow.

Vinegar contains acetic acid which is made by the fermentation or chemical breakdown of ethanol by acetic acid bacteria. Lemon juice has a high amount of citric acid which is commonly used to provide a sour taste to foods and beverages. Baking soda is comprised of sodium bicarbonate, which is very basic, and reacts with foods in special ways.

Household ammonia is a reliable cleaner because of how strong of a base it is and it can be dangerous if it's exposed to one's eyes or mouth. This is why we're using a 1:1 ammonia-water solution. Also, never mix ammonia with other household cleaners. Dangerous gases can be released in the reaction!



Further Investigations

Look at other examples of basic or acidic solutions and compare the pH of that to water.



- With brush or cotton swab, write a message on the paper with a 1:1 solution of household ammonia and water. As the ammonia-water solution evaporates, the red message will disappear
- With a wax crayon, decorate the goldenrod paper. Then, spray or paint over the paper with a basic solution to see the message.

References

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