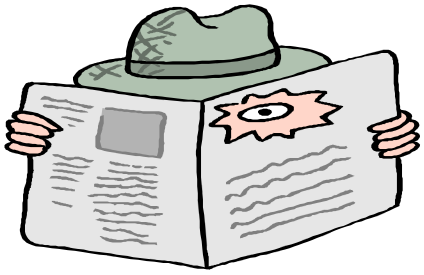
INVISIBLE INK

TEACHERS NOTES

Recommended year levels: 5-12

MYTH

Spies use invisible ink to send secret messages.



OBJECTIVES

Demonstrate the use of ferrous (iron) sulfate and Bi-carbonate of soda as an invisible ink.

BACKGROUND INFORMATION

Invisible ink was used by both British and American armies to create messages that cannot at first be seen by the reader. The ink will dry clear on the paper and then react with another substance that is brushed over the ink to form a visible result so that the ink can be read. Alternatively, the ink may damage the paper so that when heated, the paper chars more readily where the ink was used and the message can be read.

In the first experiment below, the solution of bicarbonate of soda in water is used as the ink. The grape juice is an indicator (a substance that changes colour in the presence of an acid or base). The bicarbonate of soda solution is a base, so when the grape juice comes into contact with it, it changes to a green colour to indicate the presence of the base. Hence, the message can be read.

The ferrous sulfate solution was used at the time of the American Revolutionary War as an invisible ink for secret messages. Ferrous sulfate reacts with sodium bicarbonate to form a coloured precipitate iron (II) carbonate. The receiver of the message could brush the letter with sodium bicarbonate solution to reveal a visible message.

WHAT YOU NEED

- Bi-carbonate of soda
- Water
- Grape juice
- kebab sticks
- paint brush
- Filter paper (we used Advantec #2)
- 2g ferrous sulfate
- Mass balance
- 150mL water
- 2 x 200mL beaker
- 200mL measuring cylinder

WHAT TO DO

Part I

1. Mix one heaped teaspoon of bi-carbonate of soda in 100mL of water.
2. Dip the kebab stick in the bi-carb and water solution.
3. Use the kebab stick as your writing instrument to write a word on your paper. (The kebab stick may need to be dipped in the solution before each letter of the word is written.)
4. Leave the page to dry completely.
5. Use the paint brush to spread grape juice over the page.

Part II

6. Fill the beaker with 150mL water. Dissolve 2g of ferrous sulfate in the water in the beaker.
7. Dip the kebab stick in the solution and write a short word on the filter paper.
8. Allow to dry.
9. Brush with bicarb and water solution.

QUESTIONS

1. Grape juice is a natural indicator. What colour is it in a neutral solution and a basic solution? *In a neutral solution it is purple. In a basic solution it is green.*
2. What results would you expect if vinegar was used instead of the bicarbonate of soda solution? *Grape juice turns a greenish colour in a base but it would not turn that colour in vinegar because it is an acid. It would either remain unchanged or change to yet another colour such as red.*
3. Write a balanced chemical equation for the reaction between ferrous sulfate and sodium bicarbonate. Identify the precipitate. $FeSO_4 + Na_2CO_3 \rightarrow FeCO_3 (s) + Na_2SO_4$
4. What other variables might you test to further investigate this myth? *The effect of heat on the two types of ink that were investigated. Trial using vinegar with grape juice. Trial other sorts of salt combinations that form precipitates.*

RESOURCES USED TO DEVELOP THIS ACTIVITY

1. Ash, M. et. al. (1996). *Q chemistry*. Brisbane: Jacaranda.
2. Foster, K., Ghering, C., Light, M. and McCollum, M. (1999). *Secret methods and techniques – invisible ink.* Retrieved 20 November, 2009 from, http://www.si.umich.edu/spies/methods-ink.html
3. Narasimhan, B. R. V., Prabhakar, S., Manohar, P. and Gnanam, F. D. (2001). Synthesis of gamma ferric oxide by direct thermal decomposition of ferrous carbonate. Retrieved 20 November, 2009 from, http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6TX9-44PCHKH-9&_user=62921&_rdoc=1&_fmt=&_orig=search&_sort=d&_docanchor=&view=c&_searchStrId=1089239561&_rerunOrigin=google&_acct=C000005418&_version=1&_urlVersion=0&_userid=62921&md5=07e9944c912331a36d25ed935c286c7d