

## Secret Messages- Acid/Base

### Tennessee Technological University SMACS Chapter

#### Items:

- Goldenrod paper
- Candles (preferably white birthday or tapered candles)
- Windex
- Vinegar
- Cotton balls

#### Procedure:

1. Write your secret message on the Goldenrod paper with the candle.
2. Dip a cotton ball in the Windex solution and rub it across the Goldenrod paper and watch your message appear!
3. Dip a second ball in the vinegar solution and rub it across the Goldenrod paper to make the message disappear again.

#### Explanation:

The Goldenrod paper gets its signature color from turmeric, which is an acid-base indicator. The turmeric is golden colored in acidic conditions and red in basic conditions. When the Windex, which contains ammonia (a weak base) comes into contact with the paper it turns red due to the pH increase of the paper. The candle wax is non-polar so it repels the aqueous Windex solution. This prevents the ammonia from reacting with the paper under the wax preserving the secret message in a golden color. When the vinegar comes into contact with the paper it turns the solutions acidic, which makes the Goldenrod paper turn back to its golden color so the secret message disappears.

If the Windex is left on the paper, the paper will eventually return to its golden color as the  $\text{CO}_2$  in the air reacts with the solution forming carbonic acid, which shifts the paper back to its acidic color.

An aqueous solution of baking soda or washing soda (sodium carbonate) will also cause the paper to turn red, which will reveal the secret message. These solutions are stronger bases than the ammonia in the Windex, so the paper cannot be returned to the golden color without a strong acid.

#### Hazards and Disposal:

There are no hazards associated with this demonstration if the Windex and vinegar are treated in an appropriate manner. The Goldenrod paper should be disposed of in the trash and should not be recycled.



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