

Goldenrod Indicator Paper

Goldenrod paper turns bright red when dipped in bases (ammonia, sodium bicarbonate, washing soda) and turns back to its normal color when dipped in acids (vinegar, lemon juice).

Use the paper to test the acid-base nature of household chemicals, introduce acid-base indicator concepts or study reversible reactions and equilibrium shifts (as predicted by Le Chatelier). Goldenrod paper's yellow colour is obtained from a dye that is found in kitchen turmeric powder (curry)!

It reacts reversibly with acids & bases producing visible colour changing products.



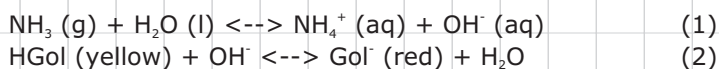
With ammonia cleaner

Procedure

For instant colour changes (that won't last)

- Tape a number of Goldenrod paper sheets together with tape, flip them over and write a hidden message or make a sketch using a wax candle. How about words like "Indicators", "Science is Fun" or "Acids & Bases" ?
- Stick the prepared paper on the white or black board with blue tac.
- Place some diluted ammonia household cleaner or "Windex®" in a spray bottle and spray the sign with the solution. The paper will turn red instantly, revealing the words / sketch in yellow. See (A) below. As ammonia evaporates easily, the alkalinity will be lost within minutes and you will have the yellow restored – just in time for the next class.

What's happening on the paper?



("HGol" = goldenrod indicator)

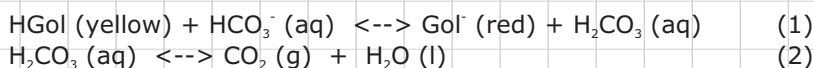
Why does the red colour fade?

The NH_3 diffuses from the solution and the equilibrium is shifted to the left in reaction 1 above, using up the OH^- ions. As the OH^- concentration decreases, the equilibrium in reaction 2 shifts to the left restoring the original yellow indicator colour (Le Chatelier's principle).

Note that the polar water molecules and polar ammonia molecules do not react with non-polar wax molecules (hydrocarbons). "Likes dissolve likes".

For slower but permanent colour changes

Use baking powder or sodium bicarbonate dissolved in water. A 2% solution should do the job. The message forms more slowly but the message does not fade. Note that the red colour gets darker due to the CO_2 that evolves leaving a basic solution:



Drying shifts the equilibrium in reaction 1 to the right as the H_2CO_3 is reduced due to the evolving of CO_2 (reaction 2) (Le Chatelier). Subsequently more of the red Gol^- forms on drying.

More things to do with your Goldenrod paper

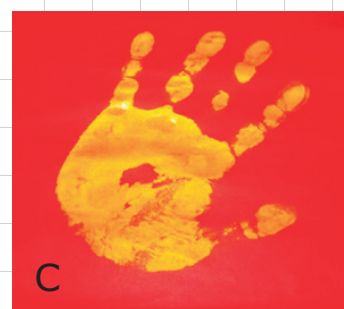
- Prepare red goldenrod paper with the sodium bicarbonate solution and let the paper dry. Make untreated yellow and these red papers available to the students. Cotton buds dipped in vinegar and bicarbonate solution should produce red and yellow trails on the paper. Great for elementary science / art classes!
- Paint pictures on your goldenrod paper with vinegar first and then paint the paper with a baking soda solution. The pictures will change colour as the chemical reactions progress.
- Spray your hand with ammonia solution and produce a red "bloody" hand impression (B). Now, do the same with vinegar on dry red Goldenrod paper (C). Be creative - have fun!



A



B



C