Acid - Base Reactions

What's the Wow?: You will observe a variety of colors in looking at acid – base reactions.

Procedure:

A. Acid-Base Reaction: Using Your Voice[1]

Safety Note: Do not allow these flasks or their contents to get close to any flames!

1. Obtain one of the blue solutions in the stoppered Erlenmeyer flasks.
2. Remove the stopper and speak into it. Restopper and swirl the flask.
3. If nothing happens, have your partner try. If nothing continues to happen, change the inflection of your voice and keep trying!

Waste: None, return the flask.

B. Stalagmites and Stalactites[2]

Safety Note: $Ca(OH)_2$ and HCl are caustic and can irritate the skin and eyes. Dry ice has a temperature of -78°C and can cause frostbite.

1. Place 200 mL of $Ca(OH)_2$ into a 500 mL beaker. In a second 500 mL beaker with 200 mL of $Ca(OH)_2$ add a few drops of bromthymol blue indicator.
2. Add a couple of small pieces of dry ice to each of the solutions.
3. To the solution without the indicator, add a stirbar and heat it to near boiling while stirring.
4. Once near boiling, allow the solution to cool.
5. To the solution with the indicator, add a few mL of 1 M HCl.

Waste: The contents of these solutions essentially neutralize each other and can be poured down the drain.

C. A Vegetable Acid/Base Indicator[3,4]

Safety Note: The stronger acids and bases are caustic and can irritate the skin and eyes.

1. Label 8 test tubes as follows: pH = 2, pH = 3, pH = 5, pH = 7, pH = 8, pH = 9, pH = 12, pH = 14.
2. Obtain ~ 50 mL of the boiled and shredded red cabbage solution.
3. Add 3 mL of the cabbage solution to each of the eight test tubes.
4. Add the following materials to the test tubes:
   a. 10 mL of lemon juice (fresh squeezed) pH = 2
   b. 10 mL of white vinegar pH = 3
   c. 10 mL of boric acid solution pH = 5
   d. 10 mL of freshly boiled water pH = 7
   e. 10 mL of sodium bicarbonate solution pH = 8
   f. 10 mL of borax solution pH = 9
   g. 10 mL of washing soda solution pH = 12
   h. 10 mL of drain cleaner solution pH = 14
5. Mix each of the solutions with a stirring rod.
6. In separate test tubes, try some other common household materials, e.g., shampoo, Windex, fruit juices, baking powder, antacid tablets, salt, fertilizer, Sprite, laundry detergent, milk, sugar, milk of magnesia, aspirin, etc.

Waste: The contents of these solutions neutralize each other and can be poured down the drain.

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[1] Adapted from *Chemical Demonstrations: A Sourcebook for Teachers,* L.R. Summerlin, J.L. Ealy, Jr, ACS, Washington, D.C., 1985.

[2] Adapted from *Chemical Demonstrations: A Handbook for Teachers of Chemistry*, Volume 1, B.Z. Shakhashiri, University of Wisconsin Press, Madison, WI, 1983.

[3] Adapted from *Chemical Demonstrations: A Handbook for Teachers of Chemistry*, Volume 3, B.Z. Shakhashiri, University of Wisconsin Press, Madison, WI, 1983.

[4] Adapted from *Chemical Activities,* C. L. Borgford, L.R. Summerlin, ACS, Washington, D.C., 1988.