CNY ACS

Demonstrations

Excerpts from 2015 Education night in Syracuse, NY

Preface

Note

The demonstrations and descriptions of use of the chemicals and equipment in this handout have been compiled using sources believed to be reliable and demonstrated before in my classroom. However, no warranty, guarantee, or representation is made by the authors or by the sponsors of this demo show as to the correctness or sufficiency of any information herein.

The authors do not assume any responsibility of liability for the use of the information herein. The authors do not assume that all necessary warnings and precautionary measures are contained in this handout. Other or additional information or measures may be required because of particular or exceptional conditions or circumstances or because of new or changed legislation. Teachers and demonstrators are responsible for learning and developing procedures for safe handling, use, and disposal of chemicals in accordance with local regulations. All demos require the use of safety goggles, aprons, and sometimes gloves.

Recommended books

Summerlin, Lee R. and James L. Ealy, Jr. Chemical Demonstrations: A Sourcebook for Teachers. American Chemical Society. Washington, D.C. 1985

Shakhashiri, Bassam Z., Chemical Demonstrations. Volume 1-4. University of Wisconsin Press, Madison, WI, 1983-1992.

CNY ACS Education Night
June 3, 2015

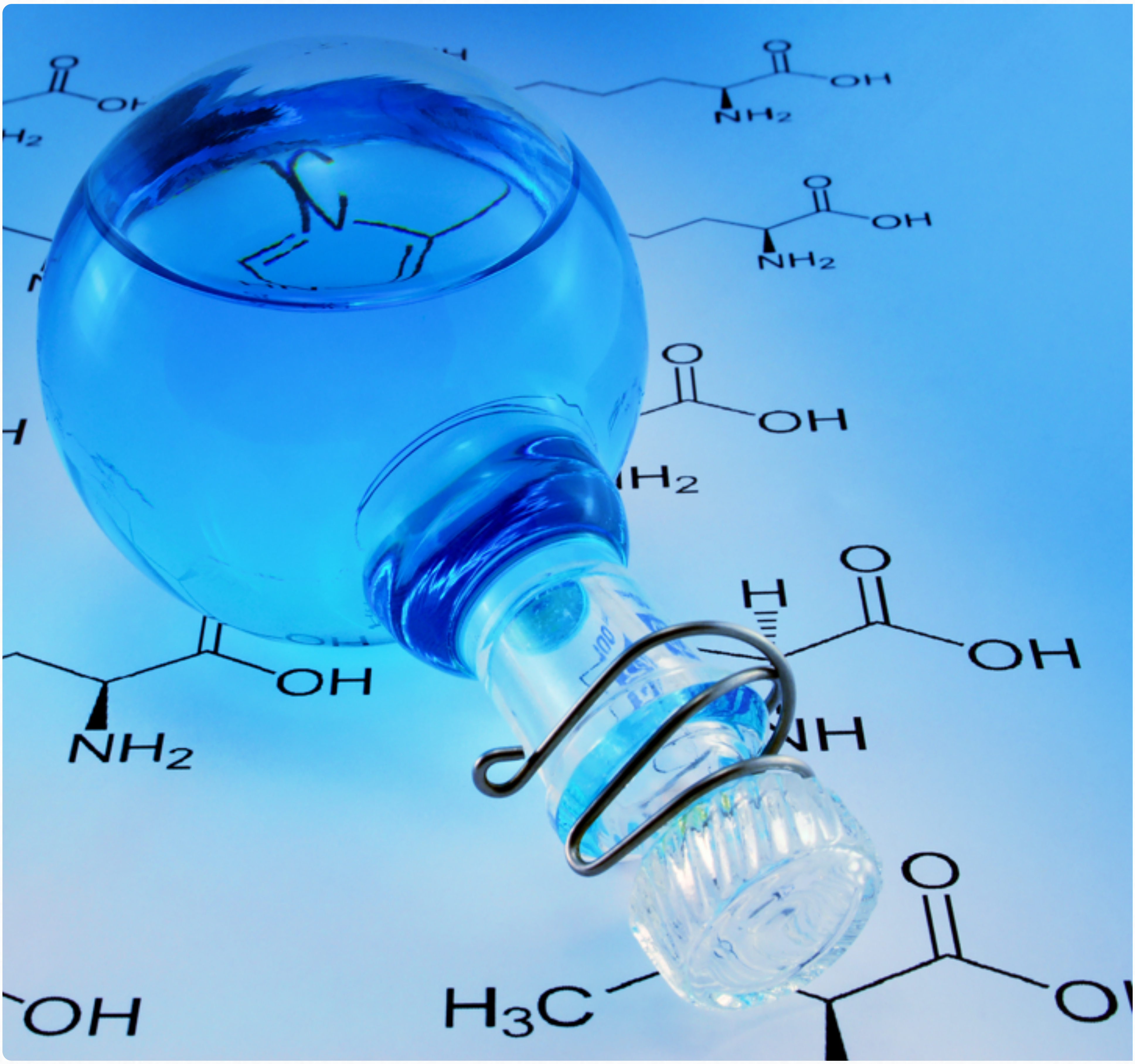
Pictured from left to right:

- Dr. Michael Sponsler, Syracuse University
- Mr. Gary Bonomo, Syracuse University
- Dr. Neal Abrams, SUNY College of Environmental Science and Forestry
- Ms. Sally Mitchell, East Syracuse-Minoa High School
- Dr. Miriam Gillett-Kunnath, Syracuse University

Chemical Demonstrations

Excerpts from 2015 Education night in Syracuse, NY

> "Chemistry begins in the stars. The stars are the source of the chemical elements, which are the building blocks of matter and the core of our subject."
> – *Peter Atkins*



Mist of Steam

A top is taken off an Erlenmeyer flask. Steam is released in a mist.

MATERIALS

- 5 grams manganese dioxide (MnO_2)
- Empty teabag
- 30% Hydrogen Peroxide (Can use Baqua Shock which is 27% H_2O_2)
- 500 mL Erlenmeyer flask
- 50 mL graduated cylinder
- Funnel
- Goggles and gloves

PROCEDURE

1. Empty out a teabag by carefully cutting the top side. Empty the tea. Place 5 grams MnO_2 into the teabag. Remove the paper label from the teabag.

2. Using the funnel, pour 40 mL of the 30% H_2O_2 into the flask. Be careful not to get the hydrogen peroxide on the inside sides of the flask.

3. Carefully place the teabag down into the flask. Use the string from the teabag to suspend the teabag in the neck of the flask. Use the stopper to hold the string in place.

4. Remove the stopper and allow the MnO_2 to drop into the hydrogen peroxide. Step aside. The steam will come out of the flask.

Alternative Presentation

Have five volumetric flasks in the following order to form an arch, about 50 cm apart. These should each be secured with an iron and ring stand. Place the following in each flask:

- 500 mL Volumetric Flask: 25 mL of H_2O_2
- 1000 mL Volumetric Flask: 50 mL of H_2O_2
- 2000 mL Volumetric Flask: 100 mL of H_2O_2
- 1000 mL Volumetric Flask: 50 mL of H_2O_2
- 500 mL Volumetric Flask: 25 mL of H_2O_2
- 500 mL Volumetric Flask: 25 mL of H_2O_2

Add ¼ of a micro spatula full of manganese dioxide to the two 500 mL volumetric flasks.

Add ½ of a micro spatula full of manganese dioxide to the two 1000 mL volumetric flasks.

Add a micro spatula full of manganese dioxide to the 2000 mL volumetric flask.

CHEMICAL REACTION

The MnO_2 acts as a catalyst in this reaction. This is a decomposition reaction.

$H_2O_2(l)$ + $2H_2O(g)$ → $O_2(g)$ + heat
Lots of heat.

SAFETY

Manganese dioxide is a strong oxidant. Avoid contact with organic materials.

30% hydrogen peroxide acts as an oxidizer with practically any substance. Do not heat the hydrogen peroxide. There is a risk of a dangerous fire and explosion risk.

The demonstrator should wear safety goggles and gloves.

DISPOSAL:

The peroxide will be decomposed to water. The teabag can be rinsed with water and disposed of in the trash can. Rinse the flasks/bottle out with plenty of water.

REFERENCES

- Alyea, Hubert N. "Tested Demonstrations in Chemistry", Journal of Chemical Education, Easton, PA, pp. 152.
- http://www.stevespanglerscience.com/lab/experiments/genie-in-a-bottle

Iodine Clock

Two colorless solutions are added together. After a brief period of time the solution turns dark blue/black.

MATERIALS

- KIO_3 Potassium iodate
- Soluble starch
- $Na_2S_2O_5$ Sodium metabisulfite,
- 1.0 M H_2SO_4 sulfuric acid
- $Na_2S_2O_3 \cdot 5H_2O$ Sodium thiosulfate crystals

PREPARATION

1.0M H_2SO_4 To make 1 L slowly added with stirring 56 mL concentrated sulfuric acid to 944 mL H2O.

Solution A: 4.3 g of KIO_3 per liter of water

Solution B: Make a paste of 4 g of soluble starch in a small amount of warm water. Slowly add 800 mL of boiling water. Boil for a few minutes and allow to cool. Add 0.2 g of $Na_2S_2O_5$. Add 5 mL of 1.0 M sulfuric acid. Dilute to 1 liter.

Alternative method: Make the starch solution by adding 30 mL liquid laundry starch to 500 mL water. Add 0.2 g of $Na_2S_2O_5$. Add 5 mL of 1.0 M sulfuric acid. Dilute to 1 liter.

PROCEDURE

Place 50 mL of solution A into a 250 mL beaker.

Place 50 mL of solution B into a second 250 mL beaker.

Mix the solutions together by pouring from one beaker to the other.

Solution will turn blue/black.

Add a crystal of sodium thiosulfate.

Stir and the solution will turn colorless.

REACTIONS:

The following sequence of steps is proposed.

IO_3^- reacts with HSO_3^- to form I^- (fast step): $IO_3^- + 3HSO_3^- \rightarrow I^- + 3H^+ + 3SO_4^{-2}$

I^- reacts with IO_3^- to form I_2 (slow)

I_2 immediately consumed by reaction with HSO_3^-: $I_2 + HSO_3^- + H_2O \rightarrow 2I^- + SO_4^{-2}$ $3H^+$

When all of the HSO_3^- has been used up, I_2 accumulates

Iodine reacts with the starch to form the blue-colored complex.

REFERENCE

Summerlin, and J. Ealy, Jr. Chemical Demonstrations, A Sourcebook for Teachers. American Chemical Society, Washington, 1985, p. 75-6.

Kenney, Michael J. and the Michigan State University Chemistry Department, A Chemusical Extravaganza, ChemEd 93, Butler University, August 1993.

DISPOSAL:

Reduce iodine to iodide using sodium thiosulfate, $Na_2S_2O_3 \cdot 5H_2O$. Then dispose according to EPA guidelines.

Stop and Go

Materials

- 250mL flask with stopper
- Solution A: 20g sodium hydroxide, 12g glucose and mix to a one liter solution.
- Solution B: 1% Indigo carmine solution in a dropper bottle.

Procedure

Mix up solution A and put about 100mL in a flask. Add about 20 drops of indigo carmine solution.

Swirl gently and then shake it harder. The colors will change to the classic traffic light colors of red, yellow and green. If you cannot get the red color, add more indicator.

Disposal

The solution should be neutralized to a pH of 5-9, then washed down the sink with plenty of water.

Reference

L. Summerlin, and J. Ealy, Jr. Chemical Demonstrations, A Sourcebook for Teachers. American Chemical Society, Washington, 1985, p. 79.

Green Emerald Catalysis

Materials:

- Hot plate
- Cobalt Chloride
- 50mL beaker
- 400mL beaker
- 3% hydrogen peroxide
- Sodium potassium tartrate
- Distilled water

Procedure:

1. Make a solution of 60g of sodium potassium tartrate in a liter of distilled water.
2. Add about 60mL of 3% hydrogen peroxide to the above solution.
3. Heat this solution to 70 °C. Do not over heat. Note the occurrence of bubbles (very minimal).
4. Add 5mL of the cobalt chloride. Notice the change from pink to green and the rapid effervescence of gas.
5. When the solution returns to pink, you can add more hydrogen peroxide and it will change again.

Disposal:

Wash down the sink with water.

Reference:

L. Summerlin, and J. Ealy, Jr. Chemical Demonstrations, A Sourcebook for Teachers. American Chemical Society, Washington, 1985, p. 72.

Magic Blue Bottle

A large flask contains a colorless solution. When shaken, the solution turns blue. After a few seconds, the solution becomes colorless again. This can be repeated several times. This is the sam as “Stop and Go” with a different dye. Scale the procedure by making only the volume you need for the demonstration.

MATERIALS:

- KOH potassium hydroxide
- Glucose
- Methylene blue indicator
- Water

PROCEDURE:

1. Add 8 grams KOH to 300 mL of water and mix. Allow to cool.
2. Add 10 grams glucose.
3. Add a few drops of methylene blue indicator.
4. Place in a 500 mL flask and stopper the flask.
5. Shake the flask until the solution turns blue.
6. Allow to sit for a few minutes and become colorless.

DISPOSAL:

The solution can be rinsed down the sink.

REFERENCE:

L. Summerlin, and J. Ealy, Jr. Chemical Demonstrations, A Sourcebook for Teachers. American Chemical Society, Washington, 1985, p. 93-4.

Egg in the Bottle

A flame is placed in a bottle. An egg is placed over the top of the bottle. The egg is sucked in. To get the egg out, blow it out.

MATERIALS:

- A glass bottle with a small opening. *Tropicana works well and may the only kind you can find.*
- 2 extra large eggs, hard-boiled, and peeled
- Cotton puff
- Ethanol
- Tongs
- Matches

PROCEDURE:

1. Soak the cotton puff in the ethanol. Hold the cotton puff with the tongs and light it with a match.
2. Drop the burning cotton puff into the bottle.
3. Quickly place the egg on top of the bottle in the opening.
4. The egg will bounce up and down until the flame goes out. It will then get sucked into the bottle.
5. To get the egg out: first remove the cotton puff.
6. Hold the bottle upside down. Blow into the bottle. Remove your mouth and the egg comes out.

DISPOSAL:

The egg can be disposed of in the trashcan. The match and cotton puff should be dipped in water and then placed in the trashcan.

REFERENCES:

P. Kelter, Kelter's Favorite Demonstrations, ChemEd '87, Kingston, Ontario.

Fire Extinguisher

Precautions: When working with an open flame, be careful that no combustible material get near it (hair, clothing, etc...)

Materials:

- 3 600 mL beakers
- Candle that can be lowered into the beaker. Or make a candle on a wire.
- 1 quart white vinegar
- Baking soda

Pre-Demonstration Preparation:

Make a "Candle on a Wire". Make a small loop in the wire at one end. Remove the tea candle from the aluminum container. Heat the straight end of the wire and allow it to melt through the tea candle. Bend a right angle on the wire, put it up to the candle, and set the candle back into the aluminum container. Lightly heat the bottom of the container to fix the candle in place.

Demonstration:

1. Light the candle and demonstrate that it burns in each beaker. Blow out the candle.

2. Add a heaping teaspoon full of baking soda to the first beaker. Pour in 1/3 cup of vinegar. Watch the reaction.

3. Light the candle again. Place in each of the empty beakers, nothing happens. Place in the beaker with the baking soda and vinegar. The flame should be extinguished.

4. Replenish the first beaker with more baking soda and vinegar.

5. Now carefully pour the carbon dioxide from the first beaker to the second. Then from the second to the third.

6. Now light the candle again and place in the first beaker. Nothing happens. Repeat in the 2nd beaker, nothing should happen.

7. Now place the lit candle in the last beaker. The flame should go out.

You were successful in pouring carbon dioxide from beaker to beaker.

Disposal:

All vinegar and baking soda mixtures can go down the drain.

REFERENCE:

Dept of Chem Creighton University, ChemEd ’97 Demo show.

Fire Starter

Played to *Twilight Zone*

Materials

- A package of yeast
- 3% hydrogen peroxide, 0.5 liter
- tall graduated cylinder
- long stirring rod
- aim'n'flame lighter (or a candle already lit)
- long wood splints (staple some together if you have to)

Demonstration

1. Pour 3% hydrogen peroxide into the graduated cylinder. Fill the cylinder ½ way with hydrogen peroxide.

2. Sprinkle 1 teaspoon of the yeast into the peroxide. Stir with stirring rod.

3. Light a splint, blow it out but make sure it is still glowing.

4. Place the glowing splint into the top of the graduated cylinder. The splint will burst back into flames.

Safety

Be careful of flames. Do not have any combustible materials around.

Disposal

Wet splints with water and throw in trash. Peroxide mixture can be flushed down the sink.

Reference

Dept of Chem Creighton University, ChemEd '97 Demo show

Disappearing Water

Played with *Get Ready for This*

Precautions: The superabsorbent material, sodium polyacrylate, can be dangerous if ingested and will irritate the nasal membranes if inhaled. Do not breathe the powder. Avoid eye contact. Wash hands after handling.

Materials:

- Three 16-oz colored plastic Solo cups with white interiors
- water pitcher with 125 mL of distilled water
- 0.7 grams sodium polyacrylate

Preparation:

1. Add 15 drops of water to the center of one cup.
2. Add 0.7 g of sodium polyacrylate to the water. Remove excess powder.
3. Place cups upside down on the table. Turn them over when the water is poured into the cup.

Demonstration

1. Pour 1/2 cup (125 mL) of the water into an empty cup.
2. Pour this cup into another empty cup.
3. Pour the water into the third cup that contains the sodium polyacrylate. Wait just a moment.
4. Pour out the water and nothing pours. The gel should stay in the cup.

Disposal

Dispose of excess powder and/or gelled material in the trash, not down the drain. This will clog drains.

Reference

Dept of Chem Creighton University, ChemEd '97 Demo sho

Somwhere Over the Rainbow

DISCUSSION:

A colorless solution is added to each of 6 beakers. The solution remains colorless. A different solution is added to each of the 6 beakers and the color of the rainbow develops. Dry ice is added to each of the 6 beakers and each solution goes colorless or yellow. Pellets of sodium hydroxide are added and the rainbow of colors reappears. The beakers are emptied into a large beaker and the solutions are colorless again.

Precautions:

The acid alcohol solution is flammable. Keep the container closed. The glycerin/acid alcohol mixture and base solutions can burn. Wash off immediately if comes in contact with the skin. Wear safety goggles. Dry ice can burn, wear gloves.

Materials:

- - light box
- 6 x 600 mL Berzelius, tall form beakers
- 30 mL beaker
- 4 L plastic Nalgene container or pickle jar
- 12” glue stick stirring rod
- 9 dropping bottles
- Reagents: phenolphthalein, thymolphthalein, p-nitrophenol, sodium hydroxide, concentrated sulfuric acid, glycerin, 95% ethanol, dry ice.

Preparation

Each of the indicators are to be dissolved in 30 mL 95% ethanol.

Indicators:

RED: 0.5 g phenolphthalein + 3.0 g p-nitrophenol

ORANGE: 0.45 g phenolphthalein + 6.0 g p-nitrophenol

YELLOW: 6.0 g p-nitrophenol

GREEN: 0.6 g thymolphthalein + 6.0 g p-nitrophenol

BLUE: 1.5 g thymolphthalein

VIOLET: 0.9 g phenolphthalein + 0.4 g thymolphthalein

ACID-ALCOHOL SOLUTION:

- 0.05 M H_2SO_4 mixed with an equal volume of 95% ethanol)
  - Dilute 2.8 mL of conc H_2SO_4 to 1 L with deionized water. Mix with an equal volume (1 L) of 95% ethanol.

H_2SO_4-GLYCERIN SOLUTION:
Dilute 10 mL of conc H_2SO_4 in 20 mL of glycerol. Transfer to a dropper bottle.

Base solution:
(0.012 M NaOH): Mix 1.00 g of NaOH with distilled water and dilute to 2.0 L

Pre-Demonstration Preparation:

1. Label the beakers with their color, and place 2 drops of indicator solution of that color in the center of each beaker. Set them on the light box in the rainbow order (ROYGBV) from left to right.

2. Label one of the pitchers as acid and fill completely with acid-alcohol solution.

3. Label the other pitcher as base, and fill completely with base solution. Set it on the floor behind the table out of view of the audience.

4. Add 25 drops H_2SO_4 glycerin solution in the center of the 4 L plastic container.

PROCEDURE:

Using the 30 mL beaker, add 25 mL of the acid/alcohol solution to each of the 6 beakers. The solutions should remain colorless. Place this pitcher down and pick up the sodium hydroxide solution.

Slowly add sodium hydroxide solution to the first beaker until it turns red but does not stay. Place beaker down and just add enough sodium hydroxide solution to each of the other 5 beakers. Keep them colorless.

Now just add a few mL of the sodium hydroxide solution until the colors develop and stay.

Now add a drop of the glycerin-sulfuric acid. Stir with stir bar. The colors should disappear.

Add more sodium hydroxide solution until the color reappears.

Pick up 2 of the beakers and pour them simultaneously into the pickle jar. The solutions should turn colorless. Add the other 4 beakers 2 at a time.

Disposal:

The final solution may be disposed of down the drain.

Reference:

- Hutton and Smith, J.Chem.Ed., 61,172 (1984)
- Dept of Chem Creighton University, ChemEd ’97 Demo show.

Universal Indicator

Discussion:

Universal indicator changes color with a change in pH. The color changes with the color spectrum from red to violet when the pH changes from 4-10 and changes from violet to red when the pH changes from 10-4. When placed underwater, dry ice sublimes and a small amount dissolves into the water. The carbon dioxide then form an equilibrium with carbonic acid, H_2CO_3.

Materials:

Dry ice, Dewar, Hot/cold gloves, Large beaker or graduated cylinder, Universal Indicator, Sodium hydroxide

Procedure:

1. Place 1 pellet of sodium hydroxide into a beaker or graduated cylinder filled with water.

2. Add universal indicator until the solution is a deep violet.

3. Drop several pieces of dry ice into the solution.

4. The solution will change colors from violet to indigo to blue to green to yellow to orange to red.

5. Place one pellet of sodium hydroxide into the beaker.

6. The solution will go from red to orange to yellow to green to blue to indigo to violet.

Disposal:

Down the sink with plenty of water.

Bubbles and Burets

Adapted from http://www.nuffieldfoundation.org/practical-chemistry/indicators-and-dry-ice-demonstration

Materials and setup

Six 4 L beakers and seven 1 L cylindrical glass containers setup in the following order, about 50 cm apart:

- Beaker (Red): ~3000 mL DI water, ~1 mL of Red food coloring
- Beaker (Blue): ~3000 mL DI water, ~1 mL of blue food coloring
- Beaker (Pink): ~3000 mL DI water, ~1 mL of pink food coloring
- Cylindrical Container: ~6000 mL DI water, ~48 mL 50 % (m/v) NaOH, ~10 mL universal indicator
- Beaker (Phenolphthalein): ~3000 mL DI water, ~24 mL 50 % (m/v) NaOH, ~5 mL indicator
- Beaker (Bromocresol Green): ~3000 mL DI water, ~24 mL 50 % (m/v) NaOH, ~5 mL indicator
- Beaker (Alizarin R Yellow): ~3000 mL DI water, ~24 mL 50 % (m/v) NaOH, ~5 mL indicator

1. Add a golf ball size piece of dry ice to beaker (Red) and beaker (Alizarin R Yellow).
   1.1. The beaker (Red) will have CO2 bubbles, but will not change color (it will stay red).
   1.2. The beaker (Alizarin R Yellow) will have CO_2 bubbles, it will change color from red to yellow.
2. Add an approximately golf ball size piece of dry ice to beaker (Blue) and beaker (Bromocresol Green):
   2.1. The beaker (Blue) will have CO2 bubbles, but will not change color (it will stay blue).
   2.2. The beaker (Bromocresol Green) will have CO_2 bubbles, it will change color from blue to yellow.

3. Add an approximately golf ball size piece of dry ice to beaker (Pink) and Beaker (Phenolphthalein):

    3.1. The beaker (Pink) will have CO_2 bubbles, but will not change color (it will stay pink).

    3.2. The beaker (Phenolphthalein) will have CO_2 bubbles, it will change color from pink to clear.

4. Add an approximately golf ball size piece of dry ice to the cylindrical container:

    4.1. The cylindrical container will have CO_2 bubbles, the color will change several times. The solution will start as purple, then turn blue, then turn green, then turn orange/yellow, and finally turn red.

5. After the dry ice has finished sublimation, begin adding 50 % (w/v) NaOH (about 1 drop/ second) using a double-stopcock buret in a clamp on a ring stand to each of the indicator containers:

    5.1. The beaker (Alizarin R Yellow) will change color from yellow to red.

    5.2. The beaker (Bromocresol Green) will change color from yellow to blue.

    5.3. The beaker (Phenolphthalein) will change color from clear to pink.

    5.4. The cylindrical container's color will change several times. The solution will start as red, then turn orange/yellow, then turn green, then turn blue, and finally turn purple.

Safety Information

Wear goggles and gloves; and other proper lab attire. The sodium hydroxide (NaOH) is very caustic… avoid contact with it!

Elephant's Toothpaste

Adapted From
http://chemistry.about.com/od/chemistrydemonstrations/a/elephanttooth.htm

Materials

- Graduated cylinders, 100, 500, and 2000 mL
- 30% Hydrogen peroxide, H_2O_2
- Dish soap
- Food coloring

Procedure

Have five graduated cylinders setup in the following order to form an arch, about 50 cm apart:

1. 100 mL Grad Cylinder: 2.5 mL of 30 % H_2O_2, ~8 drops of detergent, 1 drop blue food coloring
2. 500 mL Grad Cylinder: 12.5 mL of 30 % H_2O_2, ~2 mL of detergent, 5 drops blue food coloring
3. 2000 mL Grad Cylinder: 50 mL of 30 % H_2O_2, ~8 mL of detergent, 20 drops green food coloring
4. 500 mL Grad Cylinder: 12.5 mL of 30 % H_2O_2, ~2 mL of detergent, 5 drops yellow food coloring
5. 100 mL Grad Cylinder: 2.5 mL of 30 % H_2O_2, ~8 drops of detergent, 1 drop yellow food coloring

Procedure

1. Add 0.5 mL of saturated KI to the two 100 mL grad cylinders. A pillar of blue foam will erupt from one grad cylinder. A pillar of yellow foam will erupt from the other grad cylinder.

2. Add 2.5 mL of saturated KI to the two 500 mL grad cylinders. A pillar of blue foam will erupt from one grad cylinder. A pillar of yellow foam will erupt from the other grad cylinder.

3. Add 10 mL of saturated KI to the 2000 mL grad cylinder. A pillar of green foam will erupt from one grad cylinder.

Safety Information

Wear goggles and gloves; and other proper lab attire. Avoid contact with the 30 % H_2O_2… it is very corrosive. Avoid touching the foam, cylinder, and steam… they will be very hot!

Sodium acetate stalagmite

Adapted from
http://ncsu.edu/project/chemistrydemos/Thermochem/SatNaOAc.pdf

Description

A supersaturated solution of sodium acetate trihydrate is crystallized upon initiation by a seed crystal.

Materials

- Sodium acetate trihydrate
- Flasks
- Rubber stoppers
- Petri dish
- Water

Note: This demonstration needs to be prepared 24-hours in advance.

Procedure:

Dissolve 50 g of sodium acetate trihydrate in 5 mL of water with gentle heating. Use a watchglass to prevent evaporation and rinse the sides with a very small amount of water to avoid initiating unwanted crystallization. Stopper and let solution cool slowly.

Demonstration can be performed one of two ways:

1. **Stalagmites.** First, a seed crystal can be added to petri dish (or crystallization dish) and the supersaturated solution can be poured on top of the seeds crystal to initiate crystallization of sodium acetate.
2. **Hot pack.** Seed crystals can be added to the solution to initiate crystallization. The solutions will solidify and become hot to the touch.

Alternative for multiple repeated demonstrations: Prepare the supersaturated solution as normal, then transfer to small capped vials or test tubes.

Disposal

The demonstration can be continuously reused. The solid can be scraped/transferred back into the original flask and heated to dissolve with an additional 1-2mLs of water. If disposal is required, solid can be placed in the trash or washed down the sink.

Luminol

Adapted from
http://ncsu.edu/project/chemistrydemos/Light/Luminol.pdf

Description

Two solutions are combined to create a luminescent blue solution. The luminescence results from the oxidation of an organic molecule, luminol. The reaction is initiated by the addition of hydrogen peroxide and catalyzed with copper sulfate. The luminescent glow lasts 1-2 minutes. The glow is similar to the one found in fireflies from the enzyme luciferase.

Materials

4.0 g of sodium carbonate

0.2 g luminol

24.0 g $NaHCO_3$

0.5 g ammonium carbonate monohydrate

0.4 g copper (II) sulfate pentahydrate

50 mL of 3% H_2O_2

Preparation

Solution A.
Dissolve 4.0g of Na_2CO_3 in 500 mL of H_2O. Add 0.2g of luminol, dissolve with stirring. Add 24.0g of $NaHCO_3$, 0.5 g NH_4CO_3, 0.4g $CuSO_4$. Dilute to 1 liter

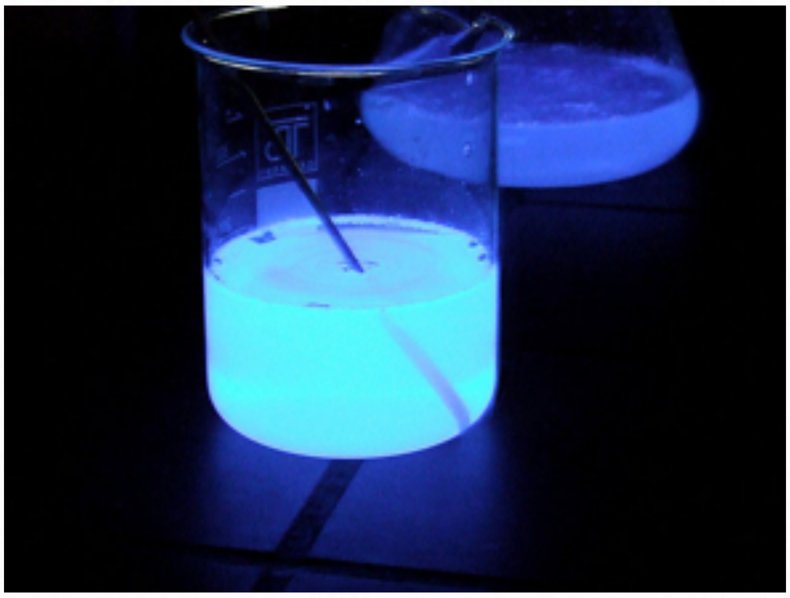
Solution B.
Dilute 50 mL of 3% H_2O_2 to 1 L. (alternatively, add 5mL of 30% H_2O_2 to 1L)

Demonstration

Turn down lights as much as possible. Combine the two solutions while pouring down a column or long tube. A glass condenser or plastic tubing works well. Try to maintain equal pouring rates and the blue glow will persist for 30-60 seconds.

Cleanup

All solutions are sink disposable.



Guncotton

Materials

- Concentrated sulfuric acid, H_2SO_4
- Concentrated nitric acid, HNO_3
- Sodium bicarbonate
- pH paper
- Long handle lighter

Preparation

Mix 70 mL H_2SO_4 with 30 mL HNO_3 in ice bath. *Solution will fume.* Add small pieces of cotton for 1 min and use a glass stir rod to push the cotton into the solution. Remove the cotton and rinse three times with large volumes of fresh water. Perform a final rinse with dissolved aqueous $NaHCO_3$ and test for pH to be above 7. Remove the cotton and let air dry. *Caution: the dried cotton is very flammable. It can be stored safely under water and dried 24-hours before the demo is performed.*

To make red-burning guncotton, soak the synthesized and neutralized guncotton in 0.05-0.1 M $SrNO_3$, squeeze out excess solution, and let air-dry. Perform combustion as described, but flame will not be as fast upon combustion.

Performing the demonstration

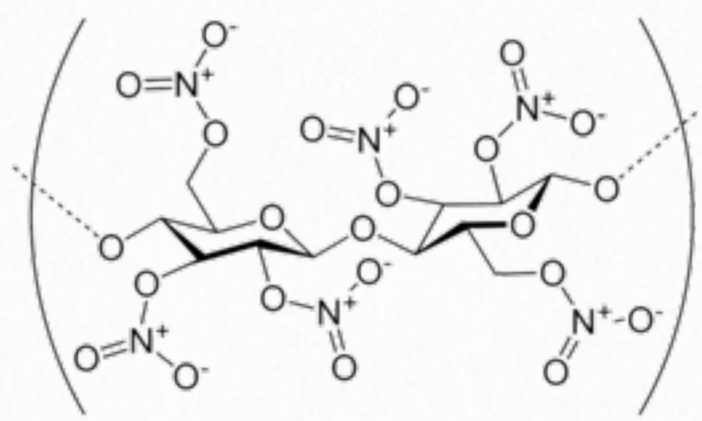
The demonstration can be performed once the guncotton has air dried for 24-hours. Please a small piece of pulled-apart guncotton in a glass dish, beaker, or flame-proof tabletop. The piece should be as large as a ping-pong ball once pulled apart. Ignite the lighter, then bring it near the guncotton so that your arm is fully outstretched when the guncotton ignites.

Cleanup

All solutions need to be neutralized before sink disposal. Residue from combusted guncotton can be cleaned with a paper towel or sponge.

Explanation

Nitrating common cellulose through the addition of nitric acid produces guncotton, also known as nitrocellulose. The nitro groups, $-NO_2$, are highly unstable producing the bright flash upon ignition. Along with destabilizing cellulose, the nitro groups also incorporate additional oxygen in the structure, allowing for rapid combustion that is not as dependent on the diffusion of oxygen from the air.



Methane Bubbles

Overview

Bubbles filled with methane rise when released. The rising bubbles are set on fire with a candle on a stick to demonstrate the combustion reaction.

Hazards

Methane gas is flammable.

Materials

- Bubble solution
    - ✓ *Make your own with 30 mL of Dawn dish soap to 500 mL of water.*
- Methane source
- 0.5 – 1 meter of Tygon (plastic) tubing
- Large crystallizing dish
- Long-handle lighter

Procedure

Attach one end of the tubing to the gas outlet. Place the soap solution in the crystallizing dish. Turn on the gas outlet so there is a gentle flow and submerge the tubing into the bubble solution. Flammable methane-filled bubbles will began to form in the solution. Once enough bubbles form, turn off the flow of methane. Wet your hands and try to scoop up the bubbles in the dish. **Make sure your hands are very wet.** Once some bubbles accumulate in your hand, stretch out your arm and ignite the bubbles. A large 1-2 foot flame will form, but be careful not to jerk-back your arm.

Alternative

Remove the tubing from the bubble solution and connect it to a long-stem glass funnel. Place the funnel into the bubble solution, then turn on the methane. As a bubble forms, turn it upwards and “flick” it off the funnel. Try to light the bubble before it breaks.

Why this works (and doesn’t set you on fire)

The bubble is mostly methane with a thin film of water and soap; it is the water that keeps you safe. Water has a high heat of vaporization, meaning it takes a large amount of heat to boil away the water. Since the water remains on your skin, you stay cool and look cool too!

Polarized Light

See Journal of Chemical Education 1993, 70, 74-75. Colors are produced with polarizers and a beaker of corn syrup. We used a light box (Logan Light Pad) with the document camera, but an overhead projector also works.

Magic Coloring Book

Can purchase at a magic store or online link to Amazon). Tabbed pages allow flipping of black-and-white, colored, or blank pages. Create story about how the changes are due to pH-sensitive dyes and CO_2 and H_2O from breath creating carbonic acid – or other good sounding explanation. But then show how the tabs work – don't let them go away believing your story!

Yellow Brick Road

A flask containing a red colored solution is opened and the words “Follow the Yellow Brick Road” are said into the flask. After a few Munchkins say this phrase, the solution turns yellow.

MATERIALS

- 250 mL of water
- 2 drops of phenol red
- Dilute NaOH
- 500 mL Erlenmeyer Flask, stopper to fit.

PREPARATION

Place 250 mL of water in the 500 mL Erlenmeyer flask. Add 2 drops of phenol red. Add just enough dilute NaOH to produce a red color. Stopper the flask until used.

PROCEDURE

Open the stopper and say “Follow the Yellow Brick Road” into the flask.

Pass the flask around and speak into the flask until the solution turns yellow.

DISPOSAL

This solution can be flushed down the sink with plenty of water.

REFERENCE

L. Summerlin, and J. Ealy, Jr. Chemical Demonstrations, A Sourcebook for Teachers. American Chemical Society, Washington, 1985, p. 40.

Sneaky mystery reaction (oscillating reaction)

Of the known oscillating reactions, the Briggs-Rauscher is among the best for demonstration. The three solutions have several chemicals (H_2O_2, KIO_3, H_2SO_4, $MnSO_4$, malonic acid, and starch) and take an hour or so to prepare, but the solutions will still work for a month or more. See either Shakashiri or Summerlin for the procedure. The explanation for this reaction is rather complicated; see the Shakashiri reference for more details. A simple explanation is that iodine in the solution is oscillating between an ionic form (I^-, the clear solution), a free state (I_2, the amber color), and a starch complex (the blue color). The H_2O_2 in the first solution drives the reaction. (We used liquid starch, which is simpler than using soluble starch.) Sodium thiosulfate ($Na_2S_2O_3$) is used afterwards to reduce the I_2 formed. The reduction is exothermic, so go slowly. Once colorless, the contents can be poured down the drain.