2004 National Chemistry Week
Discovery World Shows
Health and Wellness

Demonstrations:

The theme this year is meant (obviously) to focus on the interaction of the human body and chemistry with a particular notice paid to keeping our bodies healthy. The demos will attempt to integrate this theme with notes prior on how you can segue from one demo to the next. In the interest of blowing a few things up, the correlation begins to break down towards the end (the health and wellness of the woosher bottle is not overt, but fun).

Note: Demonstrators may alter the demonstrations or the order.

Chemistry and Food:

Begin this segment with a discussion of the daily necessity of food and water. Can discuss some of the major components of food (protein, fat, carbohydrates, etc) and the amount of water our bodies need. The students should be well versed on nutrition.

1. Iron in Total Cereal

Concept: Magnetically attract the iron (fine particulate) in total cereal to a white spin bar.

Experiment: Setup: Stir plate and large (white) spin bar
800 or 1000 mL beaker (the larger the better)
400-600 mL of water
2-3 cups of Total cereal

1. Have the water ready in the beaker, stirring.
2. Add the cereal and let this soften and stir until the end of the show (this takes time – a good demo to begin with and come back to).
3. Once the cereal has softened and sufficiently mixed, remove the spin bar and place on a paper towel. The iron will collect on the spin bar (rather fine particulate). Can leave on the towel for after the show and students to view.

Discussion: Total cereal claims to have daily supply of many vitamins and minerals. One of these is our daily need of iron (can talk about iron in blood if you would like). Prompt the children for properties that we know about iron – (answers will range) magnetic, metallic, gray color, hard, etc. By softening the cereal into a water-based slurry in the presence of a magnet, can collect the iron in the cereal.

Notes: As stated above, this works best under the following conditions: allow the cereal to sufficiently soften, have the spin bar continuous mix the cereal (if too thick may need to manually move around periodically with a stirring rod), and using enough cereal.

2. Red Cabbage Indicator

Concept: Following the total cereal demo, segue to the acidity of food versus the basicity of blood and how to observe this. One food product is a natural indicator – red cabbage.

Experiment: Setup: Red cabbage juice (prepared ahead)
Various pH liquids (will be marked for this demo) – most likely diluted lye, vinegar, white soda, water
Color Chart (?)
Series of same size beakers (250 mL) with liquids listed above (150 mL for good visualization)
Stirring rod
One large beaker for overall mixing (800 or 1000 mL)

1. Pour 150 mL of cabbage juice into empty beaker and discuss the color (explain the term indicator and what should change as we go from acid to base).
2. Pour 25 mL of the cabbage juice into the water. Discuss why no change is observed.
3. Pour 25 mL of the cabbage juice into the vinegar – discuss color changes (and acids).
4. Pour 25 mL of the cabbage juice into the lye – discuss bases.
5. Discuss the pH of foods (and the stomach) and pour 25 mL of the cabbage juice into the white soda. Discuss the pH of foods again.
6. Can mix the solutions to observe how the mixtures can neutralize (and how we would know by color if that happened) – can tie this settling upset stomachs with baking soda or antacids.

Discussion: Tie into the prior demo by discussing the iron fines and how these get into or become a part of our blood. Metals are dissolved by acids, which are present not only in food, but also in our stomachs (about 1 M HCl – which doesn't need to be said ✍).

3. Water Composition in Fruit – Floating / Sinking Oranges

Concept: Water content of oranges (in solution) cause oranges to be more dense that water and sink when pealed. However, to protect the water in the orange the peal itself is a less dense covering that aids in sealing in the water, so an unpealed orange (or a peal carefully reapplied) will allow the orange to float – less dense.

Experiment: Setup: A large clear container, half filled with water
Two naval oranges
Draw a face on the balloon astronaut.

1. Holding the oranges, discuss the importance of water in our diets.
2. Discuss the amount of water in foods as well as beverages.
3. Oranges have a large amount of water, but are also protected against the water loss by a peal. Placing the oranges in the water, show how they are less dense and float (the peals are spongy, etc)
4. Peal one orange and again drop into the water and it will now (since unprotected) sink.
5. If the peal was carefully removed, can be placed around the orange and should float once more.

Discussion: This is a boring demo, but does help the kids think about the sources of needed diet components. Can certainly prompt the children for information and also discuss the concept of density. Leads well into the next demo.

4. Water Composition in Fruit – Shattering Oranges

Concept: By freezing the water in an orange in liquid nitrogen, the fruit can be dramatically shattered like glass.

Experiment: Setup: LN_2
Dewar
Orange slices (use previous orange)
Tongs

1. Using a thin piece of orange and a pair of tongs, lower the orange into the LN2 and wait until the majority of the boiling around the orange ceases.
2. While waiting discuss the difference between liquid water and solid water and what would be expected of all of the water in an orange was frozen and then the orange was dropped.
3. Remove the orange and drop (or throw) onto the table – should shatter.
4. Can do again.

Discussion: Again, the underlying idea is the amount of water needed in our bodies and the sources we have for the water we need – not only actually drinking water, also other beverages and foods.

5. Digestion – Burning Gummi Bears

Concept: We talked about food and food composition. Also discuss the stomach and pH. Next discuss the process of digestion by which these foods are broken down. This experiment shows this process in a more expedited fashion than our bodies use.

Experiment: Setup: Ring Stand and blast shield
Tongs
Potassium chlorate
Large test tube

Methane
Bunsen burner
Lighter
Gummi Bear (or other high sugar candy like licorice / jelly beans, etc)

1. Add potassium chlorate into test tube ($^3/_4$" to 1" full) – have blast shield between the test tube and audience.
2. Light the Bunsen burner.
3. Gently melt (must all be melted to work) potassium chlorate.
4. Turn off gas (extinguishing flame).
5. Using tongs, drop gummi bear into melt – should "dance" prior to being entirely consumed.

Discussion: Talk about what happens in the process of digestion (in as much or as little detail as you like). Can discuss how the speed at which it happens to the Gummi bear in our demo is quite as fast (and in as few steps) as our body. Can also discuss the amount of energy we observed from only one Gummi bear and correlate this to our bodies and energy.

Chemistry Within Our Bodies

6. Enzyme Action – Halloween Colors

Concept: Observing the catalytic properties of a material analogous to the catalytic properties of enzymes.

Experiment: Setup: Large test tube sitting on an inverted cork ring
Iron (III) nitrate solution
H_2O_2 (30%)
25 mL and 50 mL graduated cylinders

1. Measure 20 mL iron nitrate into the large test tube.
2. Add 50 mL H_2O_2 and have the students observe the color change (orange ✍ black ✍ orange).
3. Continue to add H_2O_2 in 50 mL increments; remembering once the catalyst is hot (usually after the first addition) the reaction goes (and bubbles) much more vigorously.
4. Stop after the last addition that comes within 3-4 inches of the top.

Discussion: Talk about catalysis and correlation to enzymes. Use the observations to explain this (how the orange solution was always returned after the reaction ended). Can also discuss about the initiation and heat (the test tube will still be very warm at the end of the show).

7. Neuron Communications – Electrical Conductivity of a Pickle

Concept: A electrolyte (students most understand by explaining a salt solution) will conduct electricity, making the analogy to the communicating occurring with our nerological system.

Experiment: Setup: Pickle
Pickle set up
Extension cord
Variac

1. Plug cord into variac, check to make variac is on zero and switched off.
2. Attach the pickle to the pickle set up. To do this, slide one electrode approximately one inch into the pickle on one side and (holding the pickle) adjust the other electrode so it also is inserted into the pickle one inch.
3. Plug the variac into power.
4. Turn off the lights.
5. Turn the variac on and slowly increase the power (do not touch the metal portions of the set up or the pickle).
6. The pickle should glow (may slightly smoke or have a small odor).
7. When done, turn the variac to zero, switch off, and unplug. Remove the pickle from the set up and discard.

Discussion: Tie the glowing pickle to our nervous system.

Chemistry in Our Clothing

8. Making Nylon – Synthetic clothing

Concept: Making the polymer nylon.

Experiment: Setup: 50 mL of 0.5 M hexamethylenediamine in 0.5 M NaOH
50 mL of 0.2 M sebacoyl chloride in hexane
250 mL beaker
Forceps or tweezers
Stirring rod

1. Pour the NaOH solution into the beaker.
2. Slowly pour the hexane solution into the beaker as a second layer (may be easier to pour down a stirring rod). You may want to do this on a pie pan or dish in case of spilling.
3. Place the beaker on the floor (in front of the table).
4. Gently grasp the interface with the forceps and slowly pull the nylon. Should be able to get a long string to pull out.
5. To clean up following the show – stir the solution to react and make a maximum amount of nylon. Remove the ball, wash and discard in trash. Liquid can now be poured down the drain.

Discussion: Polymers are important in many functions of our lives. Some are naturally occurring (can discuss DNA) and some are synthetic. We know them more by the name plastic. All (in their most basic) are combinations of the same or similar building blocks. One type of polymer is nylon.

9. Flammable Clothing – Gun Cotton

Concept: Demonstrate the flammability of cotton clothing, versus non-flammable treated clothing, versus cotton treated with nitric and sulfuric acid.

Experiment: Setup: Plain cotton
Cotton treated with borax
Gun cotton (treated with nitric and sulfuric acid)
Lighter
Three large Petri dishes

1. Prompt the children for what happens to cotton when ignited. Ignite the cotton.
2. Ask the children about flame retardant materials (pajama fabric for one) and what they would expect to happen when lit. Attempt to ignite the borax treated cotton.
3. Tell the children that chemicals can treat cotton in a completely different manner, rather than no or slow burning cotton, one can have fast burning cotton. (Turn off the lights for a dramatic effect here). Using a piece the size of a marble and fluffed to the size of a golf, ignite the gun cotton (it will ignite very quickly).

Discussion: Discuss the need for protective clothing.

Respiration and Combustion

This section can be segued from the previous by tying in the fun of watching trained professional blow stuff up. More to the theme, you can talk about respiration and the analogy to respiration (prompt for the reactants (oxygen and fuel) and products).

10. Methane Mamba

Concept: Methanol gas will ignite quickly in the presence of oxygen and rise in air due to its density.

Experiment: Setup: Methane
Half bottle equipped with tube at the base.
Lighter
Candle on a stick
Soap solution

1. Fill bottle reservoir with soap solution.
2. Ignite the candle stick and leave burning (this could be a two person job – keep the candle stick lit, but away from the methane until needed).
3. Begin slow flow of methane to form column of bubbles.
4. Allow column to get tall (approx. 1.5-2 ft) and sever a portion of the column (1 ft). Bubbles will rise.
5. Ignite the bubbles with candle stick. (Turning off the lights can be dramatic, but hard to find the bubbles to ignite).

Discussion: You can relate this to respiration and our bodies burning food.

11. Woosher Bottle

Concept: Methanol gas will ignite quickly in the presence of oxygen.

Experiment: Setup: Large and larger Nalgene jugs
Candle taped to end of meter stick or paper matches and tongs
Lighter
Methanol

1. Pour about 15 mL of methanol into smaller jug and roll it around the inside surfaces for about 10-15 seconds.
2. Pour out any remaining liquid. For drama, turn off the lights.
3. Light the candle on the meter stick and slowly move candle over the jug. You may need to tip the candle into the bottle. Instead of this you can also drop a lit match into the bottle with a pair of tongs (this will burn more rapidly, so be ready).
4. You will get a loud whoose when the methanol vapors burn.
5. You will likely see the flame oscillate into and out of the bottle for several cycles caused by the pressure flucuations due to the air in the bottle be heated and cooled.
6. You can ask if the bottle will relight (it shouldn't) and what was consumed (oxygen and fuel). By only adding fueling, the jug will not relight, but can repeat when you expel air into the jug (careful not to pass out).
7. Repeat with the larger jug.

Discussion: Similar to previous explanation.

12. Methanol Cannon

Concept Similar to above, but now blocking the reaction with a stopper and initiating with a spark.

Experiment Setup: Nalgene bottle(s) of various sizes with metal files protruding
Telsa coil
Corks
Methanol

1. Pour a small amount (less than 5 mL) of methanol into the bottles. Put the cork into the bottle.
2. Vigorously shake the bottle. Open and pour out the liquid. Recap (remember – the tighter the cork is on, the louder the pop).
3. Warn the students it may be loud (protect ears).
4. Turn on Telsa Coil and hold to one of the files.
5. POP!

Discussion: Similar to previous explanation.