West Side Science Club – Event #14 – "Chemistry of Pranks and Gags"

Original Presentation

Date: 8 June 2013
Time: 10 am to 12 pm
Site: West Side Science Club

Brief Description

This lesson plan describes a set of activities where students learn about the chemistry behind many common pranks and gags.

Big Questions

Word of the Day: "Pranks"

(1) How can chemistry be used in the entertainment industry?

(2) What are the chemical reactions behind many common pranks and gags?

Concepts

Concepts to cover from the "Work of CCI Solar" Mind Map:

Level one (concepts): combustion, energy, reactions, fuels, conversion, light, wavelength, emission, acids, bases

Level two (skills/affective): developing good safety habits, chemistry is useful, chemistry is fun

Motivation for this Activity

This meeting was originally planned at the mini-retreat as "temperature and gases", but our work with dry ice in the last session covered much of this area. We thought a session on "the chemistry of pranks" was something sure to be engaging to the kids as a fun end-of-the-school-year activity.

Lesson Plan

Student Objectives

- To discover how knowledge of chemistry can be applied to the construction of pranks/gags
- To appreciate that chemistry has uses in the entertainment industry

Schedule/Agenda

- Review: Event #13 – "Carbon" (10 min.)
- Activity: Foaming Sugar (25 min.)
- Activity: Stink Bombs (10 min.)
- Activity: Flame Balls (30 min.)
- Activity: Disappearing/Invisible Ink (30 min.)
- Wrap-up (10 min.)

Materials

Foaming Sugar

- Cup of coffee (??)
- Citric acid (Paul)
- Baking soda (??)
- Table sugar (??)
- Spoons (??)
- Cups (??)
- Food coloring (to make "fake" coffee) (??)

Flash Balls

- Nitrocellulose cotton balls – synthesized in lab (Paul)
- Lithium chloride (Paul)
- Boric acid (Paul)
- Sodium chloride (Paul)
- Hair dryer (Paul)
- 3 Long tweezers (already at the club?)
- 3 Candles (Levi)

Stink Bombs / Fart Spray

- Commercial fart spray (??)
- Hydrogen sulfide (Paul)
- Ethanethiol (Paul)
- Skatole (Paul)

Disappearing Ink

- Phenolphthalein solution (Paul)
- Vinegar / acetic acid (Paul)
- Sodium hydroxide solution (Paul)
- Flasks for mixing (Paul)

Safety

- Students must wear their eye protection.
- Students must wear gloves for the flame balls and disappearing ink activities.
- Ignition of the flame balls must be done only while supervised by a mentor at the table. The mentors should monitor use of the candles, but kids can light their flame balls by themselves (using tweezers or tongs to hold the balls at a distance)
- No items should be eaten.
- Proper (wafting) technique should be used to smell the chemicals with foul odors. The technique involves open the container, holding it at a distance in one hand, and using the other hand to fan vapors to the nose.

Review of Previous Event: "Carbon"

- Recall that burning fossil fuels like oil and gasoline generates what gas? (Carbon dioxide, CO_2)
- Recall that increased levels of carbon dioxide in the atmosphere can lead to acidification of the oceans and global warming.
- Recall that dry ice is solid carbon dioxide and is very cold. When it heats up, it sublimes from a solid to a gas. In a closed container, this can lead to explosions. We used this property to blow up small plastic containers, which is a common and fun prank when done safely.

Facilitation Questions

- What is the main element in fossil fuels? (Carbon.) What are some examples of fossil fuels? (Oil, gasoline, coal, natural gas.) Locate carbon on the periodic table. (#6)
- Does CO_2 make water acidic or basic? (Acidic.) What experiment did we run a while ago to show this? (Blowing bubbles into a solution with pH indicator and observing a blue-to-yellow color change.)
- What is solid CO_2 called? (Dry Ice.) What is its temperature? (Very cold.) What happens when it heats up? (It turns into a gas.)

Activity: "Foaming Sugar"

- Introduce this activity by acting out the prank. Someone can offer Ben a cup of coffee, and then (prank) sugar. When Ben adds the prank sugar to his coffee, it will foam and overflow the cup.

Procedure

1) Supply each table with a sample of citric acid, baking soda, and table sugar.

2) Have the students dissolve a small portion of each solid in three separate vials. Label the vials!

3) In a fresh vial, have students mix the solutions. Try all three combinations (sugar and citric acid, sugar and baking soda, citric acid and baking soda). Have them make a chart for observations in their notebooks.

(They should only observe a reaction when citric acid is mixed with the baking soda.)

The reaction is:

H^+ (from citric acid) + HCO_3^- (bicarbonate, from baking soda) $\rightarrow$
H_2CO_3 (carbonic acid, which is unstable) $\rightarrow$ H_2O + CO_2 (gas = bubbles)

Carbon dioxide rears its head at Science Club once again! (Make the connection to last session's work with dry ice.)

4) Now have the students mix solid bicarbonate and solid citric acid in a fresh vial.

(They should note that no reaction occurs. You need water to serve as a solvent. That is why this prank works so well, you can mix the reactants ahead of time and store them together, but they will only react when placed in someone's drink, where water is present.)

5) Now add the solid mixture to a cup of water/coffee, and watch the prank in action.

Facilitation Questions

- What are the bubbles? (Carbon dioxide.)
- Why do you think people add table sugar, if it does not react with either of the other ingredients? (To fake people out, because baking soda and citric acid do not look like table sugar.)

Activity/Demo: "Stink Bombs and Fart Spray"

- This activity/demo is quick.
- Introduce this activity by spraying fart spray and accusing someone (Ben?) of farting. ☺

Procedure

1) Each table has vials with samples of ethanethiol, sodium sulfide, and skatole. Take turns opening the vials and using proper wafting technique to smell the vapors. Do not let the kids put the vials right up to their noses!

2) Discuss what they smell like. (Each vial contains a pure sample of a known molecule. These molecules are what make things smell bad to us.)

3) Note that it takes very, very little sample to create a lot of smell. (Our noses are very sensitive machines!)

4) Cap the vials tightly and return them to Paul.

Facilitation Questions

- What do you think these molecules could be used for, besides fart spray?

  (To repel animals or humans. Also, they are used as bait to attract and trap insects that like to eat poo.)

Activity: "Flame Balls"

Introductory Demo

1) Light a candle and use tweezers to burn a regular cotton ball. (Note that it chars and smokes).

2) Extinguish the ball by dunking it in a cup of water.

3) Hold up a nitrocellulose ball to the fire. Ask kids what is the difference in how the balls burn. (The nitrocellulose burns much more quickly and cleanly. The fire is assisted because the nitro groups on the material are better oxidizers than oxygen at making the material burn.)

4) Burn a nitrocellulouse ball treated with lithium chloride. Note that it burns pink/magenta. (Can they remember where they saw this before? The colored flame activity run by Dylan, Harry, and Jackson!)

Now, it is their turn:

Procedure

1) Put on gloves. Each table will be supplied with pre-made nitrocellulose balls and vials of solid lithium chloride, sodium chloride, and boric acid.

2) The students should dissolve the solids in 2-4 mL of water.

3) Use a pipette to place ten drops of one of the salt solutions onto a nitrocellulose ball. Count them out!

4) Holding the ball with tweezers, bring it to a hair dryer to dry the water off. (~Two minutes.)

> Why do we need to dry it out? (Fire is retarded by water.)
>
> What remains behind when the water is gone? (The solid salts, but we can't see them on the cotton balls because everything is white.)

5) Light the candle at your table. Let a kid take tongs or tweezers and hold the ball to the flame.

6) Repeat as desired.

Mentors: Do not leave the candle unguarded. If you need to leave the table, blow it out and re-light it upon your return.

Facilitation Questions

- What color light has the most energy of magenta (LiCl), boric acid (green), or yellow (NaCl)? (Green.)
  …the least? (Magneta.)

Activity: "Disappearing Ink"

Intro Demo

Spill disappearing pink ink on someone?

Procedure

0) Everyone keeps his/her gloves on.

1) Each table will be supplied with solutions of acid (vinegar), base (sodium hydroxide), and a pH indicator (phenolphthalein, in ethanol.)

2) Have them properly smell the acid vial. What does it smell like? (Vinegar, because it is vinegar.)

3) Have them properly smell the base vial. What does it smell like? (Nothing.)

4) Take a sample of water and add one drop of pH indicator.

5) Add one or two drops of base. What happens? (It turns pink.)

6) Now, add two or more drops of acid. What happens (It turns clear.)

7) Repeat as desired.

8) Take your cup and add base drop by drop until it just turns pink. This is now your disappearing ink.

9) Spill a portion onto a paper towel.

10) Wait, or breathe on the paper towel. What happens (The pink color disappears.)

Facilitation Questions

- Why does the pink color go away? (The spill must come into contact with acid.)
- What do you think is the source of this acid? (Carbon dioxide from the air and your breath! Tie it back to our old work on the acidification of the oceans and blowing bubbles into the samples that turned from blue to yellow.)

Wrap Up

- Plenty of options.

Check for Understanding

- Does carbon dioxide make mixtures of water more acidic or basic? (Acidic!)
- How do you smell a substance properly? (Waft the vapors to your nose.)

References

(1) Flame Balls:
http://chemistry.about.com/od/makechemicalsyourself/a/make-nitrocellulose-flash-paper.htm
http://www.youtube.com/watch?v=_utrFBo8DzY

(2) Disappearing Ink:
http://chemistry.about.com/od/demonstrationsexperiments/ss/disappearink.htm

(3) Foaming Sugar
http://www.sillyjokes.co.uk/frothing-foaming-sugar (check out the list of ingredients)