Elementary School Demonstrations

Introduction

Each year Dixie State College teams up with some Washington County elementary schools to do some service learning. The organic chemistry students go over to different elementary school classes to do some chemistry demonstrations for the kids. This has turned out to be a lot of fun in years past, and hopefully you will have fun too.

Teams of two or three students are assigned to a one hour block of time with 1 class of 25-30 students (usually 5th graders). Experience has shown that you should prepare around 6-7 demonstrations (some are shorter than others). We will use one lab period to let you chose as a team which ones you want to use, practice to make sure you can do them effectively, and get all of the equipment ready that you will need. Only electricity, tap water, and a table are available at the elementary school, so you'll need to bring everything else with you. Make sure to have detailed instructions handy when you perform your demonstrations, as in the excitement it is easy to forget important details. If you have any other demonstrations that you would like to use, please consult with me about them first.

The idea here is not to try to teach scientific principles so much as just to wow the kids. At their age the spark that may lead them to study science can be kindled just by having them see that chemistry is fun and exciting. Ask questions so that they can participate (what do you think will happen now? what did you see?) and let them ask questions as well. They are also impressed by lab coats and goggles!

Before coming to lab, please read through the demonstrations and get some ideas about which sound best to you. There are no pre-lab questions, and no questions at the end of the lab. You do not need to write an introduction in your lab notebook. After you have done your demonstrations at the elementary school, you will write a one-page description of what you did and how it went. You may want to include enough details that you could repeat these demonstrations later!

Demonstrations

Appearing and Disappearing Grape Juice

This demonstration uses indicators which change color in acid or basic solution – it isn't actually grape juice, but it kind of looks like it. Two clear liquids are poured together to make a bright pink solution, and then a third is added to make it clear again. This can be a good demonstration to start with. You may want to have one set up ahead of time, and do another one in front of them to show how it works. They often like to see something again when they know what to expect.

Equipment:

- dropper bottle of vinegar

- dropper bottle of ammonia
- dropper bottle of phenolphthalein
- three 400 ml beakers
- 300 ml distilled water (tap water isn't neutral)

Procedure:
1. In beaker 1, mix 100 ml of water with 20 drops phenolphthalein.
2. In beaker 2, mix 100 ml of water and 40 drops of ammonia.
3. In beaker 3, mix 100 ml water and 50 drops vinegar.
4. Pour beaker 1 and beaker 2 together; it turns pink.
5. Add beaker 3; it goes clear again.

Bubbling beakers

While deceptively simple, the kids love this. You put dry ice in colored water, and it bubbles and vapors pour out of the top. The kids can feel the cool air coming out, and may stop up the flasks with their hands and feel the pressure building up.

Equipment:
- beakers or Erlenmeyer flasks
- dry ice
- food coloring
- tap water

Procedure:
1. Fill beakers or flasks mostly full of water.
2. Color with food coloring if desired.
3. Add chunks of dry ice. Don't add too much dry ice, or the water will freeze and stop bubbling. Let kids feel the vapors.

Exploding balloons

If you stuff a balloon full of dry ice and tie it off, the dry ice will gradually sublime and blow up the balloon; it may even pop. This takes some time, so you can set it up at the beginning and have them check back with it from time to time between the other demonstrations.

Equipment:
- dry ice
- balloons
- funnel
- something to crush it with

Procedure:
1. Crush dry ice into powder and small chunks.

2. Add dry ice to balloons using the funnel, tie them off.
3. Allow them to inflate.
4. Eventually they will pop – leave them with the kids if they haven't popped when you're done.

Balloon trick

A match held up to a balloon will normally pop it. However, if there is some water in the balloon, it will absorb the heat, and the balloon will resist the heat (for a while, anyway). This is pretty quick but can be impressive.

Equipment:

- two balloons
- tap water
- matches

Procedure:

1. Blow up one balloon with just air.
2. Fill the other with water and then blow it up also.
3. Light a match, put it under the first balloon - it will pop! You may wish to have a volunteer hold the balloon while you put the match under it.
4. But then put it under the other balloon, and if you only heat it where the water is, it won't pop.

Hot and cold packs

Description: This demonstration allows the students to feel the effect of two different solids dissolving in water – one gets warm and the other gets cold. It allows them to use their sense of touch, which they are always eager to do.

Equipment:

- a generous scoop of anhydrous calcium chloride ($CaCl_2$)
- a generous scoop of ammonium nitrate (NH_4NO_3)
- 4 plastic ziploc bags
- tap water

Procedure:

1. Prepare the bags beforehand by covering the bottom with either calcium chloride or ammonium nitrate.
2. Allow students to observe the contents of the bags up close, ask what they look like (ammonium nitrate looks sort of like sugar, calcium chloride looks like pellets).
3. Add water, asking what they think will happen. Nothing appears to, except that the solids begin to dissolve.

4. Then tell them that something is happening, but it isn't something they can see, but rather something they can feel. Ask: Who can keep a secret? (otherwise they blurt it out and ruin it for the others) Walk around holding them out so the students can feel the bottom of the bag.
5. When everyone has felt both, ask what they felt. Calcium chloride is warm, and ammonium nitrate is cold. Explain that this is similar to what happens with hot or cold packs used in first aid.

Making Gak

Description: This experiment makes a fun, rubbery substance from Elmer's glue and Borax. It is safe to hold (but should not be eaten), and can be played with for several hours before it starts to dry up and get hard.

Equipment:

- 40 ml borax powder
- 50 ml Elmer's glue
- 350 ml hot water(hot tap water is fine)
- 50 ml room temp water
- food coloring (optional)
- 600 ml beaker
- 250 ml beaker
- two stir rods or spatulas

Procedure:

1. In the 600 ml beaker, mix 350 ml of hot water and 40 ml of borax.
2. In the 250 ml beaker, mix 50 ml of water and 50 ml of glue – color the glue mixture if desired.
3. Pour the glue/water mixture into the borax solution – immediately reach in and scoop out the stringy polymer that forms.
4. Work it with your hands until enough of the water has been absorbed for it to form into a ball.
5. Let the kids hold and play with it. You can leave it with them, but tell them not to put it in their pockets (if it dried, I don't know if you could get it off).

Fireworks

Description: By adding different chemicals to a butane burner flame, you can color the flame, create sparks, and make a very bright glow. This can be a good finale.

Equipment:

- butane burner
- iron powder
- strontium nitrate
- copper nitrate

- magnesium strips
- 2 spatulas
- tongs
- newspaper

Procedure:
1. Ask: What happens on the 4th of July? Fireworks! The colors come from different chemicals as they burn.
2. Spread newspaper under the butane burner, then turn off lights (leave enough for you to see what you're doing). Put some strontium nitrate in the flames on the end of the spatula – what color is the flame?
3. Do the same with copper nitrate – it will be green.
4. Sift the iron powder into flame the flame by tapping on the spatula – this looks like sparklers (which are coated with iron powder).
5. Finally, hold the magnesium strip by the tongs and light the bottom of it – it makes a bright white light (don't stare at it for too long!).

Magic string

Description: This demonstration involves making a polymer, nylon, at the surface between a layer of water and a layer of cyclohexane. This creates a strand of polymer which can be pulled from the liquid and wound up on a tube, which makes more of the polymer, so that it looks like a string is being created out of nowhere.

Equipment:
- two 150 ml beakers
- 50 ml cyclohexane
- 50 ml distilled water
- 1 ml 40% NaOH (or 2 ml of 20% NaOH)
- 500 mg adipoyl chloride
- 500 mg hexamethylenediamine
- large test tube wrapped with paper towel (brown gives better contrast)
- paper clip

Procedure:
1. In one beaker mix NaOH, water, and hexamethylenediamine.
2. In the other mix cyclohexane and adipoyl chloride.
3. Carefully pour second mixture on top of the first so that two layers are formed.
4. Bend the paper clip into a hook and pluck up the polymer in the middle of the two layers, then start to wrap it around test tube.
5. Allow a few children to wind it.
6. Bring some dried and washed polymer for them to feel (don't let them touch the wet one – it has concentrated NaOH still in it).

Collapsing Can

If you heat a little water in the bottom of a soda can, it will push out most of the air, and if you quickly put it upside down in ice, it will collapse dramatically. It takes a little practice to make sure you know how much water to use, and how long to let it boil. Doing two is also a good idea, as the kids usually want to see it again.

Equipment:

- empty aluminum cans
- hot plate
- tap water
- tongs
- ice
- bowl

Procedure:

1. Put a small amount of water in an aluminum can.
2. Heat on hot plate until water boils.
3. Make an ice bath in the bowl.
4. With tongs, quickly stick open end of the can into the ice – the can will collapse.
5. Let the kids keep the cans (if they want).

Golden pennies

If you coat a penny with zinc powder, then hold it in a flame, the zinc and copper will melt together and form brass, which looks like gold. This is a little more involved, so you should have some pennies already done to pass out (or make a quick switch if you can't get it to work well on site!).

Equipment:

- 5 - 10 pennies (clean with soap and water – try to use new, shiny ones)
- 15 pellets solid NaOH
- 2 g zinc powder
- 3 ml water
- butane burner
- gloves
- tongs

Procedure:

1. Mix water and NaOH, add zinc powder.
2. Rub pennies with mixture (protect your hands with gloves).
3. Carefully wash off excess zinc (pennies should appear silver-coated).
4. Hold pennies in flame for a few seconds. Copper and zinc combine to form brass (which appears gold-colored).

5. Let the kids compare them to ordinary pennies (they are a very different color).
6. Make enough to give away a few - tell them that since they've been altered they shouldn't try to spend them.

Magic writing

By using base and an indicator, you can let the kids paint something in invisible ink (indicator), then reveal what they've painted (by spraying it with base). This is a good one for getting them involved.

Equipment:

- 0.5 g phenolphthalein (solid)
- 60 ml ethanol
- 500 ml distilled water
- 0.2 g NaOH, paint brushes
- poster board (or other paper)
- spray bottle
- paint brushes

Procedure:

1. Prepare a solution of phenolphthalein in ethanol and NaOH in water before hand.
2. Have a volunteer paint a secret message using the phenolphthalein solution (their name, the name of their school, teacher, etc).
3. Do another demo while you wait for it to dry.
4. When it has dried, spray the message with the NaOH solution. Spray lightly, trying to avoid too many drips. The color will appear then disappear (I'm not entirely certain why…)

Blue bottle

A stoppered flask is prepared with 150 ml of a clear solution. If you shake it up, the liquid turns a brilliant blue. Let it sit a few minutes and it goes back to clear. This can be repeated over 20 times, but gradually goes yellow over a day or two. What's happening is that the air is oxidizing some methylene blue when you shake it up, and then as it sits the glucose gradually reduces it back.

Equipment:

- 1 g glucose
- 1 g KOH
- a few crystals of methylene blue
- 150 ml distilled water.
- 250 ml flask with stopper

Procedure:

1. Add all ingredients to the flask and stopper it.
2. Let it sit still; after a few minutes, it will go clear (hopefully – this is the tricky part).
3. Shake up the flask just enough for it to go blue (hold onto the stopper). Volunteers can do this after the first time if you make sure they don't let the stopper come off.
4. Let it sit, and in a few minutes it will go back to clear. The more you shake, the longer this part will take.
5. If it stops working well, unstopper the flask to allow more oxygen to enter.