Script for Chemsations Demonstration Show

***Note**: This script is written in individual sections with one section for each demonstration so that the demonstration can be done individually and in any order. The script should be considered a suggested narration. Demonstrators and narrators can improvise and ad lib as they choose, as long as the chemistry is still correct.*

This script assumes that there is one narrator and two demonstrators; however, a separate narrator is not really necessary. The demonstrator can also narrate. In this script the narrator does all the explanations. In actual practice the demonstrator usually does some of the explanations.

Goldenrod Paper (opener)

(Narrator walks on stage and sprays, with dilute ammonium hydroxide solution, a large yellow paper taped to the demonstration table. The word "Chemsations" remains yellow while the rest of the sheet turns red.)

NARRATOR: Welcome to the Chemsations show! I'm ____________________.

(One by one, demonstrators walk on stage with sheets of goldenrod paper upon which they have written their names in yellow crayon or a clear wax candle. As each demonstrator appears, the narrator sprays the paper, revealing the demonstrator's name).

DEMONSTRATORS: *Introduce themselves as the NARRATOR sprays their papers revealing their names.*

NARRATOR: Hi everyone! Thank you for coming to see our show. Today we are going to show you some things that look like magic, but are really based on interesting chemistry. Some of the reactions are actually used by magicians. But unlike magicians, we will tell you how our demonstrations work.

Let's start with our magic writing. This paper, called goldenrod paper, is ordinary colored paper, except that coloring agent or dye is sensitive to a kind of a compound called a base. Household ammonia (it's what is in most window cleaners) is a base, so when we spray it on the paper, the base reacts with dye in the paper and the paper turns red.

(Holds up a piece of paper and sprays it)

We write messages with wax or a crayon, so the ammonia doesn't wet that part of the paper. It stays yellow and the rest of the paper turns red.

Red Green Reaction

NARRATOR: Magicians can make colors appear and disappear, but so can a chemist.

DEMONSTRATOR 1: Watch the liquid in this bottle. (*Picks up the bottle of yellow solution and swirls it gently until the liquid turns orange or reddish*.) See how the color is now reddish? Do you think I can change it again? *(Shakes the bottle vigorously up and down until the liquid turns green. Then places the bottle in a visible location)*. Keep an eye on that bottle and let us know if anything happens during the show. *(After a few minutes, the liquid should become yellow again. When an audience member notices, swirl or shake the bottle again)*.

NARRATOR: This bottle contains a dye called indigo carmine, which reacts with the oxygen that's in the air to cause the color to change. When we swirl the bottle like this (demonstrate swirling motion) a small amount of oxygen reacts with the indigo carmine to change it from yellow to red. When the bottle is shaken, more oxygen mixes with the liquid and it causes the red to change to green.

When the bottle is not shaken, sugar, or dextrose, in the solution reacts with the indigo carmine to slowly change it back to yellow and release the oxygen so the reaction can take place all over again. Eventually the dextrose gets used up and the reverse chemical reaction can no longer take place.

Disappearing "Witch"

NARRATOR: Magicians often make things disappear. Chemists can too.

DEMONSTRATOR 1: I was watching the Wizard of Oz last night. It was really good, but I fell asleep before it was over. Do you know what happened to the wicked witch?

DEMONSTRATOR 2: Sure, I've seen that movie a bunch of times. Let me show you what happens to the witch. *(Takes a dish with a small amount of clear liquid and puts in a piece of Styrofoam™ with a witch drawn on it. It appears to melt slowly and sink into the dish). (In witch's voice)* I'm meeeeeeeeltiiiiiing.

DEMONSTRATOR 1: Look, she's disappearing. What's happening? IS the witch melting?

DEMONSTRATOR 2: Well, if the witch is melting, shouldn't the dish be hot? Touch the bowl. How does it feel?

DEMONSTRATOR 1: It's not hot. But it is getting smaller. What is this stuff? *(picks up residue in the dish)* What's going on?

DEMONSTRATOR 2: Styrofoam^{tm} is made of a plastic called a polymer that's made of long strands like very, very thin spaghetti. The strands trap gas, holding pockets of gas inside the plastic. So this piece of Styrofoam^{tm} is mostly gas bubbles surrounded by little bits of plastic. When the Styrofoam^{tm} is exposed to a particular kind of liquid, called acetone, the strands begin to slip around, like spaghetti in a bowl. The gas that was trapped escapes, and all that's left is the plastic strands in a gooey heap. The liquid acetone is often found in nail polish remover.

Disappearing Water

NARRATOR: I am going to pour water into this cup and at the count of 5 I will empty it over ________________'s (Demonstrator's) head. *(Makes a show of pouring water into cup).*

DEMONSTRATOR: *(Looking distressed)*

NARRATOR: *(Holds cup over Demonstrator's head)* Count with me… One, two, three, four, five. *(Turns cup as if to pour, but nothing comes out).*

DEMONSTRATOR: Phew! *(Looks pleased)*

NARRATOR: What happened to the water?

DEMONSTRATOR: The cup had a small amount of a chemical called water lock or aqua lock in it. The chemical is made of a plastic and starch and it soaks up many times its weight in water, like a sponge.

NARRATOR: *(Turns cup upside down and taps it hard on the table, revealing the gel that has formed).* This is what happened to the water. It made a kind of gel with the aqua lock. Many disposable diapers use aqua lock to soak up liquid.

Fake Snow

NARRATOR: Not only can chemists make things disappear, but they can make them appear too. Here in Ithaca, we usually get plenty of snow in the winter. But suppose you want snow other times of the year? You could climb a very high mountain or use chemistry.

DEMONSTRATOR: *(Adds water to instant snow powder in a large glass container and shakes gently).* It looks like snow, but is it really snow? *(Putting hand in container).* It isn't cold!

NARRATOR: No, it isn't snow. It's called instant snow. It's a polymer that absorbs a lot of water. It's similar to the aqua lock, but it breaks into pieces, so it looks like snow. But it doesn't need to be cold. *(To the audience)* Can you think of any uses for this? *(Listen to answers)*. Instant snow is often used in movies to make a scene look snowy when the air is too warm for real snow.

DEMONSTRATOR: After the show you can come up and see what it feels like.

Balloon and Skewer

NARRATOR: How many of do you think I can push this pointed skewer through this balloon? (audience has mixed reactions)

DEMONSTRATOR: (carefully and slowly pushes the skewer through the balloon)

NARRATOR: The balloon is made out of a polymer. If it is done carefully with some soap on a skewer, then the skewer can push the polymer strands aside allowing it to pass through the balloon without breaking it.

NARRATOR: Just to show you that the balloon is not a trick balloon, we'll poke it with the tip skewer.

DEMONSTRATOR: (breaks the balloon with the skewer to show it is not a trick balloon)

Disappearing Ink

NARRATOR: Two large classes of chemicals are called acids and bases. Many people think of acids as dangerous chemicals that should be avoided. But only a few acids are dangerous. Most of you have eaten some kind of acid. If you have eaten an orange you have eaten citric acid. And if you have had a salad with oil and vinegar, you have eaten acetic acid. Bases are also common, but never eaten. They taste very bitter. You find bases in soaps and cleaners and you may have tasted a base if you ever accidentally got soap in your mouth.

When acids and bases are mixed together they react and the chemicals use each other up. Many so-called magic tricks use acids and bases along with other chemicals called indicators. Indicators are special dyes that change color depending as an acid uses up a base or a base uses up an acid.

DEMONSTRATOR 1 and DEMONSTRATOR 2 walk toward each other across the stage. DEMONSTRATOR 1 is carrying a small beaker of blue liquid.

DEMONSTRATOR 2: Hey, how do you like my new shirt/lab coat?

DEMONSTRATOR 1: It's nice! *(Stumbles and spills blue liquid on Demonstrator 2).*

DEMONSTRATOR 2*: (Angry)* You ruined my new shirt!

DEMONSTRATOR 1: Don't get angry. If you just blow on the stain, it will disappear. *(To audience)* Everyone help blow the stain away*. (Blows on blue stains until they begin to disappear)*

NARRATOR: Your breath contains many gasses, including something called carbon dioxide. Carbon dioxide is an invisible gas that can combine with water to make a very weak acid.

The blue liquid that was spilled on the shirt is actually an indicator that turns blue in a base and turns clear when there's no base present. In the beaker it was mixed with water and a weak base. When we blew on the fabric, the carbon dioxide in our breath combined with the water to make an acid that used up the base. As the base was used up, the indicator became clear. But it's still there, and you can tell because if you spray the cloth with more base, the place where the indicator spilled will turn blue again. *(Sprays shirt with ammonia and spills turn blue)*

Dry Ice And The Pink Liquid

NARRATOR: Now we are going to show you another reaction with dry ice.

Notice we have this big tube filled with pink liquid.
I'm going to add dry ice and watch what happens.

DEMONSTRATOR: *(adds dry ice to tube)*

NARRATOR: asks audience: What do you see?
(It looks like fog or smoke and then after a minute the liquid becomes colorless.)

NARRATOR: Dry ice doesn't melt like regular ice. Dry ice is a frozen carbon dioxide gas – the same gas that you breathe out. It goes directly from a solid to a gas - this process is called sublimation.

The pink color is because an indicator has been added to a basic water solution. The indicator is pink in a base solution and colorless in an acid or neutral solution. When carbon dioxide combines with water to make an acid, it neutralizes the base causing the indicator to change from pink to colorless.

Rainbow Tube

NARRATOR: Because acids use up bases, and vice versa, we can make a rainbow tube.

DEMONSTRATOR: *(Using a water solution of a universal indicator, fills a long transparent plastic tube with a rubber stopper at each end. The indicator should be light greenish. There should be a 4-6 inch space at the top of the tube. Puts about 10 drops of acid in one end of the tube. Stoppers it tightly and turns the tube end over end, then adds 10 drops of base to the other end of the tube and stoppers it tightly.)*

NARRATOR: Did you see that as base and acid were added, the ends of the tube turned blue and red?

DEMONSTRATOR: *(Turns the tube over in front of the light)*

NARRATOR: When the tube was turned end over end, what happened? Notice the rainbow. The tube was filled with an indicator. It's acid at one end and basic at the other. The indicator shows that the acid and base use each other up as they meet in the middle of the tube.

DEMONSTRATOR: *(Holds tube in front of light box to show off colors)*

NARRATOR: What will happen if the tube is turned over again? Will it all turn red? Will it all turn blue? Should we try and find out?

DEMONSTRATOR: *(Turns tube end over end, repeats)*

NARRATOR: The rainbow colors remain even after the tube is turned over several times because the liquid flows around the air bubble and the acid and base ends of the tube do not mix very well. It is very difficult to mix things in a long tube, but after turning it over many, many times, acid and base would use each other up and the entire tube would be green.

Ripping a Soda Can in Half

NARRATOR: Did we mention that studying chemistry could make you strong?

DEMONSTRATOR: *(Selects an adult from the audience)*. Can you please tear this can in half? *(This will be very difficult to do. After the adult tries, NARRATOR selects a child from the audience, hands him or her a pair of gloves and asks)* Can you please tear this can in half? *(The child can do it easily).*Child must wear gloves to protect hands from the can's edges.*

NARRATOR: Soda cans are made of aluminum with a plastic coating on the inside and outside. We scratched the inside and then added some copper chloride solution. The copper in the solution reacts with the aluminum so that the can was only held together by the paint on the outside.

CARBON DIOXIDE DEMONSTRATIONS

Before the show, the dry ice should be broken up into pieces, the soda can filled with water, and the large standing cylinder filled with the Phenolphthalein solution and sodium hydroxide solution. It should be dark pink.

NARRATOR: You may already know that when you breathe out, carbon dioxide is in your breath. When you exhale, carbon dioxide is invisible, but many of you have seen CO2 in the form of dry ice. "Dry ice" is frozen carbon dioxide. Unlike frozen water, carbon dioxide changes from a solid to a gas without becoming a liquid in between. This is called sublimation. Dry ice is also much, much colder than even the coldest winter day you can think of. It's so cold you have to use gloves to pick it up, so you don't freeze your fingers. There are some interesting "tricks" that can be done with dry ice. Let's see what happens when we put some dry ice in water that has an indicator in it.

DEMONSTRATOR: *(Puts a chunk of dry ice in the large cylinder with the pink solution.)*

NARRATOR: *(Watch for a moment)* What is happening?
(Audience will answer: bubbles, smokes, turns from pink/red to clear)
Wow! Lots of things are happening! Why does it bubble? It bubbles because the water is much warmer than the dry ice and it is sublimating. Remember that dry ice doesn't melt, it just turns from a solid to a gas. The bubbles you see are the gas formed from the dry ice in the warm water.

What looks like smoke is actually water vapor that comes out of the air when it gets very cold forming a tiny bit of fog.

Why does the color change? The indicator in the water is pink when there's a base in it. The carbon dioxide mixes with the water and makes a weak acid. The pink disappears because the acid uses up the base. The dye, or indicator, changes color.

Dropping Bubbles

Before the show, add dry ice to the bottom and cap the container. Wet the paper towel with soap solution. Put a tray down for bubbles to drip into.

NARRATOR: There's water in the bottom container. Dry ice is added to the water and the cap is sealed. There's soap on the top end. What do you think is in the bubbles? *(Audience will answer smoke, carbon dioxide, water vapor)*

Because dry ice is so cold, it causes water vapor in the air into tiny droplets; a cloud or fog, and that is what looks like soap. Of course there is also carbon dioxide in the bubble, but because it is colorless, you cannot see it. Notice that the bubbles drop quickly to the ground? What does that show about the gas in the bubble?
(That it's heavier than air)
We can show you that carbon dioxide is heavier than air because soap bubbles filled with hot air float on top of carbon dioxide.

Floating Bubbles

Before the show, place dry ice in water in a dish on a piece of foam in the fish tank.

DEMONSTRATOR:
(Lights the tank from the side if possible. Adds warm water to the dry ice.)

NARRATOR: As the dry ice warms up, the fish tank fills with carbon dioxide.

DEMONSTRATOR: *(Uses bubble wand to blow bubbles over the tank filled with carbon dioxide. Not into the tank).*

NARRATOR: Notice that bubbles don't sink to the bottom of the tank. The carbon dioxide is heavier than air and the air filled bubbles float on top of it.

Luminol

NARRATOR: So far we have seen that mixing chemicals can cause color change, make a gas, and make things change. Combining chemicals can also make heat. Think about a fire. It's a chemical reaction, or perhaps lots of reactions happening all at once. Mixing chemicals can also make light.

DEMONSTRATOR: *(Pours small amounts (10-20 milliliters) of luminol demo solutions A and B into separate containers. Turns off the lights. Pours both mixtures simultaneously into the funnel attached to the spiral tubing at the same time. Blue light appears in the liquid that runs through the spiral.)*

NARRATOR: This reaction is similar to what happens in fireflies when they light up. In the firefly's body, two chemicals are mixed and light is emitted. In our reaction we used a mixture of chemicals called Luminol and hydrogen peroxide. Thank you all for coming to our show. Let's give our chemists a big round of applause!

Simple After-Show Activities

- Q & A
- Pass around fake snow
- Children write their names on goldenrod paper

Credits and Disclaimer

Acknowledgments: These activities were developed by the Sciencenter with a grant from the Camille and Henry Dreyfus Foundation, Inc.

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