**THIRTY DEMOS IN FIFTY MINUTES**

**(and maybe a few more)**

**Presented by the Secondary Science Methods class at the**

**University of Northern Colorado**

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***The authors take no responsibility for any injuries that might***

***result from using these activities. Proper safety precautions***

***should be taken during the performance of all of the above activities.***

**1. DISAPPEARING INK (Amy Nachtigall)**
In a beaker combine 50 mL of 95% ethyl alcohol, a few drops of thymolphthalein indicator, and just enough sodium hydroxide solution (a few drops of 1M NaOH) to produce a deep blue color. Put the solution in a squirt bottle and enjoy! When squirted on a piece of cloth the blue ink will gradually disappear. The reason the ink disappears is because the sodium hydroxide in the solution is a base. As carbon dioxide from the air dissolves into the solution it forms an acid which reacts with the base to form a more neutral solution. The indicator is blue when in a basic solution with a high pH but it loses its color when the pH drops below about 9.5 as the CO2 makes the solution more and more acidic.

**2. TORNADO IN A JAR (Jocelyn Friedman)**
This is a good demonstration to do when starting a lesson on tornadoes. Another ideas is to have the students create one of their own.

The materials you need are: 1 mayonnaise jar, 1 spoonful vinegar, 1 spoonful Ivory soap, Water, light food coloring

Mix the vinegar and Ivory soap in the jar. Then add water to fill the jar. Add in a drop of food coloring and your tornado in a jar is complete. Shake the jar horizontally and a funnel cloud will appear.

**3. PATRIOTIC DEMONSTRATION (Lance Mosness)**
A single solution is added to three different indicators. When it is added the solutions will be red, white, & blue, respectively. This demonstration can be done in test tubes, beakers, or petri dishes. The primary solution added to each of the indicators is a combination of ammonium hydroxide ( NH4OH ) and ammonium sulfate ( (NH4 )2SO4 ). It is made by dissolving 3.5 ml of concentrated Ammonium Hydroxide and 3 grams of Ammonium Sulfate in 100 ml of Distilled Water. The red indicator is a phenolphthalein solution. It can be made by crushing 5 or 6 EXLAX tablets into a bottle of rubbing alcohol. About 3 drops are needed in the test tube. It turns red when it reacts with the basic Ammonium Hydroxide. The white is formed when the Ammonium Sulfate in the primary solution forms a precipitate with a Barium Chloride ( BaCl2 ) solution. The Barium Chloride solution is formed by dissolving about 5 grams in 10 ml of water. Only about 6 drops are needed. The blue color is formed by reacting the primary solution with a thymolphthalein solution. A few milliliters of thymolphthalein solution can probably be obtained from a local high school chemistry teacher. Only 3 drops are needed. The thymolphthalein turns from clear to blue when it reacts with the basic Ammonium Hydroxide.

**4. CELLULAR RESPIRATION (Tara Denison)**
Blow through a straw into a bromthymol blue solution. Bromthymol blue is an acid/base indicator that is slightly basic and has a blue color. As you blow into the solution, CO2 (from your breath) makes the solution slightly acidic. This turns the solution a light yellow. This is proof that our bodies do, indeed, produce CO2 via cellular respiration.

Materials: bromthymol blue, straw, beaker

**5. HOW TO FILL A BOTTLE WITH WATER USING A CANDLE (John Erdkamp)**
This experiment is truly a classic but unfortunately it is often misexplained. Place a small lump of clay (or "Playdough", etc.) in the center of a plate or shallow pan to serve as a candle holder. Place one candle into the clay. Pour about 1" of water into your pan with the candle and clay base. Light the candle. Quickly cover the burning candle with an inverted glass jar or beaker, making sure the entire rim of the glass is under water. As expected, after a few seconds, the candle will go out as the oxygen inside the jar is consumed. At the same time, water will rise and partially fill the inverted glass jar.

MATERIALS: Several small candles, Lump of clay (1" to 2" cube), Plate or shallow pan, water, glass jar or beaker (glass cranberry juice jar)

Somehow, the pressure inside the inverted glass jar was reduced, and water was pushed inside by outside atmospheric pressure. Did this reduction in pressure really occur because the oxygen was consumed by the candle?

Do the experiment again, this time using 3 candles burning at once. After all candles go out from lack of oxygen, notice how much water was pulled into the jar this time. You will see that 2 to 3 times as much water was pulled into the jar. Both times, the jar held the same amount of oxygen. Both times, the same amount of oxygen was consumed, but the water level was higher the second time. Why?

As the candle burned, the air above the candle and then the jar was heated. The hot air expanded and left the jar. Soon the candle went out, the air cooled, and contracted. Water from the pan entered the jar to take the place of the air that escaped. More candles made the air in the jar warmer than only one candle, thus creating a more dramatic result when the air cooled.

**6. THE BURNING CANDLE (Nicholas F Barnes)**
This is a simple demo that I like to use to allow students to make hypothesis and observations about a common item that is readily used. This demo can be modified to fit many levels of difficulty. The materials used are a candle, match, holder, and piece of paper for the wax to drip. Some questions that might be asked are: What is the color of the flame? Does it smell? What did the candle look like before and after it was ignited?

**7. FUN WITH CO2 (ACID/BASE CHEMISTRY) (Michael David Kaiser)**
In this demonstration a small piece of dry ice is added to a large graduated cylinder containing a weak basic solution and a few drops of universal indicator (purple cabbage juice can also be used). The basic solution can be made by filling the cylinder with water and adding a few drops of concentrated ammonia until a purple color is reached. This indicates that the solution is basic. Add a very small piece of dry ice to the cylinder. The solution will froth and turn from purple to blue to green to yellow etc. as the pH decreases. As the dry ice sublimes, carbonic acid is produced in the solution. The universal indicator indicates the change in pH as the solution changes from acidic to basic. This demonstration clearly shows students that dissolved gases can effect the pH of a solution in much the same way as an addition of acid or base to a solution. Dry ice is fun to observe but the same effects can be obtained by dropping in a couple of tablets of Alka-Seltzer.

**8. GLACIAL MOVEMENT (Trey Griffin)**
The manner in which a glacier moves across the land is rather complex. In this demonstration, I will use common household materials to simulate a glacier. The material shows the kind of motion the top of the glacier has as it moves downhill and where the fastest movement is in the glacier.

MATERIALS: 1 oz. shampoo concentrate, 2 index cards (one 4x6, one 3x5), 5 numbered circles of paper from paper punch, tape

Prepare a V-shaped valley by folding a 4x6 index card lengthwise and taping it to a 3x5 card. Add additional tape where the two cards meet so that any material placed in the V will not flow through the crack.  Holding the trough so that the open end is up and the closed end forms a pocket, squeeze about 1 oz. of shampoo concentrate into the trough. Number the five small circles of paper 1 through 5. Hold the trough so that no movement of the concentrate occurs while you line up the five paper circles in order across the concentrate near the 3x5 card. If you dampen a finger, it will pick up the circles. As the shampoo concentrate is allowed to slowly flow down the valley, you can record the position of the circles every 30 seconds.

This demo shows how a glacier moves through a valley. The dots can be considered the markers and then the end moraine product. By tracking the movement we can then observe the fluid motion of the glaciers in a valley.

**9. SUPER SATURATED SOLUTIONS (Karen James)**
This will demonstrate the behavior of a super saturated solution, and show that things are not always what they seem. Gradually warm hydrated Sodium Acetate in a large flask until it dissolves into its own water of hydration before presenting the demo. To begin the demo, explain to students that the solution is super saturated Sodium Acetate. This means that the solution is at the very edge of staying a liquid (for younger students, explain that there is not any more room left in the solution for anymore molecules of Sodium Acetate, and that the solution doesn't want more molecules in with it). Then add one or two crystals of solid Sodium Acetate into the flask. The solution will rapidly solidify. Proceed to turn the flask upside-down, showing that the solution is now solid.

This demo can be used over and over. The super saturated solution can be returned to a liquid state by heating and can be stored at room temperature for the next time.

The reusable chemical hot packs available from drug stores work on exactly the same principles except they use a shock wave from a "clicker" to initiate the crystalization.

**10. THE CELL (Kim Hulse)**
This is a great demonstration or model that allows students to make the abstract idea of a cell concrete. All you need is a small rectangular box, a plastic baggie, gelatin, balloons, and assorted beads. The box represents the cell wall of a plant. The baggie represents the nucleus of the cell while the gelatin represents the cytoplasm. The balloons represent vacuoles and the beads represent the organelles of the cell. After a study of the cell and its parts, this makes a great "dissection" activity.

**11. EMULSIFICATION (Jill C Reynolds)**
This is a good demonstration to show how bile emulsifies fats and makes them easier to digest. You will need a jar with a tight lid, vegetable oil, water, and detergent. Pour water half way into the jar, add any color of food coloring to it. Then fill the other half of the jar with oil. Cover and shake. Note that they do not mix. Remove cover and add some detergent. Cover and shake again. Note that this time the oil breaks up into tiny droplets and mixes with the water. This is called emulsification. Explain that this occurs in the small intestine and that it increases the surface area of the fat droplets so they can be easily broken down by digestive enzymes. It is also why detergents are able to remove grease from your clothes.

**12. ENZYME ACTION (Donna M Wilson)**
To start the discussion of enzymes, hand out to each student a chocolate covered cherry. Explain how the cherry is coated with a thick crystal sugar and then dipped in chocolate. The enzyme invertase is mixed in with the sugar. During the time that the candy is packaged, shipped, stored, and sold, the invertase causes a breakdown of the solid sugar creating a thick sugar syrup. While the sugar might have eventually broken down on its own it would have taken a very long time without the enzyme. Enzymes are organic catalysts which increase the rates of chemical reactions.

**13. VISCOSITY (Noah Oyler)**
Liquids of different viscosities are sealed inside clear of plastic bottles along with a couple of dark marbles. When turned upside down the students can clearly see the difference in viscosities by the rate of decent of the marbles. Some possible liquids might be: water, vegetable oil, rubbing alcohol, and corn syrup.

**14. SUNKEN ICE CUBES (Amy Nachtigall)**
Kids tend to jump to conclusions when things appear to be identical. Fill one beaker with plain water. In another beaker, place alcohol (rubbing alcohol from the drug store is fine but any other alcohol will work). The beakers will look essentially identical. Place an ice cube in each beaker. The ice will float in the water because its density (about .9 g/cm3) is less than the density of water (about 1 g/cm3). The ice will sink in the alcohol because the density of the ice is more than the density of alcohol (about .8 g/cm3). This is a great demo to introduce density because it really surprises the students and gets them to think.

**15. CLOUD IN A JAR (Jocelyn Friedman)**
This is a good demonstration to do while teaching a lesson on how clouds form. You will need a liter size soda bottle, wooden matches, and a fizz keeper top for a soda bottle from the grocery store. First, start by asking the students what is needed to make a cloud.

1. Water or moisture
2. Low pressure
3. Condensation Nuclei (smoke from the matches)

To begin the demonstration fill the bottom of the bottle with about 1/2 centimeter of water, put the fizz keeper lid on the bottle and pump to raise the pressure inside the bottle. Now unscrew the fizz keeper to release the pressure. Nothing will happen because only the first two ingredients were present; there were no condensation nuclei in the bottle.

Repeat the experiment but this time light a match, blow it out, then drop the smoking match into the bottle. Quickly put the fizz keeper lid on the bottle and again pump to raise the pressure. When the fizz keeper is unscrewed this time, a cloud should form due to the lowered pressure, moisture from the water, and condensation nuclei from the smoke. In order for the cloud to be easily seen, try to wear dark colored clothing. If you do not have a fizz keeper to increase and decrease the pressure in the bottle you can use your mouth instead. After you light the match drop it in the bottle, when it goes out put your mouth over the top of the bottle and blow into the bottle. This will increase the pressure. To decrease the pressure, quickly inhale.

**16. PLASTER OF PARIS (Lance Mosness)**
This demonstration is a spectacular precipitation reaction. The solutions need for this demo are a 2 molar concentration of Sulfuric Acid ( H2SO4) and a 2 molar concentration of Calcium Chloride ( CaCl2). Take equal amounts of each and pour into a tall glass or beaker and stir for a second. Immediately a white solid precipitate is formed. Try turning the glass upside down, the solid precipitate remains in the glass. The 2 molar solution of Calcium Chloride can be made by dissolving 22 grams of Calcium Chloride in 100 ml of water. Calcium Chloride is often available as "ice melter" for your sidewalks.

The 2 molar solution of Sulfuric Acid can be made by dissolving 11 milliliters of concentrated Sulfuric Acid in 90 milliliters of water. CAUTION: Sulfuric acid is very caustic in both its concentrated as well as its diluted forms. Take appropriate cautions.

**17. FERMENTATION (Tara Denison)**
Heat a 10% sucrose solution up until it's warm to the touch. Pour some solution into a fermentation tube. Put about 2 grams of fresh yeast in the tube with the solution. Shake and invert the tube so the solution and the yeast gets mixed up and so the solution stays at the bottom of the tube when it's turned right side up. Stopper the tube with a cotton ball, and set the tube down to wait for a reaction. Bubbles of CO2 will be produced because of the fermentation that's going on with the sucrose and the yeast. During the process of fermentation the yeast consume the sugar and give off CO2 and ethyl alcohol ( C2H5OH ). Students will see, smell, and be grossed out (fun!) when the bubbles push the cotton ball out and begin to ooze out the top of the tube.

Materials: 10% sucrose solution (10 grams of table sugar in 90 grams of water), yeast, fermentation tube, heating device (hot plate, microwave, etc.), beaker, cotton ball.

**18. MAGIC POLYMER BALLOON (Michael David Kaiser)**
In this demonstration an inflated balloon is pierced from the bottom by a large needle that has been previously coated with cooking oil. The non-polar oil acts as both a lubricant and a binding agent allowing the rubber to polymerize around the needle and thus seal the hole without popping the balloon. Be sure not to pierce the balloon from the side because it will pop. The materials for this demonstration are simply one balloon, one twelve inch needle, and cooking oil. If you can't find a 12 inch needle try a Shish-Ka-Bob bamboo skewer. You do not even have to apply the oil since bamboo contains its own natural oils.

Polymers are an important area in chemistry. This demonstration gives students a good idea of some important properties of polymers. Other common polymers include PVC tubing, Kevlar, other plastics and even bubble gum!

**19. ANTI-GRAVITY? (John Erdkamp)**
This demonstration will seem to "defy gravity" while at the same time illustrating the concept of center of mass.
    Materials Needed: A 16 oz carpenter's hammer, A wooden 12 inch ruler, About 10 inches of string, Small piece of tape (any kind)
Make a small loop with about 10 inches of string that is strong enough to hold the weight of the hammer. Slip this loop around the handle of the hammer (if the handle is polished, you may need to tape the string in place around the handle to prevent sliding). Next, slide the ruler through this same loop. Put the "head" of the hammer towards the 1" mark end on the ruler.

Depending on the size of your hammer, the string should rest between the 3" and 5" mark on the ruler. The edge of the handle should rest against the wooden ruler. The ruler and handle should form an angle of about 30 to 45 degrees. It is important that the head of the hammer extends beyond the edge of the ruler... an inch beyond the edge of the ruler should be more than enough. Now you should be able to carefully balance the device off the edge of a table. The hammer head should be under the table surface that the ruler is resting on. With a little practice, you will be able to balance this heavy, seemingly awkward device with only one 16th of an inch... or less in contact with the table.

This works because the center of mass (somewhere near the hammer head) is under the supporting end of the ruler on the table top. It looks impressive because the majority of the ruler and handle is suspended off the edge of the table.

**20. LIVING OR NONLIVING (Nicholas F Barnes)**
In this demo, a "critter" is created with super glue and distilled water in a petri dish. The dish is placed on the overhead so the students can see this "critter" move around the dish. A good conversation is then generated to discuss what is characteristic of living and nonliving things. I would use this demo towards the beginning of the year to help the students to understand the study of biology.

**21. NON-BURNING DOLLAR BILL (Michael David Kaiser)**
This is an old chestnut that is often used in magic shows as well as chemistry demonstrations. It can be easily demonstrated that alcohol burns in air by putting a few mL in an evaporating dish and lighting it. All students know that water puts out fires. A solution of half water and half alcohol however has some interesting properties. If a dollar bill is soaked in a 50/50 solution and then ignited by a match, the dollar bill will catch fire but not burn. This is because a 50/50 mixture still has enough alcohol to burn but there is enough water in the solution to wet the bill and keep it from burning. If you only have 70% denatured rubbing alcohol available, try mixing 100 mL of the alcohol with 50 mL of water. This should be close to the correct proportions.

**22. MOVING FAULTS (Trey Griffin)**
The way faults move is an interesting and important concept. Through the use of clay you can easily simulate the types of faults that occur.

With your hands flatten four different colored pieces of modeling clay into flat pancakes about.5 to 1 cm thick. Put them on top of each other to make a stack of different colored layers.  These layers represent the layers of the earth's crust. Make a line across the top of the clay to represent a road on the surface of the earth. Cut the stack in half. Pick up the two halves of clay. Move one half up. Keep the other half down. That is one way faults move. It is called a dip slip fault. This is what people normally think of as a fault. Now align the two halves of clay on a table top. Move the two halves past each other horizontally. This is another way faults move and it is called a strike slip fault. This is the way the famous San Andreas fault in California moves. Sorry but California is not going to fall into the ocean someday.

**23. DISAPPEARING PENNY (Karen James)**
This will demonstrate the principles of refraction and total internal reflection. Put a penny underneath a clear plastic tumbler. Show that the penny can be seen from the side even when a piece of cardboard covers the top of the tumbler. Then fill the tumbler with water to the very top and again cover the top with a piece of cardboard. The penny will have seemed to have disappeared. Explain that the light from the penny is being refracted as it enters the bottom of the tumbler. When it hits the side of the tumbler it strikes at such an angle that it undergoes total internal reflection and can only exit the water at the top surface. This is really the principle of fiber optics. Light enters one end of the fiber and can only exit at the other end.

**24. ECOSYSTEM BOUNDARIES (Kim Hulse)**
Two colors of paint and white posterboard work well to demonstrate the overlap of ecosystems. Primary pigments (red, yellow, blue) work best, because when blended together they make easily recognizable colors. Paint the two colors near each other without letting them touch. These two colors represent two ecosystems. Then, while the paint is still wet, show how when the two ecosystems (colors) begin to overlap, they blend together in the real world and on the page.

**25. TRANSMISSION OF INFECTIONS (Jill C Reynolds)**
This activity simulates the transmission of infectious agents and is great to use with the entire class. It can take as long as you want it to to run. Use it as a minilab or an introduction to a new unit. Materials needed include clear plastic cups or beakers, saltwater, fresh water and a small amount of silver nitrate solution.

In advance, speak to two students. Ask one not to interact (mix) with anyone and ask the other to interact with as many people as possible. The one student whom you have asked to interact will begin with a half a glass of clear saltwater while the rest of the of the students will receive the same amount of fresh water in their cups. Ask the students to interact with other students by pouring their water into the other persons glass and then having the other person pour half the liquid back into their glass. After a few minutes stop the interactions. Drop one drop of the silver nitrate solution into each cup and explain that if it turns cloudy then they had become infected. Many interesting avenues can be taken with this activity. If students keep track of whom they interacted with and in which order, the class can actually determine who was the original infected person. This is similar to how health officials try and trace the progress of an infectious disease.

**26. CHOCOLATE CHIP MINING (Donna M Wilson)**
This activity represents the limitations of the earth's natural resources. A chocolate chip cookie will represent an area of Earth that is rich in minerals (chocolate chips). Have the students take a cookie and "mine" the chips with toothpicks. Have the students note that different cookies have different amounts of minerals and resources. The amount of minerals may vary. When students have removed all the resources from their cookies, ask them to try and put the cookie back together so that it can be an area full of abundance again for future generations.

**27. EXPLODING COLORS (Nicholas F Barnes)**
This demo deals with surface tension. This works by adding 2% milk to a round aluminum pan, adding different colors of food coloring (red, yellow, green, blue) at points equally spaced around the pan. Then add the "magic solution" (clear dish detergent). And enjoy the magic colors!

**28. WATER TO GRAPE JUICE TO WATER (Courtney W. Willis)**
Students are amazed to see both colored and clear liquids poured from the same container. Before the presentation you will need to prepare a pitcher full of water into which about 7 or 8 ml (one pop bottle cap) of household ammonia is added. You will also need 3 clear glasses. The first glass remains empty, while about 3 ml of phenolphthalein indicator solution is added to the second and 7 or 8 ml of household vinegar (5% acid) is added to the third. The phenolphthalein indicator solution can easily be made by adding 5 or 6 crushed EXLAX tablets to a 16oz bottle of rubbing alcohol.

To begin the demo pour the clear liquid from the pitcher into the first glass and the liquid remains clear. When the clear liquid from the pitcher is poured into the second glass a bright pink liquid is produced. The liquids are all poured back into the pitcher and the pink liquid is again poured into the first two cups but is turned clear when it is poured into the third cup. The most fun though is making up a story to go along with the demonstration.

**29. THE COLORS OF MOM (Courtney W. Willis)**
Phillip's Milk of Magnesia (MOM) can be used to show a very colorful demonstration. Add about 10 ml of MOM to about 500 ml of water and a couple ml of universal indicator. Stir well.

This will produce a cloudy purple liquid. While continuously stirring, add a few milliliters of 1 molar hydrochloric acid until the solution turns red. As you continue to stir the color gradually goes through the colors of the rainbow and back to the purple color.

The MOM ( Mg(OH)2 ) is not very soluable in water therefore not all of it dissolves leaving the cloudy texture. The little that does dissolve makes the liquid slightly basic and accounts for the indicator turning purple. When the acid is added, the dissolved MOM is neutralized and the excess acid turns the indicator red. As some of the undissolved MOM begins to dissolve into the water, the pH gradually increases which accounts for the rainbow of color changes by the indicator. Eventually the solution is saturated with MOM and the pH is back to where it started. This demo can be repeated several times. When all the MOM has been dissolved and neutralized the liquid in the beaker will be a clear red.

**30. FLOATING EGGS (Trey Griffin)**
This demonstration will amaze students with an egg floating between in the center of a clear liquids. Mix a solution of epsom salt and water to a point of super saturation. It will still look like clear water. Carefully add warm water on top of the solution. Once the mixture is created, it will appear to be homogeneous. Slip the egg into the solution and it will appear to be suspended in the container. It will remain above the epsom salt and below the warm water so that it floats in the middle.

MATERIALS: 1 300 ml jar, epsom salt, 1 egg

**31. WHAT TEMPERATURE IS IT? (Kim Hulse)**
Have a student put one hand in cold water and the other in warm water. While their hands are in the water, have them explain to the class what temperatures they can feel. Then have them quickly place both hands in room temperature water. The hot hand will feel the water as cool and the cold hand will feel the water as warm. This is a good demonstration that shows the inaccuracy of the human body as a thermometer.

**32. NEED FOR A THUMB (Donna M Wilson)**
This activity demonstrates the utility of our opposable thumbs. Tape a students thumb to the adjacent index finger. Ask them to try to perform a number of normal everyday activities such a picking up and holding a variety of objects. It will quickly illustrate some of the many ways that we utilize the use of our thumbs in everyday activities.

**33. THE BURPING JAR (Courtney W. Willis)**
A simple but very convincing demonstration that air expands when heated can be done with just a glass bottle and a coin that just rests over the mouth of the bottle.

Wet the coin and place it over the mouth of the bottle. The water helps provide a good seal. Gently wrap your hands around the bottle so that the warmth of your hands will gradually warm the air of the bottle. As the air is warmed the pressure inside will rise until it is great enough to push the coin up and allow some of the air to escape. This will usually happen several times.  A quarter works well on a typical pint vinegar bottle or a half dollar on a fruit drink bottle.

**34. WEIGHING A FINGER (Meg Chaloupka)**
Place a hexagonal pencil on a flat surface. Place a 12 inch ruler on the pencil so that is is balanced and not touching the table on either side (like a teeter-totter). Place a clear plastic glass at each end of the ruler. Fill one glass to within 1/2 inch of the top with water. Slowly pour water into the second glass until it is just slightly heavier than the first glass. Ask your students what they think will happen when you put your finger in the glass that is slightly lighter. Demonstrate the reaction by putting one finger into the lighter glass of water. Be careful not to touch the rim of the glass. Ask your students if they can explain why the balance tips. By sticking your finger in the lighter glass you increase the volume that the glass is holding by an amount equal to the volume of your finger. The increase in volume makes the glass heavier and it tips the balance to that side. Now ask what will happen when you remove your finger!

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