

## 2014 Science Demonstrations

The following science demonstrations were prepared and presented by the teacher candidates in the University of Northern Colorado's SCED 441/541 (Methods in Teaching Secondary School Science) in Fall 2014. Dr. Rob Reinsvold was the instructor for the course. Most of the demonstrations were presented at the 2014 Colorado Science Conference as "*30 Demos in 50 Minutes*". This continued the tradition started by Dr. Courtney Willis over a decade ago.

Although each demonstration was tested by the teacher candidates, you are encouraged to test it yourself before using it for instruction. Often a slight change in materials can affect the success of the demo. Also, even though some safety considerations are mentioned, please use additional caution with any of the demos, especially if students will be using the demos.

You are free to use these demos if you like.



## A Needle through a Balloon

*Devin Quinn – Post Baccalaureate*

### MATERIALS:

Balloons  
Long wooden or metal skewers  
Petroleum jelly  
A sharp pin  
Cellophane tape

### SETUP:

1. Blow up a balloon to a medium size
2. Take your sharp pin or skewer and cover its entirety in Vaseline.

### PROCEDURE:

1. Take the skewer and insert it into the balloon at the end opposite the knot
2. Push the skewer all the way to the middle of the balloon
3. No pop!
4. With a different balloon insert the skewer through the side of the balloon
5. Pop!
6. Now place a piece of tape on the side of the balloon and insert the skewer
7. No pop!

### EXPLANATION:

Polymers explain why the balloon does not pop. Polymers often cross-link which facilitates the stretchy nature of the balloon. The rubber at the ends of the balloon is less stretched out than those on the side. This is evident in the different coloration observed at the balloon's ends. Inserting the pin through the sides does not work, but adding a piece of cellophane tape stabilizes the polymer cross links keeping the balloon intact.

### SAFETY:

Wear safety goggles as balloons will pop.



## Fireproof Balloon

*Devin Quinn – Post Baccalaureate*

### MATERIALS:

2 round balloons; not inflated

Water

1 matchbook at least half full of matches

### PROCEDURE:

- 1 Inflate one balloon and tie shut
- 2 For the second balloon add  $\frac{1}{4}$  cup water, then inflate it and tie shut
- 3 Light a match and hold it under the balloon with no water (the balloon will break)
- 4 Light another match and hold it under the second balloon (has water)
- 5 The balloon with water does not break!

### EXPLANATION:

Without water the balloon breaks quite easily, sometimes the flame does not even have to touch it. The balloon with the water inside does not break. The water absorbs the heat from the match saving the rubber balloon from breaking. Water is a fantastic absorber of heat because it has a high specific heat capacity.

### SAFETY:

Care should be taken when handling matches to avoid accidental fires and burns.



## An Alternative way to Inflate Balloons

*Devin Quinn – Post Baccalaureate*

### MATERIALS:

3 Packages of Pop Rocks Candy  
3 24oz bottles of soda  
Balloons

### SETUP:

Prepare 2 of the 3 balloons by placing one packet of Pop Rocks into each of the two balloons.

### PROCEDURE:

- 1 Use a narrative to explain why you needed to find an alternative way to inflate balloons
- 2 Take the pop rocks and put one package into the final balloon (the other 2 balloons should be prepared).
- 3 Carefully, take each balloon and place it over the mouths of the three soda bottles
- 4 Watch the balloons inflate!

### EXPLANATION:

The reaction that takes place when the candy is introduced to the soda produces CO<sub>2</sub> gas. The carbon dioxide rises and fills the balloons. In fact the popping sound you hear and sensation you experience when eating Pop Rocks is explain by the escaping CO<sub>2</sub> molecules.

### SAFETY:

NO SAFETY CONCERNS.



## The Aggravating Gold Fish in the Ziploc Bag

*Devin Quinn Post Baccalaureate*

### MATERIALS:

Ziploc bag gallon size  
Sharp number two pencil  
32 oz. water

### SETUP:

32 ounces of water should be added to the Ziploc bag before the demo begins.

### PROCEDURE:

- 1 Tell a narrative about purchasing a gold fish over the weekend. The gold fish was a magical fish that could speak! Problem was the fish was a big jerk. The fish insulted you, calling you ugly. Fuming mad you take a sharp pencil and try to hurt the fish.
- 2 Push the pencil through the Ziploc bag . . . no leaks!

### TIPS:

Pushing the pencil through the Ziploc bag slowly, as opposed to rapidly, will increase the likelihood that no leaks will form.

### EXPLANATION:

Polymers can explain why the bag did not leak when the pencil was pushed through both walls of the bag. Essentially, when the pencil is inserted into the Ziploc bag the polymers are disrupted. The monomers created during the disturbance find new places to bond, which helps seal the two wounds created by the pencil.

### SAFETY:

- 1 This demo should not be performed near electronics for risk of water spills.
- 2 Water spills should be attended to promptly.



## **Ketchup: America's Favorite Cartesian Diver**

*Devin Quinn – Post Baccalaureate*

### MATERIALS:

1 Liter plastic bottle  
1 Ketchup packet from fast food restaurant  
Kosher Salt

### PROCEDURE:

- 1 Remove any labels from plastic bottle
- 2 Place ketchup packet in bottle full of water
- 3 If the ketchup floats you're ready for the next step. If the ketchup sinks add kosher salt a teaspoon at a time until the condiment floats.
- 4 Squeeze the plastic bottle hard and watch the ketchup dive to the bottom!

### EXPLANATION:

This demonstration deals with the concepts of buoyancy and density. This classic demonstration is often referred to as the Cartesian diver after Rene Descartes. When the bottle is squeezed the diver (ketchup packet) will sink to the bottom of the bottle due to increased pressure. Also, there is a little bit of air inside each ketchup packet. This allows the packet to float. However, when you squeeze the bottle you exert pressure on the ketchup packet. This causes the air bubble in the ketchup packet to become smaller and consequently the entire packet becomes denser. The packet sinks when it is denser than water. When you stop squeezing the bottle the air bubbles in the packet enlarge and the ketchup packet rises.

### SAFETY:

No safety concerns



## Elephant Toothpaste

*Elizabeth Garren - Biology Senior*

### MATERIALS:

- 1 plastic water bottle
- 1 9 x 13 cake pan
- 1 small container
- 2 Tablespoons warm water
- 1 teaspoon yeast
- ½ cup 6% hydrogen peroxide
- 4-5 drops food coloring
- 1 squirt of dish soap

### SETUP:

No advanced set up is necessary.

### PROCEDURE:

1. Place plastic water bottle in middle of cake pan
2. Mix warm water and yeast in a small container and swirl for one minute
3. Mix hydrogen peroxide, food coloring, and a squirt of dish soap in the plastic water bottle
4. Pour the yeast mixture into the water bottle and watch the elephant toothpaste explode!

### TIPS:

6% hydrogen peroxide cannot be found at a regular grocery store, it can be bought online or a 20 volume clear developer from a beauty supply store will work just as well.

### EXPLANATION:

Hydrogen peroxide naturally breaks down into water and oxygen. In this demo, the yeast acts as a catalyst to speed up this reaction, the dish soap catches the released oxygen, and the bubbles burst out of the water bottle. The water bottle also feels warm following the reaction, signaling the release of energy as heat, or an exothermic reaction.



### SAFETY:

6% hydrogen peroxide can irritate the eyes and skin, safety goggles should be worn and any contact with the skin should be washed immediately.

### SOURCE:

[www.stevespanglerscience.com](http://www.stevespanglerscience.com)



## Restaurant Napkins

*Elizabeth Garren - Biology Senior*

### MATERIALS:

2 paper napkins  
2 glasses  
Water  
Table salt

### SETUP:

No advanced set up is necessary.

### PROCEDURE:

1. Fill two glasses with water
2. Drop some water on bottom of glasses to emulate condensation
3. Place one glass on napkin and lift up to show the glass sticking to the napkin
4. Sprinkle salt on other napkin
5. Place the second glass on this napkin and lift up to show the glass does not stick to the napkin

### EXPLANATION:

Water molecules create a surface tension due to the fact that water is dipole. The electrons are slightly off balance in each molecule, causing the water to stick together. This is why the first glass sticks to the napkin. Salt is an ionic compound, that when dissolved in water, releases positive and negative ions. This dissipates the surface tension, stopping the second glass from sticking to the napkin.

### SAFETY:

Always be careful when working with glass objects.

### SOURCE:

[www.darylsience.com](http://www.darylsience.com)



## Surface Area Reactions

*Elizabeth Garren - Biology Senior*

### MATERIALS: (CALIBRI 11 FONT IN ALL CAPS, UNDERLINED AND RED)

2 Alka Seltzer tablets  
2 empty film canisters  
Water

### SETUP:

No advanced set up is necessary.

### PROCEDURE:

1. Place one Alka Seltzer tablet in a film canister
2. Crush the second Alka Seltzer and place the pieces in the second film canister
3. Fill both film canisters  $\frac{3}{4}$  of the way full with water and tightly press on both caps
4. Wait and see which lid pops off first!

### TIPS:

Remember to label each canister with which Alka Seltzer tablet it contained. This will help eliminate any confusion after the caps blow off.

### EXPLANATION:

This activity demonstrates that chemical reactions will occur at a quicker rate over a larger surface area. The crushed Alka Seltzer canister lid should pop off first due to the quickened rate of the reaction. The gas released during the reaction creates the pressure inside the canister and that is what causes the lid to pop off.

### SAFETY:

The film canister caps popping off can be potentially dangerous. Remember to wear safety goggles at all times.

### SOURCE:

[http://www.alkaseltzer.com/as/student\\_experiment.html](http://www.alkaseltzer.com/as/student_experiment.html)

## Limp Salad



*Elizabeth Garren - Biology Senior*

### MATERIALS:

2 clear beakers  
2 pieces of cut celery  
Water  
Table salt

### SETUP:

Dissolve an adequate amount of salt into a beaker half filled with water.

### PROCEDURE:

1. Fill one beaker half way with water
2. Fill the second beaker half way with salt water
3. Place one celery piece into the plain water beaker and one in the salt-water beaker
4. Ask students to hypothesize which celery will remain crisp
5. After setting for a while, break each celery piece in half to see if they were correct!

### TIPS:

Place the celery in the water cups prior to the beginning of class. This will speed up the process by not having to wait for the osmosis to occur.

### EXPLANATION:

This demo displays the process of osmosis and concentration gradients. The celery in the salt water will become limp because the higher concentration of water inside the celery will force the water out.

### SAFETY:

Always be careful when working with glass objects.

### SOURCE:

[www.darylscience.com](http://www.darylscience.com)



## Inseparable Books

*Elizabeth Garren - Biology Senior*

### MATERIALS:

2 notebooks, phone books, or textbooks

### SETUP:

No advanced set up is necessary.

### PROCEDURE:

1. Line up the notebooks on a flat surface with the bindings facing outward
2. Overlap the covers completely with one another
3. Alternate pages from each notebook placing one over another until all of the pages are interlaced
4. Holding the books by the bindings try to pull them apart as hard as you can
5. Have two students each grab one end and try to pull the books apart, they will not budge

### TIPS:

If you have two extra notebooks you can interlace the pages before the start of class. This will save the time of overlapping every single page during class time.

### EXPLANATION:

The friction between the pages causes the pages to stick together. Friction is the force that opposes motion when two surfaces are in contact. The friction in-between each page is very minimal, but when it is multiplied by numerous pages, the amount of friction is intractable.

### SAFETY:

Exercise caution when trying to pull the books apart.

### SOURCE:

[www.stevespanglerscience.com](http://www.stevespanglerscience.com)



## THE IMPLODING CAN

*Mel Daghestani – Earth Science Senior*

### MATERIALS:

One soda can  
One shallow, clear dish  
Hot plate  
Water  
Tongs

### SETUP:

Allow the hot plate to heat up before beginning the demonstration

### PROCEDURE:

- 1 Fill a pop can with a small amount of water
- 2 Place the can on top of the hot plate and bring water to a boil
- 3 Fill the shallow dish with cold water
- 4 Once the water comes to a boil, flip the can immediately into the dish of cold water. The can should crush once it hits the cold water.

### TIPS:

Place the can on the hot plate before the demonstration begins so that the water is starting to boil before the demonstration begins

### EXPLANATION:

As the water inside the can begins to boil, the water vapor replaces the air inside the can. When the can is inserted into the cold water, the temperature drops suddenly. The temperature decrease changes the evaporation phase to the condensation phase, meaning an abrupt decrease in pressure. As a new equilibrium is trying to be reached, the can will shrink.

### SAFETY:

- 1 Hot plates appear exactly the same whether hot or at room temperature. Always assume they are hot and act accordingly.
- 2 Keep the electrical cord of a hot plate away from water and the heating surface.

CREDIT: Credit for this demo goes to Dr. Courtney Willis (University of Northern Colorado)



## EGG IN MILK BOTTLE

*Mel Daghestani – Earth Science Senior*

### MATERIALS:

One glass milk jar  
Matches/lighter  
A strip of paper 3cm x 10cm  
One peeled hardboiled egg

### PROCEDURE:

- 1 Demonstrate that the hardboiled egg does not fit through the opening in the bottle
- 2 Next take the piece of paper and light it on fire
- 3 Drop the paper into the bottle and allow it to burn out
- 4 Place the egg on the opening and watch for the egg to fall into the bottle

### TIPS:

For a larger bottle, use a larger piece of paper to account for the larger volume. Have paper already in bottle ready to light.

### EXPLANATION:

The principle of the experiment has to do with hot air increasing pressure, thereby forcing gases out of the bottle, and then, once the burning paper is out, a quick change in temperature resulting in a lower pressure inside the bottle pulls the egg into the bottle.

### SAFETY:

When lighting paper on fire, ensure that it is already in the bottle to prevent possibility of fire outside the system

CREDIT: Credit for this demo goes to Dr. Courtney Willis (University of Northern Colorado)



## INERTIA RINGS

*Mel Daghestani – Earth Science Senior*

### MATERIALS:

A ring cut from a four or six inch PVC pipe (the ring should be approximately 1/2 in wide)  
A bean or small dense object  
A glass soda bottle

### PROCEDURE:

- 1 Balance the ring upright on the top of the bottle
- 2 Place a small object (bean) on top of the ring directly over the mouth of the bottle
- 3 Snatch the ring from under the bean. The bean should fall into the bottle.

### TIPS:

The key is to have the ring parallel to your body and catch the ring on the inside and on the side opposite to the hand you are using

### EXPLANATION:

If the ring is struck firmly in the center, it will be jerked from under the bean without imparting any energy to it. The bean should then fall straight down into the bottle. The purpose is to show that objects at rest tend to stay at rest.

CREDIT: Credit for this demo goes to Dr. Bill Brent (Stephens College)



## SUNKEN ICE CUBES

*Mel Daghestani – Earth Science Senior*

### MATERIALS:

Two large beakers  
Water  
Rubbing Alcohol  
Ice Cubes  
Water cooler to hold ice cubes  
Tongs

### SETUP:

Fill one beaker with water and the other with rubbing alcohol ahead of time.

### PROCEDURE:

- 1 Fill one beaker with water and the other with rubbing alcohol ahead of time
- 2 Place ice cubes in water beaker and then ice cubes in rubbing alcohol beaker
- 3 Repeat process with ice cubes from water beaker to show that they don't float as well
- 4 Take cubes from alcohol beaker and place in water beaker.

### TIPS:

Begin experiment with different expectations of the two glasses

### EXPLANATION:

People 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 ( $0.9 \text{ g/cm}^3$ ) is less than the density of water ( $1 \text{ g/cm}^3$ ). The ice will sink in the alcohol because the density of the ice is more than the density of alcohol ( $0.8 \text{ g/cm}^3$ ). This is a great demo to introduce density because it really surprises the students and gets them to think.

### SAFETY:

Keep rubbing alcohol away from flammable items such as matches, lighters, and other chemicals.

CREDIT: Credit for this demo goes to Dr. Courtney Willis (University of Northern Colorado)



## WEIGHING A FINGER

*Mel Daghestani – Earth Science Senior*

### MATERIALS:

Balance scales or (pencil & 12 inch ruler)  
2 clear plastic glasses  
Water

### PROCEDURE:

- 1 Place a clear plastic glass at each end of the scale
- 2 Fill one glass to within 1/2 inch of the top with water
- 3 Slowly pour water into the second glass until it is just slightly heavier than the first glass
- 4 Put one finger into the lighter glass of water. Be careful not to touch the rim of the glass. The balance will tip to the cup where you inserted your finger due to the increase in volume
- 5 Remove your finger and watch the balance return to previous position
- 6 Repeat process and insert finger again

### PROCEDURE: (FOR PENCIL & RULER)

- 1 Place a hexagonal pencil on a flat surface
- 2 Place a 12 inch ruler on the pencil so that is balanced and not touching the table on either side (like a teeter-totter)
- 3 Place a clear plastic glass at each end of the ruler
- 4 Fill one glass to within 1/2 inch of the top with water
- 5 Slowly pour water into the second glass until it is just slightly heavier than the first glass
- 6 Put one finger into the lighter glass of water. Be careful not to touch the rim of the glass. The balance will tip to the cup where you inserted your finger due to the increase in volume.
- 7 Remove your finger and watch the balance return to previous position
- 8 Repeat process and insert finger again.

### TIPS:

Tape a long straw or light flag to the top of the needle on the balance beam to see the movement easier in large classrooms

### EXPLANATION:

The increase of volume makes the glass heavier. 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.

CREDIT: Credit for this demo goes to Dr. Courtney Willis (University of Northern Colorado)

## Straw Trombone

### *Adrienne Larson-Biology Post Bac*

#### MATERIALS:

2 straws of different sizes

#### SETUP:

For advanced setup, have the straw already precut and placed inside the other straw.

#### PROCEDURE:

1. Take the smaller straw and cut it into to the shape of a triangle.
2. Then chew with your back teeth on the base of the triangle shape.
3. The warmth and the chewing will make the flaps very flat, this will help the straw vibrate.
4. Then place this cut up straw inside the other straw.
5. Blow through! You are ready!

#### TIPS:

Use a Subway straw and a Dixie brand straw, those work best! The longer the straw the higher the pitch, so you can use longer or shorter straws to show the difference.

#### EXPLANATION:

The inside straw is cut in a triangle, and is flat, so that it vibrates on each other to create a sound. If the straw is too wide then too much air flows through, if the straw is too flat on top of each other then it won't work either. The cut straw will work by itself however when you add a second straw it increases. Also, the length of the instrument changes the pitch.

#### SAFETY:

There are no safety concerns. Great for all ages.

## Tuning fork and Ping pong ball

*Adrienne Larson-Biology Post Bac*

### MATERIALS:

- 1 Tuning fork
- 1 Ping pong ball
- 1 Sting
- 1 piece of tape

### SETUP:

For advanced setup, make sure to tape the ping pong ball to a string .

### PROCEDURE:

- 1 Place one piece of tape on the string and connect it to the ping pong ball.
- 2 Hold it up high.
- 3 Then take a tuning fork and hit it, which allows it to vibrate.
- 4 Place the ping pong ball next to the side of the tuning fork.
- 5 Then the ping pong ball will bounce!

### TIPS:

Make sure to hold the ball directly on the side of the tuning fork otherwise it will not work.

### EXPLANATION:

In this demo, the tuning forks vibrations hit the ball enough to make it bounce

### SAFETY:

There are no safety concerns.

## Cloud in a Bottle

*Adrienne Larson-Biology Post Bac*

### MATERIALS:

Clean Clear 16oz Plastic Water Bottle and Lid  
Rubbing Alcohol

### SETUP:

For advanced setup, have the alcohol already coated on the insides of the bottle.

### PROCEDURE:

1. Take a 16 oz clear plastic water bottle and dump out or drink the water.
2. Fill the bottom of the plastic bottle with rubbing alcohol. Swirl the alcohol around the sides coating the inside of the bottle.
3. Screw the cap on firmly.
4. Grab the bottle around 1/4 of the way up from the bottom and start twisting it with both hands in opposite directions. As you twist notice the pressure in the top begins to increase. Keep twisting until you can twist anymore. Now the pressure is very high!
5. Slowly unscrew the cap until you feel it's about to pop off. Make sure the cap is not pointing at anyone!
6. Now give the cap one last quick flip with your finger to and let it pop off. Make sure to do it fast and not to block the cap coming off in a bang.
7. Instantly the clear bottle is filled with a nice white cloud.

### TIPS:

Make sure your water bottle is the lightweight kind (not heavy duty plastic that wont bend easily). This will allow you to bend the bottle more.

### EXPLANATION:

Invisible water molecules are always present in the air that surrounds us. That is what we call water vapor. Twisting the plastic bottle compresses the air molecules inside. When we release the cap, we are permitting the air molecules to expand. When the air molecules expand the temperature lowers and they get colder. As they cool, the molecules start sticking together (water / alcohol vapor, and air molecules). This combination allows small water drops to form. Just like the clouds in the sky. Except water vapor in the sky finds pollution and other particles to stick on as well!

### SAFETY:

Make sure the cap is not pointed at anyone when taking it off.

## Coloring Without Crayons

*Adrienne Larson-Biology Post Bac*

### MATERIALS:

1 large piece of paper  
phenolphthalein indicator  
0.1 M sodium hydroxide  
5 ml vinegar  
paintbrush and cotton balls

### SETUP:

1. Prior to the demo, use a paintbrush dipped in the phenolphthalein indicator to paint a picture on the large piece of paper.
2. Make sure the picture is dry before the experiment--the picture will disappear as it dries off.

### PROCEDURE:

1. Draw a picture on the paper using the phenolphthalein indicator.
2. Let it dry--it will appear colorless on the paper.
3. Next, dip a cotton ball in the sodium hydroxide solution and wipe it over the paper where the drawing is. The drawing should appear.
4. To make the drawing disappear again, dip a cotton ball in vinegar, and wipe it over the picture once again. The drawing should disappear.

### TIPS:

MAKE SURE TO HAVE A LARGE PAINTBRUSH TO DRAW A PICTURE WITH.

### EXPLANATION:

The piece of paper is slightly acidic, and the phenolphthalein indicator is also acidic, as can be seen from the way it is colorless on the paper. The sodium hydroxide, however, is a base containing hydroxide ions (OH<sup>-</sup>), so when it is added to the picture, it turns the indicator a bright pinkish color. Vinegar, when added to the picture, will make the drawing disappear because it is a weak acid, leading to a colorless picture once again.

Therefore, with the aid of an indicator, an acid/base reaction will occur and will show color changes on a piece of paper.

### SAFETY:

There are no particular safety precautions for this experiment. However make sure to have appropriate waste disposal. Dispose of the remaining vinegar, indicator, and sodium hydroxide down the sink. Throw the picture away in the garbage.

Acid Base Reaction:

Vinegar or acetic acid + Sodium Hydroxide ---> Sodium Acetate + Water

$\text{HC}_2\text{H}_3\text{O}_2 + \text{NaOH} \text{ ----> } \text{NaC}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O}$

## Tornado in a Bottle

*Adrienne Larson-Biology Post Bac*

### MATERIALS:

2 plastic Bottles (empty 1 liter water bottles work well)  
Water  
Food Coloring (Optional)  
Small Washer 1/4"  
Duct tape

### SETUP:

For advanced set up, complete steps 1-5.

### PROCEDURE:

- 1) Fill one of the empty bottles to the top with water.
- 2) Add a couple drops of food coloring if you want.
- 3) If you have small styrofoam balls put them in to simulate flying debris.
- 4) Put the 1/4 inch washer on top of the filled bottle.
- 5) Now invert the other bottle on top of it so they are connected. Use duct tape to make a nice water tight secure connection between the bottles. One bottle should be empty and one should be full.
- 6) Take a little extra time to ensure the bottles are snug / flush against the washer before duct taping together. You want everything perfectly flat when you tape.
- 7) Turn the bottle with the water upside down so the water is on top.
- 8) To make a Vortex put the bottle with the water on top. Hold the bottles with your hand in the middle where the two connect. Then twirl the bottle around in a circular motion for a few seconds and hold still. Wham!

### TIPS:

Make sure the bottles lie flat with tape, so that no water leaks out. Use a liter bottle for the demonstration.

### EXPLANATION:

Twirling and swirling the bottle creates a vortex as the water moves down through the hole in the washer. What you see is basically a tornado in a plastic bottle. When the vortex is generated, air from the bottom bottle can more easily move to the top bottle and the water comes out quicker.

### SAFETY:

There are no safety concerns.



## Surface Tension using a Water Bottle

*Alyssa Baker- Biology Senior*

### MATERIALS:

1 plastic water bottle  
Nylon  
Rubber band  
Permanent marker  
Scissors

### SETUP:

Poke a small hole into the water bottle and mark it with a permanent marker. Wrap a piece of nylon over the top of the bottle and secure it with a rubber band.

### PROCEDURE:

- 1 Tip the water bottle upside down with your finger over the hole.
- 2 Ask your students what they think is happening to make the water stay in the bottle.
- 3 Explain the concept of surface tension and introduce air pressure
- 4 Ask your students to take a deep breath all together in order to decrease the air pressure in the room.
- 5 As soon as everyone takes a huge breath, take your finger off of the hole.
- 6 The water will fall.
- 7 Then explain the hole in the water bottle to your students.

### EXPLANATION:

Surface tension is caused by the cohesive property of water. In liquid water, every molecule is pulling the other molecules toward it equally. This creates internal pressure and gives the surface strength. The water falls when you remove your finger from the hole because the atmospheric pressure on the bottom is no longer compensating for the force of gravity on the water column.

### SAFETY:

None

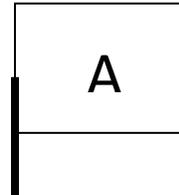


## Blood Types

*Alyssa Baker- Biology Senior*

### MATERIALS:

- 4 Styrofoam disks
- 4 Skewers
- Two colors of paper
- Tape



### SETUP:

Use the colored paper and skewers to create flag that symbolize A and B antigens. The four Styrofoam disks represent red blood cells. Demonstrate A, B, AB and O blood types by sticking the skewer flags into the Styrofoam disks.

### PROCEDURE:

- 1 Stick an A antigen flag onto a ball to create type A blood.
- 2 Stick a B antigen flag onto a ball to create type B blood.
- 3 Stick A and B antigen flags onto a ball to create type AB blood.
- 4 Use not antigen flags for type O blood.

### TIPS:

Ask for volunteers to hold the Styrofoam disks and walk through procedure with students. After explaining rationale for type A and B blood types ask students to come up with ideas to create AB and O blood types.

### EXPLANATION:

Blood types are determined by the carbohydrate(s) that are associated with red blood cells (erythrocytes). The blood type is determined by the presence of one or both of the antigens A and B.

Antigen	Blood Type
A	A
B	B
A, B	AB
None	O

### SAFETY:

*No safety concerns*

**Source:** [http://www.researchandteaching.bio.uci.edu/lecture\\_demo.html](http://www.researchandteaching.bio.uci.edu/lecture_demo.html)



## Rubber Egg

*Alyssa Baker- Biology Senior*

### MATERIALS:

1 egg  
Vinegar  
Plastic cup

### PROCEDURE:

- 1 Hold an egg up for your students and describe the shell of an egg
- 2 Put the egg in a cup and pour the vinegar over it until it covers the surface of the egg
- 3 Observe the bubbles created and explain that a chemical reaction is taking place
- 4 Leave the egg in vinegar for 24 hours.
- 5 The egg shell is removed and the membrane is exposed.

### TIPS:

Be careful when taking the egg out of the vinegar because it is fragile.

### EXPLANATION:

An egg shell is made primarily of calcium carbonate. The acid in vinegar breaks apart calcium and carbonate. This can explain how acid rain or ocean acidification affects the lives of creatures who need a shell to survive.

### SAFETY:

The vinegar can irritate eyes.



## Small Intestine Length

*Alyssa Baker - Biology Senior*

### MATERIALS:

Small scarves that measure to 20 ft

- You can also use ribbon or whatever is available at your local secondhand store.

### PROCEDURE:

- 1 Roll up the scarves/ribbon as tight as you can
- 2 Ask for a student volunteer
- 3 Tell the class you are going to pull out their small intestine
- 4 Begin unraveling the scarves/ribbon behind the student's mouth
- 5 Once unraveled ask the students why they think the small intestine is so long

### TIPS:

Unravel the ribbon behind the student's mouth with it open for a funny dramatic effect.

### EXPLANATION:

The small intestine averages to be 20 feet in length. The small intestine is responsible for digestion and nutrient absorption.

### SAFETY:

No concerns



## Sock Chromosomes

*Alyssa Baker - Biology Senior*

### MATERIALS:

Two pairs of different colored socks (longer socks better to see)

4 hair ties

Velcro

### SETUP:

Take one sock and wrap a piece of Velcro around the top 1/3 to symbolize a centromere. Repeat this for all four socks.

### PROCEDURE:

- 1 Describe one sock as a chromosome.
- 2 The two different colors represent a chromosome from each parent. ( hold up each one)
- 3 During replication each chromosome gets an exact copy. (Hold up the replicated chromosomes joined at the centromere).

### EXPLANATION:

Humans have 23 pairs of chromosomes which is a total of 46 chromosomes per cell. In each pair of chromosomes is a chromosome from mom and a chromosome from dad. These are called homologous chromosomes. During replication all 46 chromosomes are duplicated. Once duplicated, the chromosomes are called sister chromatids.

### SAFETY:

No concerns.

**Source:** [http://www.researchandteaching.bio.uci.edu/lecture\\_demo.html](http://www.researchandteaching.bio.uci.edu/lecture_demo.html)



## Balloon Diffusion

*Cassie Waldron-Biology Graduate*

### MATERIALS:

- 1 balloon
- Imitation lemon extract (or other kinds of extract)

### PROCEDURE:

1. Stretch the mouth of the balloon over the opening of the vanilla extract bottle and pour a little into the balloon, it just can be a quick inversion of the bottle.
2. Blow up the balloon and tie it off.
3. Pass the balloon around your classroom and ask your students if they can smell the lemon through the outside of the balloon (they can).
4. Can also have other balloons with other kinds extract

### EXPLANATION:

This is a representation of diffusion. Cells use diffusion/osmosis to get various kinds of nutrients through a semipermeable membrane, from an area of high concentration to an area of low concentration. When the balloon is blown up, it causes small gaps in between the rubber molecules of the balloon (like a membrane) that allows the extract molecules (or nutrients in a cell) to fit into the gaps of the rubber molecules. This allows someone to smell the extract scent on the outside of the balloon. If this is used for an osmosis membrane representation, make sure to mention if would need water to be truly osmosis.



## Cooking an Egg Without Heat

*Cassie Waldron-Biology Graduate*

### MATERIALS:

- 4 eggs
- 60mL of Isopropyl alcohol, 70% soln. (or any rubbing alcohol found in a store)
- 2 clear jars (250-mL or larger)

### SETUP:

1. Crack two eggs into one of the jars
2. Pour 30 mL of isopropyl (rubbing) alcohol solution into the jar (you can add more as long as the alcohol is covering the egg)
3. Set it aside for 24 hours because some of the egg white will begin solidifying and turn white (opaque) as it does when an egg is cooked

### PROCEDURE:

1. Crack two eggs into the other jar
2. Pour 30 mL of isopropyl (rubbing) alcohol solution into the jar
3. The egg whites will start to change color
4. Bring out the jar that was set-aside for 24 hours, and that is an example of how “cooked” the egg will get after 24 hours.

### TIPS:

Optional: The can be done using two frying pans and compare the alcohol solution to a frying pan with water. The class then can observe the change in appearance after 5 minutes, 10 minutes, 30 minutes, and 24 hours.

### EXPLANATION:

When you cook an egg using heat, the egg changes appearance because the proteins within the egg undergo a chemical reaction. Besides heat, there are other ways to change the proteins within an egg. This process is called denaturing. When alcohol comes in contact with the proteins, it mimics the effect of cooking the egg, producing a similar chemical reaction.

Source: <http://www.flinnsci.com/Documents/demoPDFs/Biology/BF10126.pdf>



## The Magic Sponge

*Cassie Waldron-Biology Graduate*

### MATERIALS:

1 g Congo red indicator  
Hydrochloric acid, HCl, 1M, 100mL (or any acid solution that can be below a 3.0 pH level)  
Sodium hydroxide, NaOH, 1 M, 100 mL (or any base solution that can be above a 5.2 pH level)  
1 100 mL beaker  
2 1000 mL beakers or large jars  
Red food coloring, 1 mL  
Blue food coloring, 1 mL  
Sponge  
Tongs  
Rubber gloves

### SETUP:

#### **Sponge preparation:**

Make a 1% solution of Congo red indicator by adding 1 g of Congo red to 100 mL of distilled or deionized water. Rinse the sponge with water to remove any excess soap or other residual materials. If the sponge is too large for the beaker or container for the solution, cut the sponge in half. Place the sponge in the Congo red solution, immersing it completely. Wear rubber gloves to keep from staining hands, and periodically squeeze out the liquid. Allow the sponge to soak for about 15 minutes. Squeeze out as much liquid as possible and rinse with water a few times. The indicator sponge is ready to use. Other indicator sponges can be made with the remaining solution.

#### **Demonstration Preparation:**

1. Add 15 mL of 1 M hydrochloric acid to a 1000- or 2000-mL beaker. Fill the beaker about 3/4 full with tap water.
2. Add enough red food coloring (about 1 mL per 1000 mL solution) to the acid solution in the beaker until it is a deep red color.
3. Add 15 mL of 1 M sodium hydroxide solution to a 1000- or 2000-mL beaker. Fill the beaker about 3/4 full with tap water.
4. Add enough blue food coloring to the basic solution in the beaker until it is a deep blue color.
5. If the sponge is red, then wet the sponge with tap water and rinse it out.
6. If the sponge is blue, place the sponge in the base solution to convert it to a red color

### PROCEDURE:

1. Slowly place the red sponge into the beaker containing the red acid solution. Use tongs or a gloved hand. The sponge will immediately turn blue.
2. Remove the sponge and squeeze out as much red acid solution as possible back into the acid beaker or another large container containing water.

3. Slowly place the blue sponge into the beaker containing the blue base solution. Use tongs or a gloved hand. The sponge will immediately turn red.
4. Remove the sponge and squeeze out as much blue base solution as possible back into the blue beaker.
5. Rinse the sponge in tap water, to show that the sponge is actually red.

TIPS:

Optional: Rinse the sponge in tap water after submerging the sponge in the red solution to show that the sponge is actually blue and will not turn back to red. This step also minimizes the amount of acid and base being transferred between solutions. If most of the liquid is squeezed out of the sponge, this step may not be necessary.

EXPLANATION:

Congo red is used as a pH indicator. The color transition is between pH 3.0 and 5.0. Below a pH of 3.0 (very acidic solutions), the indicator is blue. Above pH 5.0, the indicator is red. When a cellulose sponge is soaked in a Congo red solution, the dye becomes permanently bonded to the cellulose fibers. The active acid/base sites on Congo red are still available and the sponge now becomes an indicator sponge for acids.

This sponge is great to have around any science lab so it can also be used to check for acid or base spills on counters after students have used acids or bases.

SAFETY:

Hydrochloric acid is corrosive to skin and eyes and toxic by ingestion and inhalation. Sodium hydroxide solution is corrosive to skin and eyes. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Neutralize the acids and bases before disposal.

Source: <http://www.flinnsci.com/media/395449/cf10376.pdf>



## Rainbow Dry Ice Titration

*Cassie Waldron - Biology Graduate*

### MATERIALS:

Universal indicator  
Large graduated cylinder (any other glass container will work)  
Dry ice  
Heavy gloves for dry ice (or tongs)  
3-5 mL of 1M NaOH (or other strong basic solutions)  
Distilled water  
Long stirring rod

### PROCEDURE:

1. Fill the 2L graduated cylinder with water and add enough universal indicator to have an easily visible color
2. Add a few milliliters of NaOH to make the solution basic (it should be a blue-violet color)
3. Stir solution with stirring rod to mix solution thoroughly
4. Add several chunks of dry ice to the solution.
5. As the CO<sub>2</sub> from the dry ice reacts with the water in the solution the solution will turn from a blue-violet to maybe a light orange.

### TIPS:

Any basic solutions can be used, such as ammonia but since it is weaker it will be a green-blue color when added. Then, to show the full color range a few milliliters of a strong acid (like HCl) to make it a red color.

### EXPLANATION:

The CO<sub>2</sub> from the dry ice reacts with the water in the solution to produce carbonic acid. The gradual change from a weak base to an acid will take the universal indicator through a range of colors. This can be used to talk about neutralization when acids and bases are mixed. It could also be used to talk about what happens in titrations of weak acids and strong bases (buffers).

### SAFETY:

Wear safety glasses. Be careful handling the dry ice, use tongs or a thick glove. Be cautious if using a strong acid or strong base since it is corrosive to skin and eyes. Neutralize the solution before disposal

Source: <http://www.youtube.com/watch?v=orW7CEwcAW8&edufilter=DRJEhfx13A6rjbBlvoPOBg>



## The Dissolving Cup

*Cassie Waldron-Biology Graduate*

### MATERIALS:

A clear flattish container (a bowl, baking pan, pie plate, etc.)  
50 mL water in a 100 mL glass beaker  
50 mL acetone in a 100 mL glass beaker (this can be replaced by fingernail polish)  
2 Styrofoam cups

### PROCEDURE:

1. Hold one cup over the container and pour water into the Styrofoam cup (nothing happens).
2. Pour acetone into another Styrofoam cup (the bottom will fall out) into the container.
3. Finish by putting the cup into the container and watching it disappear.

### TIPS:

A clear container works best so people can see the cup dissolving.

Optional: A person can start with two containers and put about 1/2 inch of acetone in the bottom of one and the same amount of water in the second one. Then place a cup in each container and watch one disappear.

### EXPLANATION:

This is a demonstration of how like dissolves like. Styrofoam is a polymer consisting of a long chain of monomers that are held together by non-polar bond interactions, thus Styrofoam is non-polar. When the acetone a non-polar solvent, is poured into the cup it dissolves because they are both non-polar. The cup did not dissolve in the water because water is polar and will not dissolve a non-polar substance. Make sure to clarify to your classroom that the cup is not melting in the acetone (it's not hot enough to melt), it is dissolving because of their similar polarities.

### SAFETY:

Dispose the "melted" solid into the trashcan. You can leave the acetone in the pie plate and allow it to evaporate and then wash out the container, or you can pour off the extra liquid down the drain.



## Movement of Water Through Plants – More Fun Than a Barrel of Monkeys!

*Brooke Lyons - Biology Post-bac*

### MATERIALS:

Barrel of Monkeys game (if you cannot find, you could make ‘monkeys’ out of paper clips)

### SETUP:

Have the Barrel of Monkeys game ready. You may want to help yourself out by joining up a few monkeys and putting them on the top of the barrel, or even using little rubber bands to wrap the monkeys together.

### PROCEDURE:

While talking about the properties of water, you can pull up the monkeys out of the barrel to demonstrate the concept of capillarity.

### TIPS:

None.

### EXPLANATION:

The attractive force that holds molecules of water together is called cohesion. Adhesion is the force that holds water molecules to solid substances. Adhesion and cohesion work together in very small tubes to create capillarity, which is the rise of water against the force of gravity. In plants, evaporation combines with capillarity to pull water from roots, through xylem, and out through stomata. This behavior of the water molecules is much like the behavior of the monkeys holding on to each other.

### SAFETY:

None.

### SOURCE:

Jacque Schmidt, Frontier Academy High School



## Color Changing Water

*Brooke Lyons - Biology Post-bac*

### MATERIALS:

Two transparent cups or other similar containers  
A drinking straw  
pH indicator such as bromothymol blue  
Tap water

### SETUP:

- 1 Half fill each cup with tap water.
- 2 Add a few drops of bromothymol blue to each of the cups. The water will appear a pale blue color.

### PROCEDURE:

- 1 Insert a drinking straw and gently blow bubbles into the water for several minutes.
- 2 After a short time (usually less than a minute), the water will change color.
- 3 Compare the color of the bubbled water with the color of the water in the other cup.

### TIPS:

Bromothymol blue can be found at most pet and aquarium stores.

### EXPLANATION:

When you blew into the water you will have noticed that the water changed from the original blue color to a green, possibly pale yellow color. This indicates that the water has changed from neutral to acid.

We describe whether things are acidic, basic or neutral by using a scale called the pH scale. Pure water has a pH of 7 and is regarded as neutral. The pH of solutions range from 0 for a very strong acid, 3 - 5 for weak acids, 8 - 9 for weak bases, and 13 - 14 very strong bases.

With every breath, we take in oxygen and exhale carbon dioxide. By blowing into the water you are adding carbon dioxide (CO<sub>2</sub>), making the water slightly acidic.

When carbon dioxide is bubbled through water, some of it dissolves into the water. That is, some of the carbon dioxide goes into the spaces between water molecules. A small proportion of this dissolved carbon dioxide creates carbonic acid, a weak acid.

### SAFETY:

Be careful not to blow too hard into the water so that it doesn't splash into your eyes. It may be a good idea to wear safety goggles for this demonstration.



## Bending Water with Static Electricity

*Brooke Lyons - Biology Post-bac*

### MATERIALS:

Balloon  
Faucet at lab table (or pitcher to pour water from, water, and bowl)

### SETUP:

Have balloon blown up with air. If no sink is available in classroom, have a full pitcher of water and a bowl to catch water.

### PROCEDURE:

- 1 Turn on the water so it is falling from the tap in a narrow stream (just a few millimeters across but not droplets).
- 2 Rub the balloon against your hair for a few seconds.
- 3 Slowly move the balloon towards the stream of water (without touching it) while watching closely to see what happens.

### TIPS:

None.

### EXPLANATION:

Negatively charged particles called electrons jump from your hair to the balloon as they rub together, the balloon now has extra electrons and is negatively charged. The water molecules are polar, which means that they are positive on the end with hydrogen atoms and negative on the end with the oxygen atom. Positive and negative charges are attracted to each other so when you move the negatively charged balloon towards the stream, it attracts the water atom's positively charged sides and the stream bends.

### SAFETY:

None.

### SOURCE:

<http://www.sciencekids.co.nz/experiments/bendingwater.html>



## Colorful Convection Currents

*Brooke Lyons - Biology Post-bac*

### MATERIALS:

Four small glass bottles (Starbucks Frappuccino bottles work well)  
Hot and cold water  
Liquid food coloring (red and blue)  
Playing card or small laminated card  
Large rimmed baking sheet

### SETUP:

- 1 Fill two of the bottles with hot water. Fill the other two with cold water. Place inside of large rimmed baking sheet to catch water in case of spills.
- 2 Place two drops of blue food coloring in the two bottles with cold water, and place two drops of red food coloring in the two bottles with hot water.

### PROCEDURE:

- 1 Hot over cold: Place the index card or old playing card over the mouth of one of the warm water bottles. Hold the card in place as you turn the bottle upside down and rest it on top of one of the cold water bottle. The bottles should be positioned so that they are mouth to mouth with the card separating the two liquids.
- 2 Carefully slip the card out from in between the two bottles. Make sure that you are holding onto the top bottle when you remove the card. Observe what happens to the colored liquids in the two bottles.
- 3 Cold over hot: Repeat steps 2 and 3, but this time place the bottle of cold water on top of the warm water. Observe what happens.

### TIPS:

NONE.

### EXPLANATION:

Warm air rises. Similarly, warm water is lighter in weight or less dense than cold water. When the bottle of warm water is placed on top of the cold water, the more dense cold water stays in the bottom bottle and the less dense warm water is confined to the top bottle. However, when the cold water bottle rests on top of the warm water, the less dense warm water rises to the top bottle and the cold water sinks. The movement of water is clearly seen as the yellow and blue food coloring mix, creating a green liquid.

The movement of warm and cold water inside the bottles is referred to as the convection current. In our daily life, warm currents can occur in oceans, like the warm Gulf Stream moving up north along the American Eastern Seaboard. Convection currents in the atmosphere are responsible for the formation of thunderstorms as the warm and cold air masses collide.

Although the bottles whose colored liquids mix are more interesting to watch, the other set of warm and cold water bottles helps to illustrate another important phenomenon that occurs in the atmosphere during the winter months.

During daylight hours, the sun heats the surface of the earth and the layer of air closest to the earth. This warm air rises and mixes with other atmospheric gases. When the sun goes down, the less dense warm air high up in the atmosphere often blankets the colder air that rests closer to the surface of the earth. Because the colder air is denser than the warm air, the colder air is trapped close to the earth and the atmospheric gases do not mix. This is commonly referred to as temperature inversion.

SAFETY:

None.

SOURCE:

<http://www.stevespanglerscience.com/lab/experiments/colorful-convection-currents>



## Color Changing Milk

*Brooke Lyons - Biology Post-Bac*

### MATERIALS:

Dinner plate or pie dish  
Milk (whole or 2% works best)  
Liquid food coloring – red, blue, green, and yellow  
Cotton swab  
Liquid dish soap

### SETUP:

- 1 Pour enough milk into the plate to completely cover the bottom to the depth of about  $\frac{1}{4}$  inch.
- 2 Add one drop of each of the four colors to the milk. Keep the drops close together in the center of the plate of milk.
- 3 Have soap and cotton swab nearby.

### PROCEDURE:

- 1 Have students predict what will happen if cotton swab is placed in the milk. After they make a prediction, just touch the swab to the center without stirring the colors around. Ask students if anything happened.
- 2 Now add a drop of liquid dish soap to the other end of the cotton swab and place in the middle of the milk and food coloring. Hold the swab in one place for 10 to 15 seconds. The colors should rapidly swirl and mix.
- 3 Ask students what is making the food coloring in the milk move.

### EXPLANATION:

Milk is mostly water but it also contains vitamins, minerals, proteins, and tiny droplets of fat suspended in solution. Fats and proteins are sensitive to changes in the surrounding solution (the milk).

The secret of the bursting colors is the chemistry of that tiny drop of soap. Dish soap, because of its bipolar characteristics (nonpolar on one end and polar on the other), weakens the chemical bonds that hold the proteins and fats in solution. The soap's polar, or hydrophilic (water-loving), end dissolves in water, and its hydrophobic (water-fearing) end attaches to a fat globule in the milk. This is when the fun begins.

The molecules of fat bend, roll, twist, and contort in all directions as the soap molecules race around to join up with the fat molecules. During all of this fat molecule gymnastics, the food coloring molecules are bumped and shoved everywhere, providing an easy way to observe all the invisible activity. As the soap becomes evenly mixed with the milk, the action slows down and eventually stops.

### SAFETY:

No safety considerations.

### SOURCE:

<http://www.stevespanglerscience.com/lab/experiments/milk-color-explosion>