2017 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 2017. These teacher candidates are from both the University of Northern Colorado and Colorado School of Mines. Dr. Rob Reinsvold and Dr. Stephanie Fanselow were the instructors for the courses. Most of the demonstrations were presented at the 2017 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.

Force over an Area

Joel Suarez – Earth Science Senior

MATERIALS:

2 full egg cartons of 30 eggs each.

PROCEDURE:

1. Open egg cartons
2. Stand on egg cartons

TIPS:

Make sure to wear smooth/flat soled shoes with little to no ridges

EXPLANATION:

P=F/A, Pressure is equal to force over area

The downward force, AKA weight, overwhelms one egg, therefore it cracks and breaks. Distributing that force over a certain area reduces the total pressure on individual eggs allowing you to stand on them.

Polarity of Fats

Joel Suarez – Earth Science Senior

MATERIALS:

Milk
Food Coloring
Dish soap
Plate
Cotton Swab

PROCEDURE:

1. Add milk to a plate
2. Place various drops of food coloring into the milk
3. Dip the cotton swab in dish soap
4. Dip the cotton swab into the plate with milk and food coloring

TIPS:

Use different colors

EXPLANATION:

Milk consists of water, fat, and protein molecules which interact with the dish soap differently.
The water has positive and negative charges, the fat has no charge, and the protein molecules have positive and negative charges all over. Molecules in dish soap have a negative charge at one end and no charge at the other. When the dish soap comes in contact with the milk, the negative charge in the soap molecules interact with the positive charge of the water molecules and the positive charges in the protein. These interactions lead to a lot of movement in the milk and soap which causes the food coloring to be pushed across the plate.

Like other oils, milk fat is a non-polar molecule and that means it doesn't dissolve in water. When soap is mixed in, however, the non-polar (hydrophobic) portion of micelles (molecular soap structures in solution) break up and collect the non-polar fat molecules. Then the polar surface of the micelle (hydrophilic) connects to a polar water molecule with the fat held inside the soap micelle.

Water Pressure

Joel Suarez – Earth Science Senior

MATERIALS:
Any-length PVC pipe that is plugged at the bottom with holes drilled on the side every three inches
Water
Tape

SETUP:
Cover holes on PVC pipe with tape

PROCEDURE:
1. Fill plugged PVC pipe with water
2. Remove tape

EXPLANATION:
Pressure is equal to force over area (P=F/A). We can change this into P=mg/A and turn mass into v*d therefore P=Vdg/A. Since volume is equal to an objects area times its height, it can be turned into P=Ahdg/A and by cancelling out the A term, P=hdg » Pressure is equal to height times density times gravity. This shows that as height (or depth) increases, so does the pressure and this is demonstrated by how far the water spews out of the holes in the PVC pipe.

Magic" Water

Joel Suarez – Earth Science Senior

MATERIALS:

Phenolphthalein
Water
Ammonia
Vinegar
3 Cups
Water jugs

SETUP:

1. Add some phenolphthalein to one cup and vinegar to a different cup
2. In the water jug, add some ammonia

PROCEDURE:

1. In an empty cup (cup A), pour the water and ammonia combination
2. In the cup with phenolphthalein (cup B), pour the water and ammonia combination
    a. Color should change to pink
3. Pour cup A and cup B back into the jug
    a. Jug should turn pink
4. Pour liquid from jug into cup A and B
5. Pour liquid from jug into cup with vinegar (cup C)
    a. Color should change to clear
6. Pour cup A, B, and C back into the jug
    a. Liquid in jug should turn back to clear
7. Pour out liquid from jug into cup A, B, and C

TIPS:

Make up a story to go with the color changing

EXPLANATION:

Phenolphthalein is an acid-base indicator. When in the presence of a base, such as ammonia, it turns pink, and when in the presence of an acid, such as vinegar, it turns clear. The constant color changes demonstrate the changes in pH in the solutions and shows the reactions occurring between all the solutions.

SAFETY:

Do not drink the solutions

Floating Paperclip

Joel Suarez – Earth Science Senior

MATERIALS:

2 paperclips
Water
Cup

PROCEDURE:

1. Pour water into a cup
2. Unfold a paperclip
3. Use the unfolded paperclip to gently lower another paperclip into the water

EXPLANATION:

Trying to put a paperclip in the water without the help of another paperclip will result in the paperclip sinking. This is because the downward force overcomes any buoyant force. But when the paperclip is placed in the water with the help of another paperclip, the paperclip “floats” on the surface of the water. This is due to the water’s surface tension.

Water molecules want to cling to each other. At the surface, however, there are fewer water molecules to cling to since there is air above and no water molecules. This results in a stronger bond between those molecules that actually do come in contact with one another, and a layer of strongly bonded water. This surface layer, held together by surface tension, creates a considerable barrier between the atmosphere and the water that allows the paperclip to “float” on the surface.

Newton's First Law

Joel Suarez – Earth Science Senior

Materials:

Plate
Empty toilet paper rolls
Rubber bands
Eggs
Cups

Setup:

1. Cover both ends of toilet paper rolls with rubber bands

Procedure:

1. Place a plate over the cup
2. Place the covered toilet paper roll on the plate
3. Balance the egg on the top of the toilet paper roll
4. While holding the cup with one hand, use your other hand to knock the plate and the toilet paper roll out from under the egg
5. Egg falls into cup

Tips:

Hit the plate/toilet paper roll combo fast enough so that the egg doesn't follow the plate and toilet paper roll

Explanation:

Newton's first law says that an object in motion will stay in motion and that an object at rest will stay at rest unless acted upon by another force. At the beginning of the demonstration, the egg is at rest and when the plate and the toilet paper roll are suddenly removed from under the egg, the egg tries to remain at rest and falls into the cup underneath while the plate and toilet paper roll move in whichever direction the force is applied in.

Water Density

Joel Suarez – Earth Science Senior

MATERIALS:

Hot water
Cold water
Cups
Food coloring
Card or cardboard

SETUP:

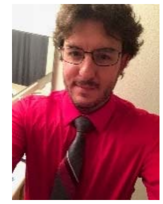
1. Get hot water
2. Get cold water

PROCEDURE:

1. Add hot water to one cup
2. Add cold water to another cup
3. Add one color to hot water and a different color to the cold water
4. Cover the hot water with a credit card or a thin piece of cardboard
5. Place the hot water cup upside down over the cold water cup
6. Remove the credit card or thin piece of cardboard
7. Repeat demonstration by placing the cold water over the hot water

EXPLANATION:

Cold water is denser than hot water. When the hot water is placed above the cold water, little mixing occurs. When the cold water is placed above the hot water, mixing occurs and this is seen by the color changes. This demonstrates how oceans mix water and how water, although one substance, can have different densities at different temperatures.



Homemade Accelerometer

Derek Weigle

MATERIALS:

Large Mason Jar
Fishing line
Soldering gun
Soldering wire
Cork
Sewing Needle

SETUP:

1. Using soldering gun and wire, solder each end of a small piece of wire onto the inside of the metal mason jar cap
2. Using needle thread fishing line through the center of the cork
3. Tie a knot on the end of the line to prevent it from slipping back through the cork
4. Fill the mason jar completely full of water and put the lid on so the cork floats up when mason jar is flipped over

PROCEDURE:

1. Set the accelerometer on a smooth surface and push it so that it obviously accelerates
2. Cork will move in the direction of acceleration
3. Hold accelerometer in one hand, straight out in front of you and spin
4. Cork will move towards the center of rotation, displaying centripetal acceleration

TIPS:

1. Fill and cap mason jar under water to insure it is completely full

EXPLANATION:

As the bottle accelerates forwards, both the water and the cork are affected by inertia and try to stay in their original position. However, the water, having a greater density than the cork, has more inertia. This means the water has a greater tendency to move to the back of the bottle and stay in its original position than the cork does. The less dense cork is therefore pushed forward in the bottle to make way for the water at the back of the bottle. As you spin around, the floating cork moves towards you, indicating that the direction of acceleration is towards the center of the circular path. Thus, the cork will always point in the direction of the acceleration.

Soda Can Crush

Derek Weigle

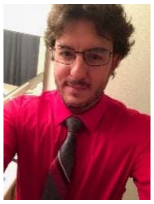
Materials:
Hot Plate
Empty Soda Can
Tongs
Shallow pie plate
Water

Setup:
1. Heat about a teaspoon of water in soda can using the hot plate
2. Dump an inch or so of cold water into the pie pan

Procedure:
1. Water in the can should boil for about 30 seconds (you should see water vapor escaping the top)
2. Grab the can with the tongs and quickly turn in over into the pie pan filled with water
3. Can will crush

Tips:
1. Don't heat the can on high as it could melt or burn

Explanation:
When it is first put on the hot plate the can is filled with air (except for the very small volume of liquid water at the bottom), and there is no difference between the air pressure on the inside and the outside of the can. When the water begins to boil the gaseous water vapor begins to take up some of the volume of the can and force out dry air that had been occupying the can. As the can top is put into the water, the can and thus the hot water vapor are cooled. The water vapor condenses back into liquid water and thus occupies a much smaller volume. Since the hole in the can is submerged in water, air is not able to rush in and fill that volume. With very little air inside the can the air pressure inside the can is much less than the air pressure outside of it. The can is crushed by the net inward forces exerted by this pressure difference.



Cartesian Diver

Derek Weigle

MATERIALS:

Two liter bottle
Pipette or medicine dropper
Metal nuts or washers (anything to add weight to diver if necessary)
Metal jewelry wire (anything to secure weight to diver)
Anything you can think of to decorate diver

SETUP:

1. Fill two-liter bottle with water
2. Attach weight to pipette using metal wire or and other method
3. Fill pipette a quarter way full of water
4. Place pipette in a glass of water (it should just barely float)
5. If pipette doesn't float correctly, add or remove weight
6. Once weight is correct, place pipette in two liter bottle and replace the lid

PROCEDURE:

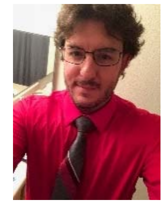
1. Simply squeeze the sides of the bottle and watch the pipette dive

TIPS:

1. Different creative ways can be used to decorate the diver to make the demonstration more fun

EXPLANATION:

The ability of an object to float in water is described as buoyancy. Buoyancy is determined partly by an object density which is describe mathematically as mass/volume. The way buoyancy works is that when an object is placed in water, even when it floats, it displaces some of the water. The amount of water an object displaces is directly related to its mass. The object will sink into the water until it displaces an amount of water equal to the objects mass. So a 5g object will sink into water until it displaces 5g of water. Since water has a density of $1g/cm^3$ this would mean that this would displace $5cm^3$ of water. If the object has a volume greater than $5cm^3$ it will stop sinking before it becomes completely submerged in the water. If it has a volume less than $5cm^3$ it will become submerged and sink. The Cartesian Diver demonstration exhibits this phenomenon as well as Pascal's law which states that a change in pressure at any point in an enclosed fluid at rest is transmitted undiminished to all points in the fluid. When you squeeze the edges of the bottle, you increase the pressure of the liquid inside. As Pascal's Law tells us, this pressure is transmitted to all point in the enclosed fluid and thus increases the pressure on the dropper itself. When you squeeze hard enough, water is pushed up into the dropper, compressing the air and filling it with water. Since water is much denser than air, when you squeeze the bottle you are increasing the density of the dropper and thus making it less buoyant. Once the density reaches the right point the dropper will sink. Decrease the pressure and the air in the dropper will expand, pushing out some water and thus decreasing the dropper's overall density, causing it to float back to the top.



Marshmallow Vacuum

Derek Weigle

MATERIALS:

Vacuum food sealer (anything that can pump air out of a container)
Marshmallows

SETUP:

1. Prepare vacuum sealer and marshmallows

PROCEDURE:

1. Place some marshmallows inside sealer
2. Demonstrate that the lid can be easily removed
3. Pump air out of container (marshmallows should grow)
4. Ask a student to try to remove the lid (they probably won't be able to)
5. Release the seal so air flows back into the container (marshmallows should shrink)

TIPS:

1. Use the large marshmallows, not the mini ones
2. Use fresh marshmallows

EXPLANATION:

Marshmallows have small bubbles of air trapped inside them. These bubbles are at atmospheric pressure. When the air inside the glass container is sucked out, the volume of the container remains the same although there is much less air inside – so the pressure is reduced. The air bubbles inside the marshmallows are therefore at a much higher pressure than the air surrounding the marshmallows, so those bubbles push outwards, causing the marshmallows to expand. When air is let back into the glass container, the surrounding pressure increases again, and the marshmallows deflate back to their normal size.

Pendulum/Conservation of Energy

Derek Weigle

MATERIALS:

Any kind of stand that a weight can be hung with a string and swung like a pendulum
Weight
String
A bar or rod for shortening the length of the string
A piece of cardboard or wood

SETUP:

1. Build or acquire the stand
2. Hang a weight from the stand using a string
3. Build a backboard with measured increments

PROCEDURE:

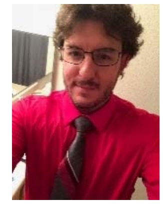
1. Pull the weight back to a specific height and let it swing
2. Observe that it swings to the same height on the other side of the pendulum
3. Insert or hold a second rod about 4 inches down the string so when the pendulum is swung, it hits the bar, thus shortening the available length of string
4. Observe that the weight still reaches the same height

TIPS:

1. On the second swing, when the length is shortened, don't raise the weight higher than the position of the block bar as it will make the weight "bounce".

EXPLANATION:

Conservation of energy tells us that the gravitational potential energy will be the same on the "drop" side of the pendulum, as it will be on the "swing" side. This is more evident on the first swing, before the rope is blocked. When this is done, it is tempting to believe that the weight will not be able to swing as high. Since energy is conserved, it does.



Rice/Vase Lift

Derek Weigle

MATERIALS:

Uncooked, long grain rice
Any vase or jar that tapers inward towards the top
Pencil

SETUP:

1. Prepare a way to dump the rice into the vase without too much spilling

PROCEDURE:

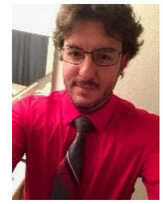
1. Let students observe you dumping rice into the vase
2. Poke pencil into rice a few times until you feel it getting difficult
3. Push pencil down far into rice
4. Lift pencil, vase will lift with it

TIPS:

1. Practice beforehand to get an idea of how it feels when the rice is packed enough to hold the pencil without slipping

EXPLANATION:

When the rice is inside the bottle, there are grains next to one another, but there is a little bit of space in between the grains. As you press the pencil into the bottle, the grains of rice are pushed together to make room for the pencil. As you continue to push the pencil in, the grains merge closer and closer together until they are rubbing against neighboring grains of rice. This is when friction comes into play. The rice grains rubbing against each other feel a force resisting their motion: friction. Once the grains are packed so closely together that the friction force becomes overwhelming, they will push against the pencil with a strong enough force overwhelm the force of gravity, allowing you to pick up the whole bottle with the pencil.



Total Internal Reflection

Derek Weigle

MATERIALS:

Two-liter bottle
Soldering Iron or Drill
Laser pointer
Stand for laser pointer (I used a piece of wood with a groove in it)
Bucket for catching water
Food Coloring (optional)
Stand to hold two-liter bottle

SETUP:

1. Use soldering iron to poke a hole about three inches up in the two-liter bottle
2. Prepare the bottle stand and the water bucket

PROCEDURE:

1. Cover the whole in the bottle with your finger and fill it with water
2. Set the bottle on the stand and position laser pointer so the laser hits the hole directly
3. Move your finger from the hole, allowing a small stream to run from the bottle into the bucket
4. Have someone turn of the lights, laser should follow the stream down into the bucket

TIPS:

1. You need to melt or drill the whole in the bottle. Just poking a hole doesn't work near as well

EXPLANATION:

In a given material, light travels a straight path. However, when light crosses the boundary from one material to another, the change in materials causes the light to experience a change in speed and it is refracted—it bends. The behavior of a ray of light at a boundary can be described by the angles made with respect to the normal line (a line perpendicular to the boundary). When light approaches the interface at an angle, the path of the light changes directions as it crosses the boundary, either bending towards the normal line (as it slows down in the new material) or away from the normal line (as it speeds up in the new material). At most boundaries, some light is transmitted through the boundary and some light is reflected back. Interestingly, in some circumstances, light traveling from a material with a higher refractive index towards a material with a lower refractive index may not cross the boundary at all. For example, imagine light passing from water to air. As the angle of incidence increases, the refracted light bends farther away from the normal line. At some critical angle (determined by the ratio of the indices of refraction), the refracted light bends 90 degrees from the normal and follows the surface of the water. If the angle of incidence is above the critical angle, none of the light is transmitted across the boundary; rather, all of the incident light is reflected back into the water. This effect is known as total internal reflection.

Leak Proof Bag

Rob Bailey – Earth Science Senior

MATERIALS:
SHARPENED PENCILS
ZIPPER-LOCK PLASTIC BAGS
WATER
PAPER TOWLES

PROCEDURE:

Before we let you loose on demonstrating this experiment for an audience, it would probably be best to practice this over a sink, outside, or at a friend's house. Just don't make Mom mad by allowing her to come home to water puddles in the living room.

1. If you have your pencils, make sure they are sharpened to a point. The sharper, the better.
2. Fill a zipper-lock bag between 1/2 and 3/4-full with water. Cold, warm… it doesn't particularly matter.
3. Now for the fun part, ask your audience what would happen if you tried to push one of these pencils through the water-filled bag? Odds are that you'll have more than one look of fear or skepticism.
4. Hold the pencil in one hand and the top of the bag in your other hand. Slowly, but firmly, push one of the sharpened pencils through one side of the bag.
5. Push the pencil through the other side of the bag, too. **NOTE: Do not push the pencil all the way through either side of the bag. As soon as the eraser gets past the bag, you'll have a big, wet mess.**
6. From here, you can keep demonstrating your science "spear-it" by repeating this feat with the other sharpened pencils!
7. Once you're finished, hold the bag over a sink and remove the pencils. The water will come pouring out of the holes.

EXPLANATION:

Despite what it looks like, the zipper-lock bag isn't covered in a magical sealant that blocks leaks. Well… not exactly. Plastic bags like these are made out of our favorite kind of materials, polymers! Polymers are long chains of individual molecules, called monomers. (See that? Mono = one. Poly = many. Mers = molecules.) When you puncture these bags with a sharpened pencil, you're essentially separating polymer chains without breaking them. The long chains of molecules than squeeze in tight around the surface of the pencil preventing any sort of leak. Polymers continue to prove an indispensable part of life.

SAFETY:

Sharp pencils, be careful.

Cloud In a Bottle

Rob Bailey – Earth Science Senior

MATERIALS:
EMPTY CLEAR LIGHTWEIGHT PLASTIC WATER BOTTLE WITH LID
RUBBING ALCOHOL

PROCEDURE:
Take a 16 oz clear plastic water bottle and dump out or drink the water. Make sure your water bottle is the lightweight kind (not heavy duty plastic that wont bend easily).

Fill the bottom of the plastic bottle with rubbing alcohol. Swirl the alcohol around the sides coating the inside of the bottle.

Screw the cap on firmly.

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!

Slowly unscrew the cap until you feel it's about to pop off. Make sure the cap is not pointing at anyone! 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.

Instantly and magically the clear bottle is filled with a nice white cloud.

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:
Pop hazard, watch that cap

CO_2 expelling O_2

Rob Bailey – Earth Science Senior

MATERIALS:

LEATHER GLOVES
DISH SOAP
WATER (WARM)
DRY ICE
LARGE BOWL
STRIP OF CLOTH
PUREX LOAF PAN
SEVERAL TEA CANDLES
LONG MATCHES OR FIRE STARTER

PROCEDURE:

1. After the soap bubble demo add the tea candles to the loaf pan, then light the candles and place the loaf pan in front of the dry ice bowl facing the audience.
2. Place Mix 2 tablespoons (30 mL) of liquid dish soap with 1 tablespoon (15 mL) of water in a plastic cup.
3. Cut a strip of cloth that is about 1” (25 mm) wide and 18” (46 cm) long.
4. Soak the strip of cloth in the soapy solution you made in step two. Make sure the entire cloth is submerged in the solution.
5. Find a bowl or bucket that has a smooth rim and is smaller than 12” (304 mm) in diameter. You don’t need a clear bowl or bucket, but trust us, you’ll want one.
6. Fill the bowl half full with warm water.
7. Using heavy gloves or tongs, transfer two or three pieces of dry ice into the warm water. You don’t want too little or too much fog to be produced.
8. Dip one or two fingers in the soap solution and run your fingers on the lip of the bowl. (Be careful not to get soap in the water, otherwise, you’ll end up doing another experiment)
9. Remove the strip of cloth from the soapy solution and run the cloth between your thumb and forefinger to remove excess soap.
10. Stretch the cloth between your hands and slowly pull the soapy cloth across the rim of the bowl. The goal is to create a soap film that stretches across the entire bowl.
11. Once you’ve made the soap film, it will start to expand and fill with the dry ice fog. Once it bulges out, it looks just like a crystal ball.
12. When the giant bubble bursts, the cloud of “smoke” falls to the floor.

Explanation:

When you drop a piece of dry ice in a bowl of water, the gas that you see is a combination of carbon dioxide and water vapor. So, the gas that you see is actually a cloud of tiny water droplets. The thin layer of soap film stretched across the rim of the bowl traps the expanding cloud to create a giant bubble. When the bubble bursts the fog rolls out over the table. Placing the loaf pan in front of the bowl allows the CO_2 to roll out over the lip of the bowl into the loaf pan. Because the CO_2 is denser than the O_2 in the pan the O_2 is expelled up and out of the pan and is replaced with the denser CO_2 and the candles go out from the lack of O_2

Safety:

Dry Ice, use leather gloves to protect your skin, better yet leather gloves and tongs.
Fire from the candles.

Lava lamp

Rob Bailey – Earth Science Senior

MATERIALS:
WATER
CLEAR PLASTIC BOTTLE
VETABLE OIL
FOOD COLORING
ALKA-SELTZER
PAPER TOWLES

PROCEDURE:

1. Pour water into the plastic bottle until it is about one quarter full. We recommend using a funnel.
2. Fill the bottle the rest of the way with vegetable oil. Leave some air.
3. Wait for the oil and water to separate.
4. Add about a dozen drops of any food coloring to the bottle.
5. Notice the food coloring will fall through the oil and mix with the water.
6. Cut an Alka-Seltzer tablet into quarters and drop one of them into the bottle. Watch the reaction!
7. When the bubbling stops, add another piece of Alka-Seltzer. Does it start going again?

EXPLANATION:

Oil and water do not mix. The two separated from each other, with oil on top, due to its lower density than water. The food coloring also doesn't mix with the oil well, falling through to the water. The piece of Alka-Seltzer tablet you drop in releases small bubbles of carbon dioxide gas that rise to the top and take some of the colored water with it. The gas escapes when it reaches the top and the colored water returns to the bottom. Alka-Seltzer fizzes because it contains citric acid and baking soda (sodium bicarbonate). The two react with water to form sodium citrate and carbon dioxide gas–the bubbles that carry the colored water to the top of the bottle.

Light Bulb

Rob Bailey – Earth Science Senior

MATERIALS:

8 D BATTERIES
0.07 MM PENCIL LEAD
ELECTRICAL TAPE
MASON JAR (CLEAR)
SMALL CUP
2 WIRES WITH ALIGATOR CLIPS
SAFETY GOGGLES

PROCEDURE:

1. An adult is advised to conduct steps 6 and 7 of the experiment. On that note, begin by putting on your safety goggles.
2. Lay the D batteries end-to-end, positive to negative, and tape them together.
3. Tape one end of one alligator clip to the negative end of the battery chain. Then tape the other clip to an upside down small cup with a with the clip extending from the bottom of the cup. Grab the second wire and tape one end on the opposite side of the upside down cup. Note: If you do not have a cup you can use an empty toilet paper roll.
4. Grab a piece of pencil lead and set it in place using the two alligator clips attached to the cup.
5. Place the mouth of your mason jar over the pencil lead, clips, and base of the upside down cup.
6. Take the free clip from the second wire and connect it to the positive side of the battery chain. This completes your circuit.
7. After a moment the graphite should begin to produce smoke and glow brightly.
8. You've now built your own light bulb! What do you think will happen if you try different weights of pencil lead—0.5mm, 0.9mm, or even lead from a wood pencil?
9. How can you tweak the setup to get the pencil lead to glow for a longer time? Consider altering these: the length and weight of the pencil lead, the position of the alligator clips on the pencil lead, whether the mason jar covers the cup or not, and more or fewer batteries.

EXPLANATION:

This experiment is a visually exciting introduction to circuits and electricity. When you attach the final alligator clip to the positive end of the battery chain, you create a complete circuit, and that allows electricity to flow through it. As electricity travels through the pencil lead, which is actually graphite, it heats it up to an extremely high temperature causing it to glow and emit smoke.

This works similarly to the filament in a common light bulb. Filaments in light bulbs are made of tungsten because it can produce a lot of visible light and has a high melting temperature. It is, however, also prone to combustion, much like our smoking graphite, which explains why your household light bulb differs in the manufacturing process: the bulb is vacuum-sealed to get rid of oxygen, one of the necessary components of combustion.

SAFETY:

Very Hot

Soap Bubble

Rob Bailey – Earth Science Senior

MATERIALS:

LEATHER GLOVES
DISH SOAP
WATER (WARM)
DRY ICE
LARGE BOWL
STRIP OF CLOTH

PROCEDURE:

1. Mix 2 tablespoons (30 mL) of liquid dish soap with 1 tablespoon (15 mL) of water in a plastic cup.
2. Cut a strip of cloth that is about 1″ (25 mm) wide and 18″ (46 cm) long.
3. Soak the strip of cloth in the soapy solution you made in step two. Make sure the entire cloth is submerged in the solution.
4. Find a bowl or bucket that has a smooth rim and is smaller than 12″ (304 mm) in diameter. You don't need a clear bowl or bucket, but trust us, you'll want one.
5. Fill the bowl half full with warm water.
6. Using heavy gloves or tongs, transfer two or three pieces of dry ice into the warm water. You don't want too little or too much fog to be produced.
7. Dip one or two fingers in the soap solution and run your fingers on the lip of the bowl. (Be careful not to get soap in the water, otherwise, you'll end up doing another experiment)
8. Remove the strip of cloth from the soapy solution and run the cloth between your thumb and forefinger to remove excess soap.
9. Stretch the cloth between your hands and slowly pull the soapy cloth across the rim of the bowl. The goal is to create a soap film that stretches across the entire bowl.
10. Once you've made the soap film, it will start to expand and fill with the dry ice fog. Once it bulges out, it looks just like a crystal ball.
11. When the giant bubble bursts, the cloud of "smoke" falls to the floor.

EXPLANATION:

When you drop a piece of dry ice in a bowl of water, the gas that you see is a combination of carbon dioxide and water vapor. So, the gas that you see is actually a cloud of tiny water droplets. The thin layer of soap film stretched across the rim of the bowl traps the expanding cloud to create a giant bubble. When the water gets colder than 50ºF, the dry ice stops making fog but continues to sublimate and bubble. Just replace the cold water with warm water and you're back in business.

SAFETY:

Dry Ice, use leather gloves to protect your skin, better yet leather gloves and tongs.

Steel Wool

Rob Bailey – Earth Science Senior

MATERIALS:

STEEL WOOL
PYREX LOAF PAN (OTHER FIRE-RESISTANT TRAY)
9 VOLT BATTERY
FIRE EXTINGUISHER

PROCEDURE:

1. Open up the package of steel wool and the 9 volt battery.
2. Gently pull apart the steel wool so that air can get in and around the steel wool.
3. Lay the wool on a fire safe tray or surface.
4. Touch the battery to the wool, several places to get the steel wool going.
5. Stand Back, a little bit, tuck in your tie.

EXPLANATION:

Steel wool is actually mostly iron and when the battery terminals touch the wool the electrons from the battery move through the steel wool making a circuit. The fine wool heats up, a lot, to about 700 degrees C. At this temperature the steel wool reacts with O2 from the air forming iron oxide, FeO_2. Because it is so hot the, the fibers so thin, and O_2 surrounds the wool, there is a chain reaction trough out the pad of steel wool.

SAFETY:

Fire! The steel wool gets hot, watch any loose clothing, ties, sleeves, etc..
Fire Extinguisher