UNIVERSITY of NORTHERN COLORADO

Bringing Education to Life

SCED 441 – Methods in Teaching Secondary School Science

Demonstrations

Presented at the

Longs Peak Science and Engineering Fair - February 19, 2013

These demonstrations are not licensed in any way.

Please use appropriate safety precautions!

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Laser Microscope

Amy Ordaz, Biology Major

Materials:
1 laser
1 plastic dropper/syringe
Pond water
Surface to project image on
Apparatus to suspend beaker (optional)

Procedure:

1. Fill plastic dropper with some of the water collected from a pond
2. Hold dropper pointed down with apparatus or with hand while suspending a single drop from the end of it
3. Orient laser a few inches away (best to stabilize with a level surface)
4. Shine the laser through the suspended droplet
5. Observe the image projected on the wall/screen

Tips:

- The more stable the dropper and the laser are, the easier the image will be able see
- Ensure that water is collected as fresh as possible, so that any microorganisms will still be alive

Explanation:

Water collected from a pond or similar ecosystem will contain a myriad of different microorganisms, from bacteria to protozoans and even invertebrate animals such as rotifers. These organisms are much too small to see with the naked eye. However, the laser can magnify these small creatures when employing the curve of the water as a type of magnifying lens. The concentrated light from the laser is refracted, and what is projected are shadows of the microscopic animals contained in the single drop of water.

Safety:

Laser should not be pointed at anyone’s eyes.

ATP Energy Jar

Amy Ordaz, Biology Major

Materials:

1 gallon jar
3 Construction paper strips, each with a "P" written on it
Novelty springing snake with the word "energy" attached to it

Procedure:

1. Attach the strips of paper to the jar horizontally, with the 3rd strip attached to the lid of the jar
2. Load the springing energy snake into the jar
3. When the lid is taken off, the snake leaps out of the jar

Explanation:

This demonstration shows how the molecule ATP works. The high energy phosphate bonds will release energy when the third bond is broken (as symbolized by the snake). Conversely, for ADP (*di*phoshate) to add on a third phosphate again, energy must be used (illustrated by the snake being put back into the jar before the P is secured again.

Safety:

Ensure that the springing snake won't injure anyone's face.

Balloon Skewer

Amy Ordaz, Biology Major

Materials:
1 Balloon
1 Kebab skewer
Oil

Procedure:

Blow air into the balloon so that it is full but not completely inflated. Soak the kebab skewer in oil and slide through the balloon from the top region to near the bottom where it is tied off.

Tips:

Practice a few times to ensure the correct amount of air and the correct placement of the skewer. After putting the skewer through the ends, the demonstrator could also illustrate the tightness of the latex in the center and pop the balloon by sticking it through the middle.

Explanation:

The latex in the balloon is made of polymers that work to stretch out as the balloon inflates. Because the most stretch occurs in the center of the balloon, the long chains of polymers are under much more stress than the chains at either end of the balloon. But if the skewer is put through the middle region, the balloon will pop.

Safety

Know that it is still possible for the balloon to pop while doing this experiment, just not as probable in the location specified.

Of Musical Proportions

Amy Ordaz, Biology Major

Materials:

8 metal pipes, cut in proportions of 1, then ½, 1/3, ¼, etc.
String to suspend the pipes
Spoon
A few volunteers to hold the pipes
Written out music for the pipes (optional)

Procedure

Suspend the pipes and proceed to play a melody with them using the spoon. Each pipe is labeled with a number, that serves as the code to read the music provided.

Explanation

Sound is created from each pipe when it is struck by the spoon because of the change in air pressure. Each pipe has a specific natural frequency that it vibrates at depending on the length of the pipe. These pitches, struck in the correct rhythm and order, create music.

Tips:

Be sure that the measurements for the pipes are exact.

Safety:

The pipes are heavy, so ensure that they are secured before striking with a spoon.

Carbon Dioxide Bubble

Amy Ordaz, Biology Major

Materials:

Block of dry ice
Bowl of water
Liquid dish soap
Rag

Procedure:

1. Soak the rag with some dish soap and water
2. Place the block of dry ice into the bowl of water
3. When the ice begins sublimate, take the rag and slide it across the lip of the bowl
4. This should create a large bubble of carbon dioxide, from the dry ice

Tips:

Place apparatus on a towel to avoid a mess

Explanation

Dry ice is frozen carbon dioxide that will change directly from solid to a gas, a process known as sublimation. The dish soap and water will create a thin layer over the top of the sublimating dry ice, and this will consequently create a bubble. When the bubble is popped, all that is released is simply the carbon dioxide gas that has built up inside the bubble.

Safety:

Dry ice should be handled carefully, as it is very cold.

Non-Newtonian Substance on a Speaker

Amy Ordaz, Biology Major

Materials:
Corn Starch
Water
Speaker, connected to a stereo
Music, preferable with loud bass

Procedure:
Mix 5 Tbs of cornstarch with ¼ cup of water. Cover the speaker with saran wrap and pour 1/8 cup of the mixture on the saran wrap, right above the speaker. Turn up the music, with an amplified bass.

Tips: The ratio of corn starch to water may need to be played with a bit to get just thick enough

Explanation:
When force is exerted on the substance, it exhibits the qualities of a solid substance, but when it's at rest, it appears liquid. This demonstration alternates between the two states of matter by the force of vibration from the stereo, so the substance appears to be "dancing".

Tips: Use caution when using electrical outlets, and make sure the speaker is covered with saran wrap to keep from getting the substance on the equipment.

Burn Paper with Ice

Lucas Owens UNC Physics

MATERIALS:

1. Sodium peroxide - $Na_2 O_2$

2. Finely chopped tissue paper, or sawdust, or starch.

3. A small chip of ice.

PROCEDURE:

1. Before doing anything, show students a piece of tissue paper and ask: Would I be able to burn this piece of tissue paper with ice?"

2. Tear or cut tissue paper into very fine pieces and place them in a heap on a fire proof surface

and build it up to a cone which is about 5 cm high in the center.

3. On top of the cone, place a half teaspoon of sodium peroxide.

4. Now show the students the small chip of ice and put it on top of the heap stand back and observe.

EXPLANATION:

Na2O2 + H2O ----> 2NaOH + On + energy(heat)

The exothermic reaction above releases enough energy to ignite the paper.

SAFETY:

Be careful to keep the flame contained on the fireproof surface.

Sodium reacts with water so the reaction can occur accidentally.

Break a Bottle with only your hands

Lucas Owens UNC Physics

MATERIALS:

1. Glass bottle
2. Water
3. Two hands
4. Bucket to catch water and broken glass

PROCEDURE:

Fill the bottle with water leaving a couple of inches of air at the top. Hold the bottle by the neck with your non-dominant hand. Hold the bottle over the bucket and strike the mouth of the bottle hard with the pad of your dominant hand. The bottom of the bottle should break off. TIP: Use cold water to prevent bubbles. Strike the bottle hard and fast.

EXPLANATION:

The bottom of the bottle breaks off due to a process called Cavitation. When it is struck, the bottle moves faster than the water inside creating a vacuum. The water then rushes into the empty space and at a high speed crashes into the bottom of the bottle breaking it.

SAFETY:

Be careful that all of the glass is caught on the bucket. The glass will be sharp and could easily cut you or an observer. Wear safety goggles to protect your eyes from shards of glass.

A HOT TONE

Lucas Owens UNC Physics

SUBJECT AREA: (Physics, General Science, Sound)

MATERIALS

1. PVC drain pipe, 1.5 to 2 inches diameter,

   possibly several lengths.

2. Propane torch

PROCEDURE:

1. Light propane torch and turn on to largest (hottest) setting.
2. Hold the torch in a position so that the flame is perpendicular.
3. Lower the pipe over the flame. Adjust height until tone develops.
4. Repeat with each pipe length.

EXPLANATION:

The heat of the flame causes the air in the tube to suddenly expand. The hot air begins to oscillate up the tube, resulting in a resonating tone. A standing wave is created in a tube with open ends. The longer the tube, the longer the wavelengths produced in the standing wave and thus the lower the tone.

SAFETY:

Caution always has to be used when working with a flame, be careful where you point the torch you could easily burn yourself or set something on fire.

Van De Graff Generator

Lucas Owens UNC Physics Secondary Ed

MATERIALS:

1. Van De Graff generator
2. Rubber pad or plastic stool
3. Volunteer with longer hair

PROCEDURE:

First ask for a volunteer with medium length to long hair who is not afraid of a little electricity. Have the volunteer stand on the stool and place their hand on the generator. Turn the generator on and wait for the volunteers hair to stand up.

EXPLANATION:

The Generator causes a buildup of like charges in the volunteer's hair. These like charges repel each other and cause the hair to stand on end.

Smoke Rings Demo

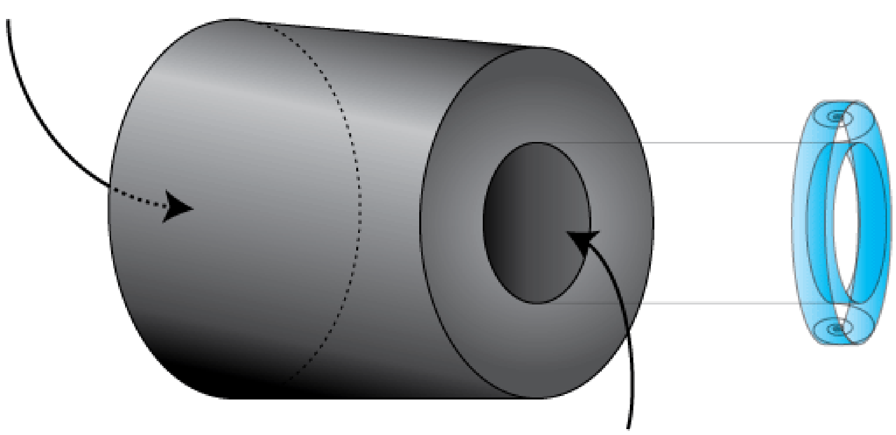
Lucas Owens UNC Physics Secondary Ed

MATERIALS:

1. Trash bin with circular hole cut in the bottom
2. Shower curtain
3. Bungee cord or duct tape
4. Fog machine
5. candle

PROCEDURE:

Use the shower curtain to cover the large open end of the trash bin and use the bungee cord or duct tape to hold it in place. Light a candle and from the other side of the room use the trash bin to put out the candle by tapping on the shower curtain forcing air out of the small hole. Fill the trash can with smoke and hit it again, showing how the air looks as it travels.



EXPLANATION:

When air is forced through the small opening in the trash can, the air near the edges is slowed by friction while the air in the center is unimpeded. This creates areas of reduced pressure in front of the ring at the edge and behind the ring in the center. The air then circulates moving from high to low pressure areas.

CRUSH A CAN WITH HEAT

Lucas Owens UNC Physics Secondary Ed

MATERIALS:

1. Aluminum soda cans
2. Water
3. Ice Water
4. Hot plate
5. Tongs to hold can

PROCEDURE:

1) Pour just a little water into aluminum can

2) Heat can on hot plate until water is boiling

3) With tongs, quickly take can and flip over into ice water

EXPLANATION:

This shows how the volume of a gas changes with temperature. The hot water vapor expands to fill the can and then when that gas is in contact with the ice water, it will cool rapidly causing a vacuum in the can. The air outside of the can rushes to fill the vacuum which crushes the can.

"Can" You Come Back!

Lucas Owens UNC Physics Secondary Ed

Materials:

1. A coffee can with plastic lid
2. An object to use as a weight

   (The object must be heavy enough to

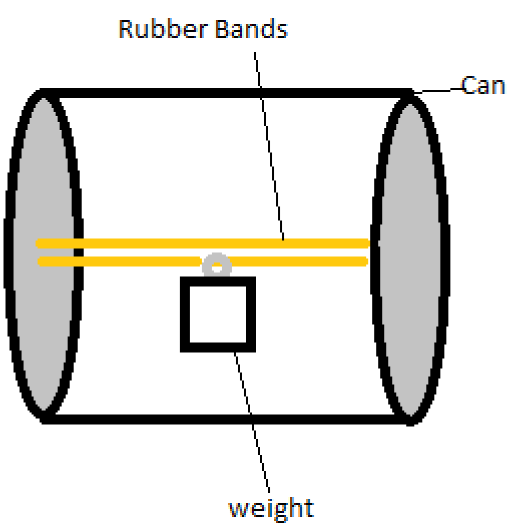
   resist movement while suspended by rubber band.

   Some experimentation may be necessary)
3. Two rubber bands or one if it is large enough to

   reach both end of the can plus be attached to the weight

Procedure: Some assembly required.

1. Punch a hole in the metal end of the can and also in the plastic end of the can
2. Push the rubber band through the holes and place a tooth pick through the loops.
3. Attach the weight to the rubber band in the center of the can so that the rubber band twists as the can rolls and replace the plastic lid. It works well to use two rubber bands and attach the weight to only one of them.



Experiment and demo Roll the can across a level surface. The can will roll and stop and then return close to the original starting point.

EXPLANATION:

This demo uses several principles that could be talked about and worked with in class. By using your hand to push the can originally kinetic energy was used. While the can was rolling the rubber band inside was being twisted and therefore potential energy was being stored. The weight in the middle of the rubber band was heavy enough that its own inertia prevented it from turning with the can. When the can stopped due to friction and the energy taken up by the rubber band the potential energy in the rubber band was released. Since the weight was heavier than the can, it was easier for the can to roll than for the weight to turn. Therefore the can rolled back toward your hand until the energy in the rubber band could not overcome the friction of the can being rolled.

Friction Meter Stick

Kai Ficek, Physics Senior

Materials:
- Meter Stick
- Variety of Weights in Paperweight Size

Procedure: Using both index fingers, place hands at opposite sides underneath the meter stick. Move fingers together at the same pace and note that they meet up at the center of mass; the stick is perfectly balanced. The marks on the meter stick can be used as a reference to show that the distance travelled by each side is equal. Next, start fingers at different points on the stick. Once again move fingers together at the same pace and note that they will meet at the same place as before. Now add a weight to one end and perform the demonstration again. The center of mass will have shifted in favor of the weight but the stick will still be perfectly balanced. Experiment with various amounts of weights at different points. The meter stick will always remain balanced.

Explanation: The friction caused by the weight of the stick causes the forces to equalize when there is no additional weight. When weight is added, the force of static friction causes the side with more weight to move more slowly until the forces are equalized. Thus, the fingers will always meet at the center of mass.

Disappearing Test Tube

Kai Ficek, Physics Senior

Materials:
- Beakers
- Test Tubes (shorter than beaker)
- Vegetable Oil

Procedure: Place test tube in beaker. Begin pouring vegetable oil into beaker. After the oil has reached nearly the height of the test tube, gradually move the pouring point to the test tube and fill the tube. The test tube completely disappears!

Explanation: The reason the test tube disappears is that both the glass and the vegetable oil have the same index of refraction so the light entering both mediums does not bend at all. The experiment can be expanded by performing the same experiment in water. The tube will remain visible because water and glass have different indexes of refraction.

Fiber Optic Water

Kai Ficek, Physics Senior

Materials:

- 2 liter soda bottle with small hole punched in the side
- Water to fill soda bottle
- Clear cylindrical receptacle to catch water
- Laser pointer; any color
- Prop for laser: book, tubberware, ring stand etc.

Procedure: Puncture the soda bottle with a small (<1cm) hole near the base of the bottle and plug the hole if possible. Set the laser on the prop so it is level with the hole. Position the receptacle near the bottle so it will catch the stream of liquid from the hole. Remove the plug and observe that the stream of water leaving the bottle is illuminated by the laser. Upon closer examination, the angles of reflection inside the stream itself can be observed. The receptacle may even glow with the same light. After the stream grows weaker the angle shifts and the stream no longer glows.

Explanation: The reason the light follows the path of the water is because it is being totally internally reflected. Every medium has a critical angle at which any light that enters will be totally internally reflected, meaning that no rays of light exit the medium. By finding this angle with water using the laser we can illuminate the water.

Burning Chemicals

Kai Ficek, Physics Senior

Materials:

- Variety of chemicals with chloride salts: $SrCl_2$, $NaCl$, KCl, $CuCl_2$, $LiCl$, $CaCl_2$
- Ethanol
- Glass Petri Dishes, one per chemical

Setup and Procedure: Mix amounts of each chemical individually with ethanol in glass petri dishes. Light each one on fire and notice how they all burn at different colors. Discuss the different chemicals in relation to their colors.

Explanation: Elements are fundamentally different from each other and that's what we observe when they burn. Each element has a different structure and it's the number and layers of electrons that determine which colors we see when they burn. The differences are at the level of every single atom that is present in the chemicals we are burning.

Safety: Always use caution with fire. The ethanol is very flammable and should be used with care. The chemicals may be caustic, use gloves any time there's any interaction with chemicals. Safety glasses and gloves are a good idea for this demonstration.

CO_2 Bubble

Kai Ficek, Physics Senior

Materials:

- Long, narrow strips of fabric (from an old t-shirt)
- Dishsoap such as Dawn or Ajax
- Bowl and cup, or two cups
- Water
- Dry ice, approximately ½ pound

Setup: Place a good amount of soap in a little bit of water and submerge the strips of fabric in the solution. Pour the pure water into the other bowl or cup.

Procedure: Place dry ice in the bowl or cup with water. Rub the soapy fabric strips around the rim of the bowl or cup. Next, scrape the fabric strips across the rim to form a bubble across the surface.

Explanation: This experiment shows two different aspects of phases of matter. First, it shows sublimation, the process by which a solid turns directly into a gas without first becoming a liquid. The second idea is it shows how gasses behave under pressure. As more gas is created it expands to fill the bubble.

Safety: Wear gloves when handling dry ice as it will burn skin on contact.

Black Whole

Kai Ficek, Physics Senior

Materials:

- A coffee can which has been specially constructed (a slanted metal or plastic piece attached on the inside to keep water in).
- A glass of water.

Setup: When making your coffee can the metal or plastic piece on the inside should be slanted down towards the bottom of the can. That way when the can is tipped on its side it will hold in the water better. Using the lid of the coffee can works well since it is already the correct shape and diameter. A hidden mark can be made on the inside rim of the can so that you can easily tell which way to tilt it.

Procedure:

1. Hold the coffee can above the observers to ensure that they cannot view what is inside it.
2. Pour a glass of water directly into the coffee can. Note: do not let observers see inside the coffee can.
3. Tip the can over onto the side which will allow no water to spill out of the coffee can.

Questions:

1. Describe exactly what you observed.
2. Based on your observations, describe or draw what might be in the coffee can.
3. How might you collect further information to support your ideas?
4. Write down some examples of how scientists use observations to explain the world around them.

Explanation: This demonstration is an excellent way to introduce the Scientific Method because it deals with observing and recording those observations. It is meaningful for students to observe that things are not always as they seem. Students can be introduced to the idea that in science there are many wonders that scientists cannot fully explain. Scientists can only make observations and try to collect as much information as possible and based on the knowledge they gain from these observations they can use analysis to begin to form a hypothesis.

Magnet Airplane

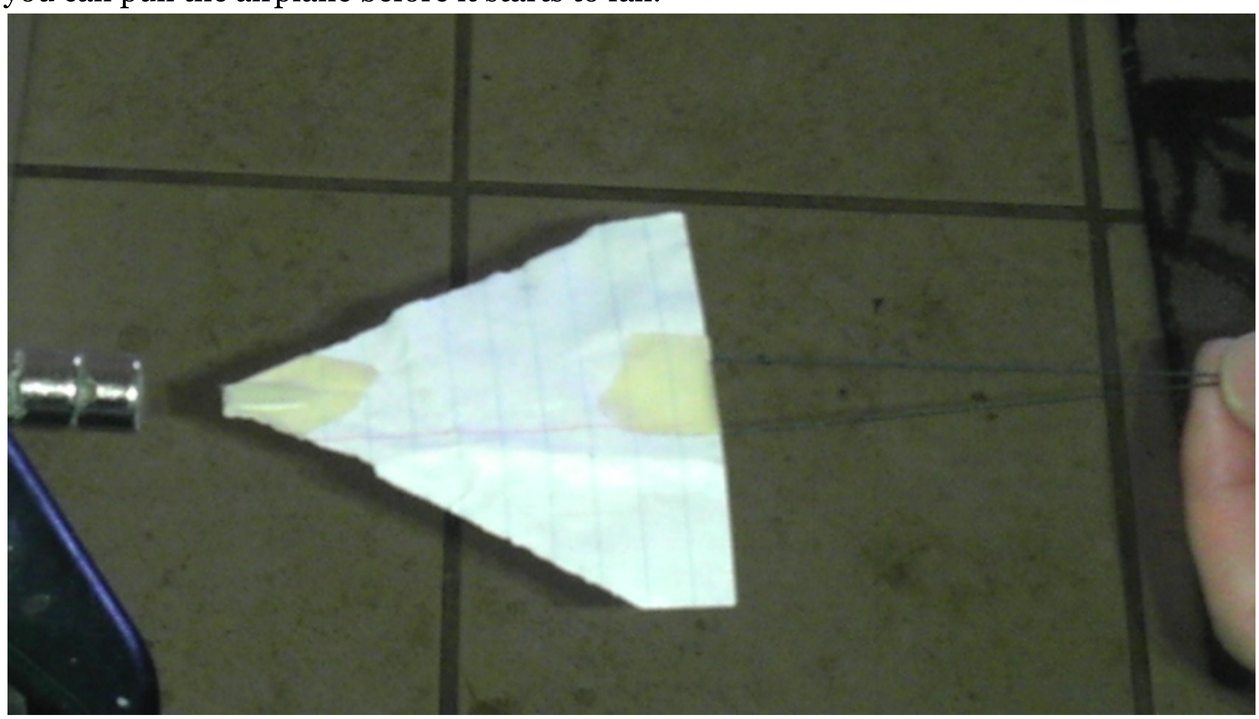
Kai Ficek, Physics Senior

Materials:

- Steel straight pin
- Sewing thread, at least 12 inches
- Tissue paper
- Strong magnet
- Scissors
- Table

Setup: Cut a small wing, 1-2 inches long from the paper. Insert the pin through the center to create a mini “airplane”. Tie the thread to the head of the pin. Place magnet on the edge of a table.

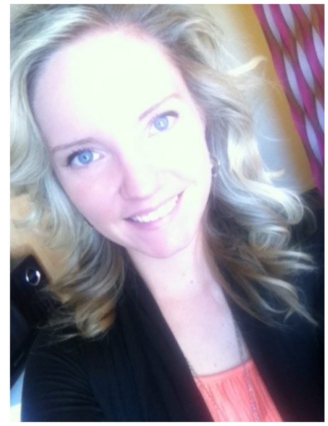
Procedure: Start with the airplane touching the magnet. Slowly pull the airplane away from the magnet with the string until it is suspended. Experiment with how far you can pull the airplane before it starts to fall.



Explanation: The pin and the magnet both have magnetic properties. They pull on each other with enough force to overcome the pull of gravity. This demonstration shows how strong the magnetic field is and how far it extends. The strength of attraction between two magnets depends on how orderly the magnetic domains are in the magnets.

Shot Put and Styrofoam Sphere

Sara Heidel- Earth Science Senior



Materials:
1. Empty two liter bottle
2. 16 lb shot put
3. Styrofoam sphere same size as the shot put

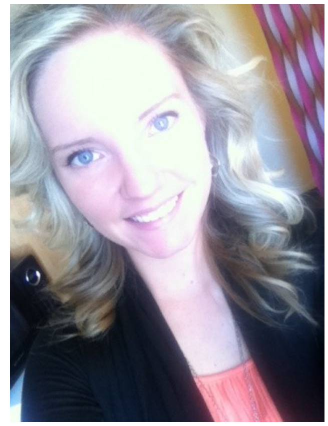
Procedure
1. Acknowledge the shot put and the sphere are the same size, and therefore hold the same volume
2. Have a student come up and hit the sphere with all their might with the two liter bottle, watch it fly.
3. Have the same student hit the shot put with all their might, watch the 2 liter bottle fly in the other direction.

Explanation:
Force is defined as mass times acceleration. By applying force to the sphere, it is easy to see it accelerate forward. By applying the same force to the shot put it may be shocking to not see it move at all. This shows that in order to move a more massive object, you have to apply more force. Due to Newton's laws, the two liter bottle fly's in the opposite direction when opposed by the shot put.

Safety:
When hitting the two objects, stand back and make sure there are not any obstacles in the way in front or behind the batter.

Alka-Seltzer Rocket

Sara Heidel- Earth Science Senior



Materials:
1- Empty, film canister with lid that snaps inside
½- Alka-Seltzer tablet
Water

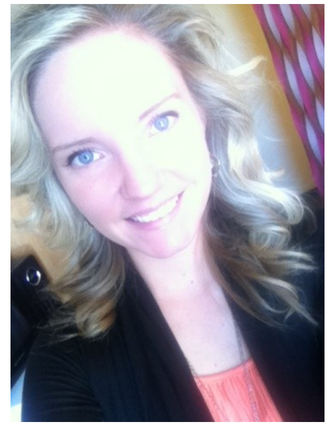
Procedure:
1. Take the lid off of the film canister.
2. Add water to the canister to one-quarter full.
3. Add a half tablet of Alka-Seltzer to the film canister and quickly snap on the lid.
4. Place the rocket on the table, lid down.
5. Stand back and wait for launch.

Explanation:
This experiment demonstrates Newton's third law of motion, "For every action there is an opposite and equal reaction." Gas pressure builds up inside the canister due to the reaction between the Alka-Seltzer and water which releases carbon dioxide. This reaction continues until enough pressure builds to blow the canister apart from its lid.

Safety:
Safety goggles are encouraged to protect the eyes. Everyone involved in the demonstration should stand away from the rocket when it is on the launch pad. It may take 15-20 seconds to build up enough pressure, do not approach prematurely. These rockets can shoot up to 5 meters in the air, no sharp object should be attached to the canister.

Combustion Reaction: Candle in a Jar

Sara Heidel- Earth Science Senior



Materials:
1 small candle
1 glass jar and lid, large enough for the candle to fit
Long matches or lighter

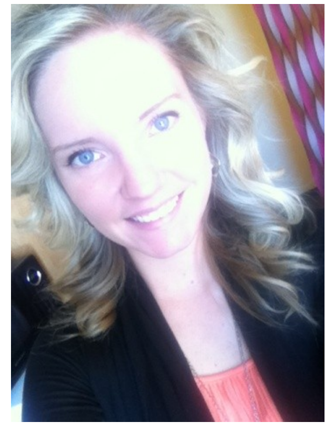
Procedure:
1. Place the candle upright in the jar
2. Light the candle
3. Screw the lid onto the jar tightly; watch as the candle is extinguished

Explanation:
As the candle burns, a combustion reaction occurs. One of the products of combustion is water; you might have noticed water condensing on the inside of the jar. Once the flame has consumed all of the oxygen in the jar, it can no longer be fueled and is extinguished.

Safety:
Use caution when handling the jar and lid, they may be hot.

Water Balloon in a Jar

Sara Heidel- Earth Science Senior



Materials:
1 ordinary party balloon
1 wide mouthed jar or bottle
1 pair of tongs
Matches or a lighter
1 tissue

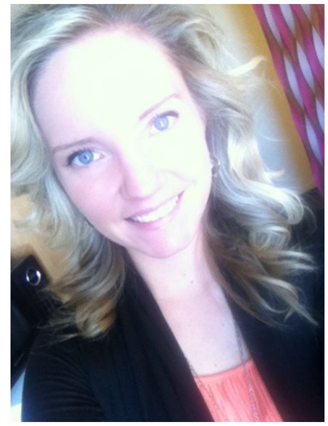
Procedure:
1. Fill the balloon with water, until it is slightly bigger than the mouth of the jar
2. Light a half-tissue while holding the tissue with tongs
3. Place the tissue in the jar, quickly
4. Immediately place the balloon on the mouth of the jar
5. Watch as the balloon is suctioned into the jar

Explanation:
As the tissue burns in the bottle it heats up the air inside. Air will always expand when you heat it up. So the hot air will press up against the edge of the jar, creating more pressure, and might make the balloon jump or jiggle. After the flame goes out, the air will cool and contract and the balloon will not let air enter the jar. The pressure drops inside of the jar, and the pressure from the air in the room pushes the balloon into the jar. We need water in the balloon to make sure the balloon does not fall off of the jar when the air inside of it is expanding and wanting to flow out of the container.

Safety:
Use caution when lighting the tissue, to not burn yourself or others.

Straw Drill

Sara Heidel- Earth Science Senior



Materials:
1 potato
1 sturdy plastic straw

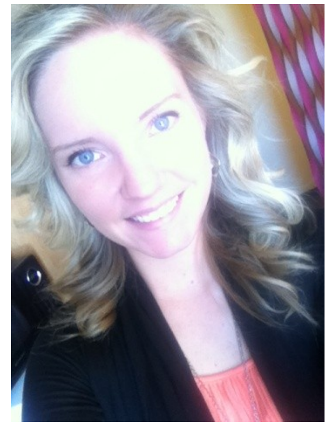
Procedure:
1. Hold the potato in a way where the straw will not penetrate your hand
2. Hold the straw in your other hand, about 2/3 of the way up the straw with your thumb on top.
3. Use a sharp thrusting movement to force the straw though the potato

Explanation:
The secret is inside the straw. Placing your thumb over the end of the straw traps the air inside. When you trap the air inside the straw, the air molecules give the straw strength, which in turn keeps the sides from bending as you jam the straw through the potato as air is being compressed. The trapped, compressed air makes the straw strong enough to cut through the skin, pass through the potato, and exit out the other side. Without your thumb covering the hole, the air is simply pushed out of the straw and the straw crumples and breaks as it hits the hard potato surface.

Safety:
Hold the potato at an angle where you will not stab your hand when the straw penetrates the potato.

Hot Air Balloon

Sara Heidel- Earth Science Senior



Materials:
1 large plastic bag
Hair dryer

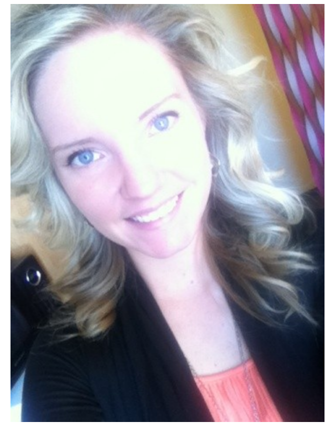
Procedure:
1. Close off the bag with your hand, leave a small opening
2. Insert the hair dryer through the opening
3. Heat the air in the bag with the hair dryer for a few minutes
4. Observe the bag rise

Explanation:
As the air inside the bag is warmed, it expands and becomes less dense than the air outside the bag. Therefore when released, it rises. Warm air will naturally rise in comparison to the cooler air surrounding it. A hot air balloon, in a small scale, was created.

Safety:
There is a possibility of the bag melting due to the high heat of the hair dryer. Be sure to choose a plastic bag that is a little thicker than a grocery bag.

Create a Sunset

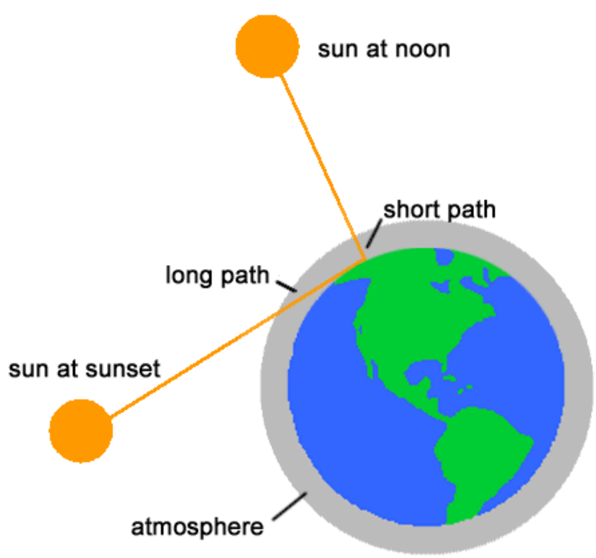
Sara Heidel- Earth Science Senior

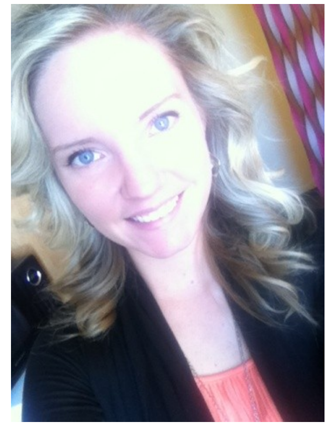


Materials:
Flashlight
Clear glass container
¼ cup of milk
2 gallons of water

Procedure:
1. Add the water to your container
2. Shine the flashlight through the water, noticing how you cannot see the beam of light
3. Add ¼ cup of milk to the water and stir
4. Shine the light through the container so the viewer can see the beam of light from the side
5. Shine the light through the container so it is shining directly at the viewer

Explanation:
When you added milk to the water, you added many tiny particles to the water. Milk contains many tiny particles of protein and fat suspended in water. These particles scatter the light and make the beam of the flashlight visible from the side. Different colors of light are scattered by different amounts. Blue light is scattered much more than orange or red light. Because we see the scattered light from the side of the beam, and blue light is scattered more, the beam appears blue from the side. Because the orange and red light is scattered less, more orange and red light travels in a straight line from the flashlight. When you look directly into the beam of the flashlight, it looks orange or red.





Make Flubber

Sara Heidel- Earth Science Senior

Materials:
Warm water
3 tsp. Borax
2 cups of white glue
Food coloring

Procedure:
1. In a large container, combine 1.5 cups warm water, 2 cups white glue and food coloring
2. In a second, smaller container, combine 3 2/3 cups warm water with 3 tsp. of Borax
3. Mix ingredients in each container thoroughly
4. Pour contents of smaller container into large container
5. Gently lift and turn the mixture until approx. a tablespoon of liquid is left

Explanation:
Flubber is a polymer. The word polymer comes from the Greek language from poly "many" and meros "parts". Polymers are large molecules consisting of repeating identical structural units connected by covalent chemical bonds. Polymers can be naturally occurring or manmade. Manmade polymers are materials like nylon, polyester, and polystyrene. Examples of naturally occurring polymers are proteins in our body like tubulin and actin. These proteins make up microtubules and microfilaments that serve as structural components within our cells.

Safety:
Do not ingest this material.

Are you Strong Enough to Break an Egg?

Dene Gallagher, Biology Major

Purpose: The purpose of this demonstration is to show that the curved, oval shape of an egg allows for force to be spread out over the whole egg. If there is a specific sharp force to the egg it will break.

Materials:

-Eggs

-Gloves or ziplocks for the weary

Procedures:

-Ask everyone to be make sure that they have taken off all their rings

-Place the egg in the palm of hand and squeeze evenly as hard as you can

-Repeat until convinced

Explanation: pressure=force/area. When you squeeze the egg, the shape of the egg allows the force you are exerting to be spread out throughout the egg, meaning the pressure the egg is experiencing is not that great at any specific point on the egg. So, it will take a much greater force, or a smaller area for the egg to break. This explains why you can break an egg on the edge of a bowl, but you can't squeeze it to break it.

Peanut Butter Jelly Time

Dene Gallagher, Biology Major

Purpose: The purpose of this lab is to help students visualize the cell membrane and it's amphipathic properties. It will help show a hydrophillic head (bread) and the hydrophobic tails (peanut butter) that phospholipid bilayers have.

Materials:

-2 slices of bread

-Peanut butter

-Knife

-Water

-Food coloring

Procedures:

1. Take one piece of bread and spread a thick layer of peanut butter on one side

2. Put another piece of bread on top of the layer of peanut butter
   -basically you will have a peanut butter sandwhich

3. Color some water with food coloring so that it is visible. A bright color like red, green, or blue that will contrast against the bread will work best.

4. Slowly pour about 30 mL of the colored water on top of the bread and observe whether the colored water has seeped through the peanut butter layer and onto the other piece of the bread.

Tips: Too much water will oversaturate the bread and and make a mess, use just enough to make your point and be convincing.

Bed of Nails

Dene Gallagher, Biology Major

Purpose: To show that spread out force is less effective than a sharp concentrated force.

Materials:

1. Mini bed of nails model

2. 2 balloons

3. A visible medium to write on

Procedures:

1. Pull out a single nail and ask students how much effort it will take for you to pop the balloon.

2. Pop the balloon with the single nail

3. Write down pressure= Force/area and briefly explain
   - you can use rough measurements as to the area of the head of the nail and just ask from 1-10 how much force it took for you to pop your balloon so that the numbers will still reflect your point

4. Show the bed of nails and ask how much force it will take to pop the balloon

5. Lay the balloon on the nails, slide the board down, and ask students to come try to pop the balloon. They will notice a lot more force is needed

6. Use the same equation as above to reflect how area affects the force needed to aquire the same amount of pressure.

Explanation: Pressure=Force/area. When the small point of a nail pops the balloon there is very little area used, so it doesn't take a very great force for the balloon to pop. When the area in which the force is being exerted is increased the force also needs to be increased in order for the pressure to be great enough to pop the balloon.

B Squared (Burning Balloons)

Dene Gallagher, Biology Major

Purpose: Show the different properties of dispersing heat through different mediums.

Materials:

-One balloon filled with water

-One balloon filled with air to an equal volume

-matches

Procedure: 1. Light a match and hold it under the air filled balloon. Prepare for it to pop immediately. Now, hold a match under the balloon that is filled with water, the balloon shouldn't pop. Don't hold the match in one spot, hold it close, but move it slowly beneath the balloon.

Concept: The balloon filled with the air pops right away because the match burns quickly through the rubber of the balloon and the air did not absorb the heat. The water balloon didn't pop because the water, not only dispersed the heat, it absorbed it as well. Also, air has a lower specific heat capacity than water does, meaning that less heat is needed to warm up the air, not a lot of energy in required to increase the kinetic energy of the gas molecules, whereas water takes a lot of energy to heat up the water and increase the kinetic energy of its molecules.

Swelling Syringes

Dene Gallagher, Biology Major

Materials:

-plasitic syringe

-multiple marshmallows (possibly colored so they are more visible)

Procedure:

1. Put the marshmallow in the barrel of the syringe
2. Cover the tip of they syringe with your finger during the demo
3. Pull they syringe back and observe the effect on the marshmallow
4. Now, plunge the syringe forward and observe the effect on the marshmallow

Follow up questions:

1. What is being compressed, the air or the marshmallow?

Concept:

When the plunger is pulled back on the syringe the air pressure in the barrel of the syringe is decreased; you are allowing the air molecules more space to move, so the air in the marshmallow moves out and causes the marshmallow to grow in size. When the plunger is pushed in the air pressure increases, thus compressing the marshmallow. Boyle's Law states P1V1=PV2, so the measurements are related. You can envision P and V on either side of a see-saw, when one goes up the other goes down.

Impacts of Pollution:

Dene Gallagher, Biology Major

Purpose: To show the effect of a small amount of pollution on a stream and its surrounding wildlife

Materials:

-1 gallon glass jar

-Measruing cup

-Red food coloring

Procedure:

-Pour ½ a cup of water into the gallon jar

-Add and stir 2 drops of food coloring into the jar

-Add 1 cup of water at a time to the jar until the red color disappears

Explanation:

The food coloring is condensed because there is not a lot of water for it to diffuse in. The molecues are close together making the red more vibrant. As more water is added the food coloring molecules can diffuse and spread farther apart. Eventually they spread out far enough that they are no longer visible because they are so far apart. Relate this to waste that is dumped into a stream; similar concepts apply. The material is dumped and it will flow downstream and it becomes more spread out and mixed with a larger amount of water. Eventually you can't see it anymore, but just like the red food coloring, it doesn't mean that it has disappeared.

Natural Acid and Base Indicators

Dene Gallagher, Biology Major

Materials:

-1.5 ml diluted blueberry juice

-Vinegar

-Ammonia

-3 100 ml beakers

Procedure:

-Add small amount of ammonia to diluted juice

-observe color change

-add vinegar and the solution will turn back to the blue color

Concept:

Acids contain a lot of H+ ions, while bases contain very few. The juice is an indicator, that for some reason is sensitive to the amount of H+ in a solution. When there are a lot of H+ ions the indicator turns green, showing an acidic solution. When there are only a few H+ ions the indicator turns a different color. Ammonia is a base and when it is added to the blueberry juice it turns deep green, showing the presence of a base. The blueberry juice is an indicator, so the color won't change when an acid, vinegar, is added. Then if vinegar is added to the ammonia/juice mixture, it will make it more basic, thus turning it back to blue.