UNIVERSITY of NORTHERN COLORADO

Bringing Education to Life

SCED 441 – Methods in Teaching Secondary School Science

Demonstrations

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Please use appropriate safety precautions!

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Eggs and Osmosis

Karen Allnutt, Biology Major

Materials:
At least 3 eggs
Large bowl
Vinegar
10% Salt water
DI Water
Corn syrup
Beakers large enough to hold egg and some liquid

Procedure:

Part 1: Making a shell-less egg

1. Place the eggs in the large bowl and cover with vinegar. Let these sit for 24-48 hours.

Part 2: Osmosis

1. Fill a beaker half-way with DI water, another with 10% salt water, and another with corn syrup.
2. Carefully use the large spoon to transfer a shell-less egg to each beaker.
3. After 24 hours, what do the eggs look like?

Explanation:
When the eggs are placed in the vinegar, the acid dissolves the hard calcium carbonate shell. However, the membrane of the egg itself will not dissolve and you are left with a shell-less egg. Osmosis is the movement of water through a selectively permeable membrane. The direction of the movement depends on the concentration of the water on either side of the membrane. Because osmosis is a form of passive transport, it does not require energy, the water will move from an area of higher concentration to lower. Because the DI water has a higher concentration of water than the egg inside the membrane, water will move in causing the egg to swell. Both the salt water and corn syrup have lower concentrations of water than the inside of the egg so the water from inside will move out, causing the egg to shrivel.

Tips:
Start off with more than 3 eggs just in case some break during transfer. This does require several days prep so make sure you plan ahead.

Safety:
Be careful not to splash vinegar in your eyes.

Eggs and Inertia

Karen Allnutt, Biology Major

Materials:
One raw egg
One hard-boiled egg

Procedure:
1. Set both eggs on the table, but don't let the audience know which one is which.
2. Spin both eggs.
3. Place your index finger on the eggs with enough pressure to stop them.
4. Remove your fingers and observe.

Explanation:

This demonstration is a great way to illustrate Newton's first law of motion: a body in motion or at rest will stay in motion or at rest unless acted upon by an outside force. This is also known as the law of inertia. When the eggs are spinning they are in motion and your finger acts as an outside force to stop them. The hard-boiled egg will stay at rest because the egg inside the shell is also at rest. However, the raw egg will start spinning again when the finger is removed because the liquid inside is still spinning: the finger did nothing to stop it.

Tips:

It might help to put a very small mark on the eggs to help you remember which is which.

Safety:

Be careful not to spin the eggs to the floor or drop them.

Balloons and Viral Replication

Karen Allnutt, Biology Major

Materials:
Large round balloon
About 20 purple colored pieces of paper (about the size of raffle tickets)
About 4 pieces of paper of a different color
Something sharp
Bright stickers
Transparent tape

Procedure:

1. Prep: set aside 1 of the purple papers and put a piece of tape on the back side of it. Put stickers on the remaining purple tickets. Push all of the raffle tickets (except the one with the tape) into the balloon, inflate it and tie it off.
2. Explain to audience that many diseases are caused by viruses. Viruses cannot replicate themselves without a host.
3. The balloon represents a body cell and the single ticket is a virus.
4. In order to replicate, the virus must attach itself to the cell (stick ticket to balloon).
5. The virus then makes the cell make copies of the virus. (Shake the balloon to indicate that more viruses have been made inside).
6. Soon there will be too many copies of the virus inside and the cell will burst (use pin to pop balloon.)
7. Viruses will spread all over the place looking for a new host.
8. Antibodies (stickers) have attached to the virus so that the body will recognize it and fight the virus off. Every once in awhile, the virus doesn't make an exact copy of itself (pink tickets). These blue viruses can still make us sick because they are not recognized by the body as being harmful.

Tips:

Try to be dramatic with the shaking and popping of the balloon so that the viruses fly far.

Safety:

Be careful with the pin so as not to stab yourself.

Methylene Blue Redox Reactions

Karen Allnutt, Biology Major

Materials:
Clear plastic bottle
Methylene blue solution
Glucose solution
Sodium hydroxide solution
Oxygen in the bottle

Procedure

1. Combine equal amounts of the glucose solution and sodium hydroxide solution in the clear plastic bottle.
2. Add 6-8 drops of the indicator methylene blue and put the cap back on the bottle.
3. Shake the bottle and observe.
4. Let the bottle sit for a few minutes and observe again.

Explanation
This blue bottle experiment is a great tool for introducing reduction-oxidation reactions. An alkaline solution of **glucose** acts as a **reducing agent** and reduces added methylene blue from a blue to a colorless form. Shaking the solution raises the concentration of oxygen in the mixture and this **oxidizes** the methylene blue back to its blue form. When the dissolved oxygen has been consumed, the methylene blue is slowly reduced back to its colorless form by the remaining glucose.

$$HOCH_2(CHOH)_4CHO+3OH^- \rightarrow HOCH_2(CHOH)_4CO_2 + 2H_2O + 2e^-$$

$$O_2 + MB(\text{Colorless}) \rightarrow MB_{ox} \text{ (blue) (fast reaction)}$$

$$MB_{ox} \text{ (blue)} + CH \rightarrow MB \text{ (colorless)} + \text{Gluconic acid}^- \text{ (Slow Reaction)}$$

Where CH is the carbohydrate MB is the reduced (colorless) form of methylene blue, MBox is the oxidized (blue) form, and X- represents the oxidation products from glucose (gluconic acid).

Tips:

This experiment can be repeated multiple times. However, the solution is time sensitive so if this is to be used over the course of a few days, you will need to prepare new solutions each day. You could also change the concentrations of glucose and sodium hydroxide to have students compare the rates of reaction.

Safety:
Goggles and glasses should be worn by the teacher preparing the solutions. Make sure the cap of the bottle is on tight before shaking the bottle.

Vascular Tissues

Stephanie Clark, Biology Major

Materials:
Stalk of celery (with leaves)
Two glasses of water
Food coloring (blue works best)

Procedure:

1. Fill cups full of water
2. To one of the cups add 5 drops of blue food coloring
3. Place one stalk of celery (with leaves) into each of the cups, insuring the leaves are sticking out of the cup
4. Observe the change in color of the stalk immersed in the food coloring as time passes
5. Compare and contrast the food coloring stalk with the plain water stalk

Tips:

- You may need to set the experiment aside and allow time to pass before coming back and observing the results

Explanation:

The purpose of this experiment is to demonstrate the movement of water into a plant through the vascular tissue known as the xylem. The color of the celery will change as the celery is allowed to soak up the colored water. Sit back and enjoy your nice green celery stalk turn a shade of blue, all the way up to the leaves!

Safety:

Although food coloring is not dangerous, it could potentially stain skin and clothing. Ensure that it is handled with care.

Sinking and Floating Lemons

Stephanie Clark, Biology Major

Materials:

2 lemons
 1 whole
 1 peeled
1 tank of water large enough to hold the lemons

Procedure:

1. Peel one lemon completely. Insure that the lemon is well peeled and does not have any of the rind left on it.
2. Fill tank full of water. (Enough water that the lemons could be submersed.)
3. Place both lemons into the tank
4. Observe the results

Explanation:

The whole lemon will float because the skin is good at excluding water. The peeled lemon will sink and the lemon that still has the skin on it will float. The skin of the lemon acts as a life jacket for the lemon. There are small air pockets inside of the rind of the lemon that allow the lemon with the skin to float. When the life jacket is removed (the lemon is peeled) the lemon will sink because it no longer has the air pockets keeping it afloat.

Safety:

Insure that knife safety is followed while cutting the lemons.

How to Light a Candle

Stephanie Clark, Biology Major

Materials:
Candle
Matches

Procedure:
1. Insure that the candle is burnt down enough so that the wax is melted around the wick
2. Use a snuffer to put out the flame of the candle so that the smoke trail is in a straight line up from the wick
3. Light another match and place the flame in the trail of smoke that is leaving the candle
4. Observe what happens to the wick of the candle

Tips:

The snuffer will work best to insure that the trail of smoke is straight up from the wick of the candle.

Explanation:

The trail of smoke leading up from the candlewick is vaporized wax. This means that by lighting the trail of that vapor, it should reignite the candle itself.

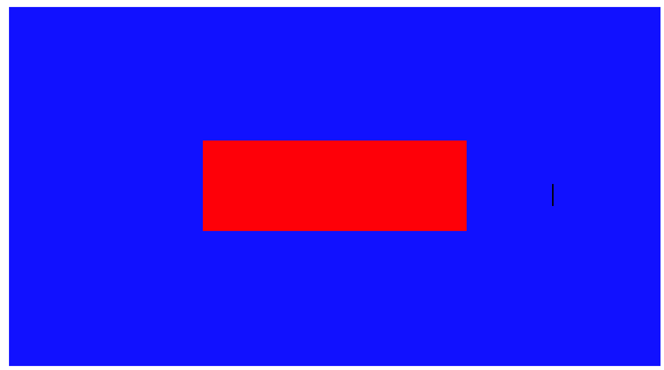
Safety:

When dealing with open flames it is extremely important to be cautious. Know where the fire extinguisher and fire blankets are or have one close to the lab station.

Optical Illusion

Stephanie Clark, Biology Major

Materials:
The optical illusion squares – large enough for an audience to see them



Procedure

1. Stare at the blue and red square for 30 seconds
2. Now stare at a flat white surface
3. What do you observe?

Explanation

Staring at bright colors for a long period of time causes the color receiving parts of the eye, the cones to get tired. When you look at the white piece of paper, those original cones rest while other cones near that original location take over. This is why the image is still visible but it is in different colors.

Tips:
Make the picture large enough to see from a distance if the class size is large, or have individual printouts.

Safety:
Do not do this too many times. It will cause your eyes to become tired and might disrupt vision temporarily.

The Dancing Penny

Stephanie Clark, Biology Major

Materials:
One empty bottle with narrow neck
One large beaker or container for warm water
A penny or dime

Procedure:
1. Get the narrow opening of the bottle moist and then place the penny or dime on top of the opening
2. Fill the large beaker or container with water (it must be hot water but insure that it is not steaming or boiling)
3. Immerse the bottle into the water. Make sure that the penny is still on top of the bottle
4. Observe the results

Tips:
Fill the beaker or container with water before the demonstration. Also, make sure that the opening of the bottle is moist in order to create the seal.

Explanation:
Before covering the bottle with the penny, the bottle is filled with air. By wetting the opening of the bottle, a seal is created between the inside and outside of the bottle. Since the bottle is placed into hot water, the air inside of the bottle will heat and thus expand. In order for that expanded air to escape, it must lift the penny out of the way. The penny will fall back and recover the opening until more heated air needs to escape, which will cause the penny to rise up again. When this process occurs quickly, it causes a vibration effect of the coin.

Safety:
Handle hot water with care to avoid burns. Also, avoid spilling. If water is spilt, clean up quickly to avoid slipping.

Faulting

Danielle Feil, Earth Science Major

Materials:

- Foam blocks cut like diagram below
- Painted rock layers optional

Procedure:

1. Put foam blocks together
2. Push on the sides causing middle block to rise
3. Hold blocks up and slowly pull apart causing middle block to slip downwards
4. Observe each and then explain what each fault is called and what stress causes it.

Tips:

- Create blocks big enough to see.
- Steady hands so that blocks do not fall anywhere

Explanation:

When the foam blocks are pushed together this is showing compression creating a reverse fault. When the blocks are slowly pulled apart, it is showing tension creating a normal fault.

Safety:

- When making foam blocks handle scissors with care.
- Do not let students eat the foam.

Slinky Waves

Danielle Feil, Earth Science Major

Materials:

- Slinky
- One other person to hold one slinky end

Procedure:

1. Have a volunteer hold one end of a slinky very still
2. You will hold the opposite end of the slinky and cause the motion
3. Represent first wave by pushing the slinky forcefully forward then going still
4. Explain P waves
5. Represent second wave by shaking slinky right to left
6. Explain S Waves

Tips:

- Practice before presenting to know how to move the slinky
- Have a spare slinky in case of tangling

Explanation:

This demonstration shows two of the types of waves that occur during an earthquake; P waves and S waves. P waves or primary waves are known as compression waves (push waves). P waves are fast and can be shown by pushing the slinky to see how places of the slinky are compressed and others are stretched out. S waves or secondary waves are known as transverse or longitudinal. These waves come second because they are slower than P waves. They can be shown by waving the slinky in a back and forth motion. Both waves are better visualized with the slinky because they are different and a lot of students just think the ground shakes during an earthquake but this shows the wave movement from the earthquake.

Safety:

- Give directions to volunteer very clearly so they do not let go of the slinky
- Stand clear of people to not hit them with slinky

Scared Pencil Shavings

Danielle Feil, Earth Science Major

Materials:

- Petri dish
- Water
- Dish soap
- Pencil shavings

Procedure

1. Fill Petri dish about halfway with water
2. Place pencil shavings on the water all over
3. Place a drop of soap in the center of the dish
4. Observe and explain what is happening

Explanation

Surface tension is highlighted in this demonstration. Surface tension refers to the cohesive properties forces between water molecules. The soap disrupts the surface molecules which lowers the surface tension causing the water molecules to spread out bringing the pencil shavings along with them showing the movement of the top layer of water molecules.

Tips:

- Make sure everyone can observe the pencil shavings
- Works the best with small pencil shavings or pepper

Safety:

- Make sure nothing is spilled especially with soap in the dish because it could cause slippery floors
- Pencil shavings are very small do not get in mouth or eyes

Hot and Cold Layers

Danielle Feil, Earth Science Major

Materials:
- Hot water in a small container
- Cold water in a small container
- Fish Bowl (or large clear bowl)
- Red food coloring in hot water
- Blue food coloring in cold water
- Jars with tin foil holders

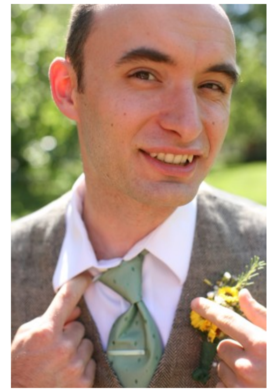
Procedure:
1. Give viewers a chance to feel each cup to know one is cold and one is hot
2. Put food die in each cup to separate colors
3. Put room temperature water in the fish bowl
4. Put the jars with foil holders in fish bowl
5. Add cold container to the fish bowl first and place it in its holder
6. Add hot container to the fish bowl and place it in its holder
7. Observe the colors and then explain why

Tips:
- Practicing this would be helpful before presenting.
- Put cold in before hot.

Explanation:

This is a great visual for explaining how when fluids are heated, they become less dense and expand causing the hot red colored water to rise to the top. The cold dense, blue colored water will then sink showing the color difference. This also shows the visual of hot air rising and cold air sinks.

Safety:
- Hot and cold water need to be handled with care
- Pour gently to reduce spilling.



Mason Jar Semi-permeable membrane

Sam Gleeson, Biology Post-bac

Materials:
Mason Jar
Corresponding lid for the jar
Mesh screen
Coffee beans
Rice
Unshelled nuts
Small rocks or marbles
Water
A bucket to catch water

Procedure:

1. Place the coffee beans, rice and unshelled nuts into the mason jar
2. Put the screen over the mouth of the jar and screw on just the ring of the lid so the opening is completely covered by the mesh.
3. Place rocks or marble on top of the mesh
4. Pour the water through the rocks and mesh and into the jar.
5. Turn over the jar and let the water come back out without losing any of the materials that were inside the jar.

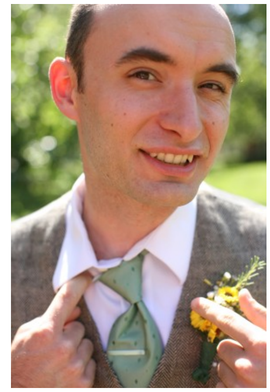
Tips:
- Push the mesh down a little bit so your rocks don't roll off when you pour water through them
- Take the rocks off the top of the jar before turning it over so they don't fly off when you dump the water out

Explanation:

This is a good and very basic model for a semi-permeable membrane. The jar is acting as a cell with organelles inside of it and the mesh is your cell membrane. By having larger objects in your jar and on top of it you can show how water is able to move freely through a cell membrane but large molecules and proteins cannot move from the outside of the cell to the inside, or the other way around freely.

Safety:

The mason jar is glass so be careful that you do not drop it. Also if you are using any kind of nut be aware that you may have a student that is allergic to nuts and it might need to be replaced with a different item.



PB&J Membrane

Sam Gleeson, Biology Post-bac

Materials:
Bread
Peanut Butter
Food Coloring
Butter knife for spreading

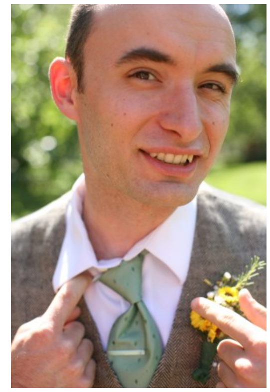
Procedure:
1. Spread Peanut butter onto a piece of bread to completely cover one side
2. Place the other slice of bread on top of the peanut buttery side
3. Cut the sandwich in half
4. Drop food coloring near the edge of the bread so it can be visible as it soaks into the top slice

Explanation:

Like a cell membrane the peanut butter sandwich acts as the Lipid bi-layer that has a hydrophilic head, represented by the bread, and hydrophobic tails, represented by the peanut butter. The food coloring spreads out in the bread like a soluble substance would in the hydrophilic heads but is not able to penetrate the lipid part of the bi-layer membrane. Thus it won't cross to the other side (the lower piece of bread stays dry).

Safety:

Some students may be allergic to peanuts in which case you could replace the peanut butter with a nut butter they can tolerate. Also if a student is gluten intolerant, do not let them eat the sandwich. Even though it is not sharp caution should be taken with the knife, as cuts could be a possibility.



Impacts of Pollution

Sam Gleeson, Biology Post-Bac

Materials:
Glass gallon Jug
Food coloring
Water

Procedure:

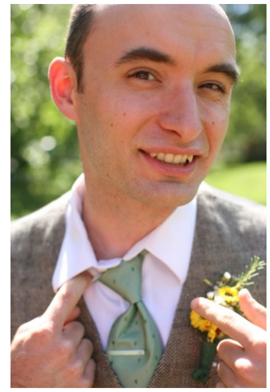
1. Add one or two cups of water to the jug
2. Add a few drops of food coloring.
3. Add water one cup at a time until you can no longer see the food coloring.
4. Drop a few more drops of food coloring directly into the jug

Explanation:

By dropping food coloring into a small amount of water and watching it diffuse it shows how pollution can greatly impact a small area. By adding in more water you can see how the dilution gives the illusion of the pollutant being removed but it is still there. The last step can be used to talk about point source pollution and how when it is coming from a single discreet source, pollution sources can be easy to identify but once it is well mixed into a water supply or downstream in a river finding exactly where the pollution is originating can be difficult.

Safety:

A large glass jug could be very dangerous if it were to fall and break. Make sure to transport it carefully and keep it on a sturdy table or flat ground when doing this demo.



Diaphragm in a Soda bottle

Sam Gleeson

Materials:
2-liter soda bottle
2 large balloons
Tape
Scissors

Procedure:

1. Cut the bottom of the bottle off with the scissors
2. Wrap the edge of the balloon around the opening of the bottle with the balloon inside the bottle
3. Tape the edge of the balloon to the bottle opening so that it is air tight
4. Cut the other balloon so it is flat and stretch it over the cut bottom of the bottle
5. Tape the other balloon so that it is also air tight
6. Move the bottom balloon up and down and watch the balloon inside the bottle inflate and deflate

Explanation:

This structure is designed to simulate how our lungs function. Your lungs do not actively inflate and deflate but rather move air in and out by the action of our diaphragm, which is represented by the balloon on the bottom of the bottle.

Safety:
The bottom of the bottle is plastic but after being cut may have sharp edges. Make sure that the edge won't cut anyone. Students with latex allergies should just watch the demo and not come in contact with the latex balloons.

Egg Drop

Allison Hanlin, Biology Major

Materials:
1 hardboiled egg
Toilet paper roll
Small cake pan
Drinking glass filled half way with water

Procedure:

6. Set up the demonstration as pictured in the demo set up below.
7. Ask the students what they think will happen to the egg when the cake pan hit is hit from the side.
8. In one motion, hit the cake pan horizontally, while holding the drinking glass below.
9. The egg will ALWAYS drop into the drinking glass.
10. Ask the students why this occurs.

Explanation:
Newton's 1st Law of Motion tells us that an object at rest stays at rest and an object in motion stays in motion, unless acted upon by an outside force. This Law explains why the egg will always fall into the glass. When the pan is hit, there is not very much friction between it and the glass. This causes the pan to move very quickly from under the toilet paper roll and the egg. When the pan is moving, the rim of the pan hits the toilet paper roll and takes it with it. However, the egg has the force of gravity pulling down and once the toilet paper roll is moved away, the egg no longer wants to stay at rest. The force of gravity is greater than the force of friction, and the egg fall straight down into the glass.

Safety:
Make sure to hold the glass when hitting the pan. If this is not done, the glass could get knocked over with the motion. Make sure nothing is in the path that the pan will move when hit. If done in a classroom setting, goggles should be worn.

Egg Drop Demonstration Set-Up

http://simplescienceathome.wordpress.com/2012/11/23/impossible-egg-drop/

Balloon Skewer

Allison Hanlin, Biology Major

Materials:

Several latex balloons (9-inch size)
Bamboo cooking skewers (approximately 10 inches long)
Cooking oil

Procedure:

1. Inflate the balloon until it's nearly full size and then let about a third of the air out. Tie a knot in the end of the balloon.
2. Find the thick area of rubber at both ends of the balloon (where you tied the knot and the opposite end).
3. Soak the skewer in cooking oil.
4. Place the sharpened end on the skewer on the thick end of the balloon and carefully slide the skewer into the balloon.
5. Push the skewer all the way through the balloon until the tip of the skewer touches the opposite end of the balloon (the other thick portion of the balloon). Keep pushing until the skewer penetrates the rubber.

Explanation:

The latex in the balloon is made of long stands of molecules called polymers. The elasticity of these polymer chains causes the rubber to stretch when 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. By piercing the balloon at the ends, where less stretch occurs, it allows the skewer to pass without popping the balloon.

Safety:

Be careful not to jab yourself or the balloon with the skewer. Also, know that it is possible for the balloon to pop while doing this experiment. Be prepared just in case this happens.

The Fire Proof Balloon

Allison Hanlin, Biology Major

Materials:

Balloons
Water
Matches or lighter
Candle
Safety glasses

Procedure

1. Blow up a balloon and tie it off.
2. Put on your safety glasses.
3. Light a candle and place it in the middle of the table.
4. Hold the balloon a foot or two over the top of the flame and slowly move the balloon closer and closer to the flame until it pops
5. Repeat the experiment but this time fill the balloon to the top with water.
6. Next blow it up with air and tie off the balloon.
7. Slowly lower the water-filled balloon over the candle. The balloon doesn't pop!!
8. Remove the balloon from the heat and carefully examine the soot on the bottom.

Explanation

Water is a great substance for absorbing heat. When the candle is placed under the balloon with water, the thin balloon allows the heat to pass through very quickly and warm the water. As the water closest to the flame heats up, it begins to rise and cooler water replaces it at the bottom of the balloon, where it can absorb more heat. The soot on the bottom of the balloon is the carbon that was deposited on the balloon by the flame.

Safety:

When doing the first part of the demo, with the balloon without water, the balloon WILL pop! Make sure that students are wearing safety goggles. Also, a flame is used in this demo, so make sure students do not burn themselves.

Egg in a Bottle

Allison Hanlin, Biology Major

Materials:

1 hard-boiled egg per class (remove the shell)
One glass gallon jar with a small neck (about 1 1/2 in, in diameter)
Matches
Paper towels

Procedure:

1. Light a small piece of paper towel and immediately place it in the milk bottle.
2. Quickly put egg lightly on the opening and watch.
3. The egg will dance or jump around on top of the bottle.
4. The egg will be pushed through the small opening and into the milk jar.

Tips:

Add a little bit of cooking oil around the rim of the milk jar to keep the egg from breaking.

Explanation:

As the flame uses up the oxygen inside the jar, the air pressure in the jar decreases. This causes a vacuum to develop, which leads to the egg to jumping around. Then, the low air pressure in the jar causes a pressure difference with the outside air. The high air pressure on the outside pushes the egg through the small opening and into the jar. The students will think it is sucked in. This is NOT true. It is pushed!

Safety:

Make sure students are careful with the flame used in this demonstration.

Pouring Air

Heath George Linville, Biology Major

Materials:
2 clear plastic cups
1 Aquarium ½ to 2/3 full of water

Procedure:

1. Submerge 1 cup in the aquarium and turn the cup up to fill it with water
2. Turn the cup full of water so the opening is down in the aquarium.
3. Push the second cup into the water opening down so that it remains full of air.
4. Push the air filled cup below the water filled cup and pour the air up into the cup full of water.
5. Now you have poured up and poured air.

Tips:

- Wear short sleeves.
- Use shallow plastic cups so the aquarium does not need to be as full of water.

Explanation:

Air is a fluid like water and this demonstration makes the properties of air visible to an observer. Buoyancy can also be demonstrated as the water pushes the air up through the aquarium.

Safety:

Make sure the aquarium is on a stable platform or table so the aquarium does not break.

Temperature Dependent Reactions

Heath George Linville, Biology Major

Materials:

2 identical glow sticks
1 clear gallon container full of hot water
1 clear gallon container of ice water

Procedure:

1. Break both glow sticks so the audience can see them both glowing the same.
2. Drop one glow stick into the hot water
3. Drop one glow stick into the ice water
4. Observe the change in how much light emanates from the jars.

Tips:
If the room is large use several glow sticks in each jar to improve the observability of temperature's effect on the chemical reaction.

Explanation:

This demonstration shows that the chemical reaction that makes the glow stick produce light is temperature dependent. The reaction is sped up by a high temperature and slowed by a cold temperature. The light is a visible display of how molecular motion is measured by temperature.

Safety:

Make sure the jars are on a stable platform or table to make sure they do not fall and break. Clean up any fluid that leaks from a glow stick immediately; it is not safe to consume.

Dollar bill drop

Heath George Linville, Biology Major

Materials:
1 crisp dollar bill
1 audience volunteer

Procedure:

1. Hold the bill vertically by its long aspect.
2. Ask the volunteer hold 2 fingers at least 3 inches apart.
3. Drop the bill between the fingers without warning and ask the volunteer to catch the bill.
4. Pick up the bill and repeat.

Tips:

Use singles and keep track of the money.

Explanation:

The brain has to detect the event, decide what action is needed and tell the muscles to react. The time the bill takes to pass through a person's fingers is a little bit less than the time it takes for the nervous signal from the brain to the muscles of the body. The task seems easy, but the bill is only caught when the volunteer reads the person dropping the bill to start catching the dollar before it is actually dropped.

Safety:

Perform the demonstration in a clear spot as people tend to follow the bill to make a second attempt at catching it. If there is a table or podium near the volunteer may hit their head while focused on the money.

Seeing what you taste

Heath George Linville, Biology Major

Materials:

Lemon and Strawberry Jell-O
Red food coloring
Small serving cups
Plastic spoons and napkins

Procedure

1. Make a batch of strawberry Jell-O according to the direction on the box.
2. Make a batch of lemon Jell-O according to the directions on the box, but add enough red food coloring to the hot liquid mix to completely obscure the yellow.
3. Put the Jell-O in different containers to keep track of which is lemon.
4. Allow many volunteers to see the lemon Jell-O before tasting it.
5. Ask the volunteers what flavor they think the Jell-O is.
6. Have the same volunteers try the strawberry Jell-O and guess the flavor.
7. If time permits tell some volunteers there is a third flavor to try. While blind folded serve the lemon Jell-O again to see if any volunteers guess the correct flavor.

Explanation

What we taste is in part what we have come to expect from a familiar food. This demonstration shows how the brain makes sense of our reality and does not just supply raw data from our senses. When we see red Jell-O we expect a flavor that fits our past experience. This experience can trump the actual taste and smell. Many but not all people will guess the Jell-O is a common red flavor. The more common Jell-O is in the volunteer's diet the less likely the person is to correctly identify the lemon flavor.

Tips:

Make enough Jell-O for everyone and have the volunteers write their first impression of the flavor immediately after eating.

Safety:

Check for dietary restrictions before starting the demonstration. Don't serve a diabetic student a cup of sugar laden Jell-O.

Twist in Time

Gwendolyn McIrvin, Chemistry Major

Materials:

Clear liquid soap
2 glasses (one must fit inside the other)
4 large binder clips
Food coloring
3 graduated pipettes
Water
3 small cups

Procedure:

1. Fill 1/3 of the large glass with soap. Place the smaller glass inside the larger one and fill with water. (a layer of soap should be between the small and large glass. If needed, add more soap between the glasses so that the soap is almost to the top.
2. Place three of the large clips evenly spaced around the lip of the larger glass. Leave room for the fourth clip (which is added later). This is to help keep the small glass from moving when you don't want it to.
3. Add a little soap to each of the small cups. Mix in food coloring so that each cup is a different color.
4. Fill the pipettes with the different colors of soap.
5. VERY CAREFULLY take the pipettes and add a "glob" of colored soap to the layer of soap between the two glasses. The different colored "globs" should be fairly close together but not touching. They should also a little ways from the top of the soap meniscus.
6. Add the final clip to the large glass. The smaller glass should now be secure (and not wobble around).
7. Slowly twist the small glass one direction to mix the colors.
8. When the small glass is twisted the other direction, the colors will "unmix"!

Tips:

- Be as smooth as possible when rotating the glass, otherwise the colors will not return to their original positions.

Explanation:

*Note: Physics professors are still determining the correct explanation for what is happening. The best explanation so far is …
…This is an example of laminar flow with a very low Reynold's number. Supposedly, there are several parallel layers to a viscous fluid. When the colored soap is added to the clear soap between the glasses, the dyes are placed in different "layers". As the small glass is rotated, the colors spread out between the individual layers but do not mix between the layers. Therefore, when the small glass is rotated the other direction, the process is revered and the dye no longer is spread out. As long as the rotations are smooth (not turbulent) the layers will not mix and will return to the original location almost perfectly.

Safety:

Goggles should be worn to protect eyes from splattered soap or dye.

Reference:

www.stevespanglerscience.com

Floating and Sinking Ketchup
(aka Cartesian Diver)

Gwendolyn McIrvin, Chemistry Major

Materials:

1 liter bottle with cap
Sealed ketchup packet
Water

Procedure:

1. Fill the liter bottle with water.
2. Add a ketchup packet to the bottle. (Before starting, test to see if ketchup packet floats)
3. Add water to the bottle so that the water is all the way up. There should be no extra air in the bottle. Put the cap on the bottle.
4. Squeeze the sides of the bottle to make the ketchup packet sink. Let go and the packet will float again.

Tips:

- This can also be done with an eyedropper filled with enough water so that it floats on its own.

Explanation:

The ketchup packet contains a little bit of air, and this is the only air in the bottle. When the sides of the bottle are squeezed, there is a greater presser on this air, therefore compressing it. This compression increases the mass of the ketchup packet (as well as the density) and the packet will sink. When the sides are not compressed, the air is no longer pressurized and the packet will float again.

Safety:

No special safety considerations required.

Balancing Hammer

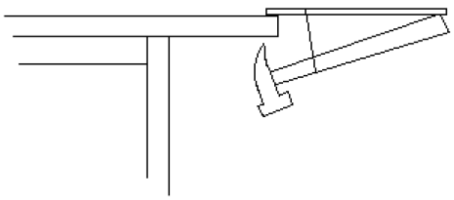
Gwendolyn McIrvin, Chemistry Major

Materials:

16 oz hammer
12 inch ruler, wooden
About 10 inches of string
Tape

Procedure:

1. Using the string, make a loop that can hold the weight of the hammer. Slip this loop around the handle. Tape can be used to hold the loop in place (but only tape it after the hammer is in the correct position).
2. Put the ruler also through this loop. The 12" side should be by the end of the hammer handle and the 1" side should be by the hammer head.
3. The hammer head should extend about 1" from the end of the ruler. The string on the handle of the hammer should be around the 3" to 5" mark on the ruler and the end of the hammer handle should rest against the ruler on the other end. The ruler and handle make an angle of about 30 to 45 degrees.
4. Carefully balance the device off the edge of a table so that the ruler is resting on the top and the hammer head is under the table.
5. With practice, the device will balance perfectly off the table with only 16th of an inch (or less) touching the table.
6. See diagram below for further clarification



Explanation:

Even though this looks unbalanced, the center of mass (somewhere close to the hammer head) is actually under the table where the ruler is supported. Therefore, it balances perfectly.

Safety:

Avoid dropping the hammer onto toes/other appendages.

Sodium Acetate Supersaturated Liquid

Gwendolyn McIrvin, Chemistry Major

Materials:

175g of $NaC_2H_3O_2 \cdot 3H_2O$ (sodium acetate)
50mL water
Hot plate
Stir rod
Crystallizing dish
250 mL beaker
spatula

Procedure

PRE-DEMONSTRATION

1. Add the sodium acetate to the water in the 250mL beaker.
2. Heat the beaker with a hot plate on a medium setting.
3. When all the crystals have dissolved into solution, turn off heat and allow to cool (this may take several hours).
   **Note: The Chemistry department has pre-made Sodium Acetate solutions. Therefore, you may not have to make the solution from scratch.

DEMONSTRATION

4. Place a few sodium acetate granules in the bottom of the crystallizing dish.
5. Carefully pour the cooled solution over the granules to make crystallized structures. The solid formed will be white, solid, and very hot.
6. Use a spatula to cut the crystallized sculptures into smaller pieces to return to the main container.
7. This solution can be stored and reused. Simply store as a solid in a covered beaker and re-melt for the next demonstration.

Explanation

Normally, only a certain amount of solute can be dissolved in water (saturated solution). When the water is heated, more solute can be dissolved and the solution becomes "supersaturated" when cooled. Such is the case here. A large amount of sodium acetate is dissolved in warm water and then cooled. When agitated or poured over solid acetate granules, the rest of the solution will immediately crystallize.

Tips:

- This is a very touchy demonstration. The solution will crystallize if there are any solid crystals remaining on the rim of the beaker.

Safety:

- Goggles must be worn at all times.
- Use caution when handling hot glassware
- This is a very exothermic reaction. Therefore, the crystals that from will be very warm. Avoid touching them.
- Solution can be recycled and used several times. Simply heat the crystals gradually until dissolved and let cool for a few hours.
- Should the solid crystals need to be disposed of, just wash down drain with water.

Water sucked into a glass

Gwendolyn McIrvin, Chemistry Major

Materials:

Small clump of clay or Playdough
Plate or pie tin
Large glass or beaker
1 to 3 Candles
Matches
Water
Food coloring (optional)

Procedure:

1. Secure the candles to the plate in an upright position. Use the clay to hold the candles in place.
2. Add drops of food coloring to the water and then pour the water onto the plate.
    a. As a test: turn the glass upside down over the candles. The water level should be above the rim of the glass. If not, add more water.
3. Carefully light the candles.
4. Turn the glass upside down over the candles so that the rim is flat on the plate and covered by the water. When the candle goes out, the water will be sucked into the glass.

Tips:

- Experiment using 1 candle versus 3 candles. The more candles, the more water will be sucked into the glass.

Explanation:

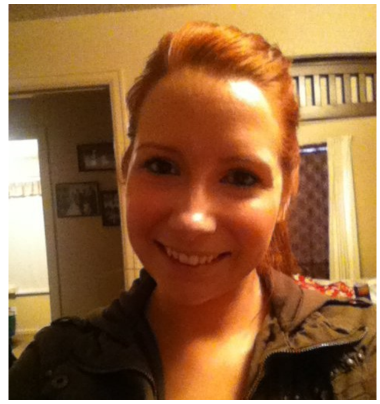
The candle flame heats the air in the glass, and this hot air expands. Some of the expanding air escapes out from under the vase — you might see some bubbles. When the flame goes out, the air in the vase cools down and the cooler air contracts. The cooling air inside of the vase creates a vacuum. This imperfect vacuum is created due to the low pressure inside the glass and the high pressure outside of the glass.

A common misconception regarding this experiment is that the consumption of the oxygen inside of the bottle is also a factor in the water rising. Truth is, there is a possibility that there would be a small rise in the water from the flame burning up oxygen, but it is extremely minor compared to the expansion and contraction of the gases within the bottle. Simply put, the water would rise at a steady rate if the oxygen being consumed were the main contributing factor (rather than experiencing the rapid rise when the flame is extinguished).

Safety:

Be careful lighting the candles. Use necessary fire precautions.

Biodiversity



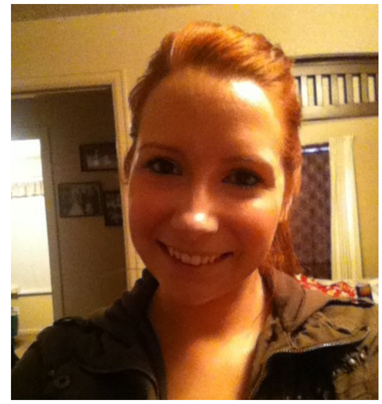
Lindsey Passantino, Post Bac- Biology

Materials:
Popsicle sticks

Procedure:
1. Take all (around 20 to 40) popsicle sticks and hold them in your hand loosely.
2. Now have a volunteer attempt to remove one of the sticks (probably one near the center) without moving any of the surrounding sticks.

Explanation:
One main idea in biodiversity is that everything is connected. This demo demonstrates to students that you cannot physically remove one stick from the pile without affecting the surrounding sticks. You can compare this to biodiversity because if a species is removed from an ecosystem, then many other species that depend on that species' existence for food, protection, spatial area, etc., will also be affected. It may be helpful for you to use multi-colored Popsicle sticks in order to represent a sample of species diversity.

Safety:
There are no safety considerations for this demonstration.



Natural Selection

Lindsey Passantino, Post Bac- Biology

Materials:
10 different colored 8 x 11” pieces of paper (can be construction paper and 5 pieces have to be red, 2 have to be green, 2 have to be yellow, and 1 has to be brown)
A large roll of nylon rope
Scissors

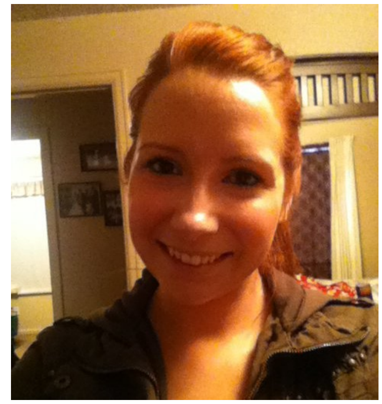
Procedure:

1. Use the rope to create a large circle with a diameter that is roughly 6 feet across.
2. Have 10 students obtain 1 piece of paper.
3. Instruct each student to create a paper airplane and custom design it in a different way from their peers.
4. Once the paper airplanes have been made, have the students form a circle around the circle you made on the ground (but have them at least 12 feet from the perimeter).
5. Students will then be told to launch their paper airplanes towards the inside of the circle. Make sure that you have the students use different speeds and angles in their throwing technique.
6. After this action, some airplanes will be inside the circle and some will be outside. Some may even be on the perimeter itself.
7. If there are airplanes on the perimeter, the species (or person) will have to play Rock, Paper, Scissors, to see who lives on. This shows competition within a community.
8. Repeat the throwing steps with only the airplanes that made it inside of the circle.
9. Keep doing this until one color is left within the circle.

Explanation:
Natural selection is a biological process that “selects” the fittest species to survive and the less fit to become extinct. This activity shows that each color symbolized a specific “species.” Certain species were more numerous than others (red is the dominant species in terms of species number). The 6 ft. circle on the ground represented the threshold for survival in a particular environment. As each student was instructed to throw their airplanes, some students used a slower velocity when throwing their planes while others launched their airplanes at different angles above the horizontal. This diversity of launching techniques is supposed to resemble the different strategies used by different species to survive in their environment. Some airplanes made it into the center of the circle and some did not. The planes (species) that made it “survived” and the ones that did not make it became “extinct.” The surviving airplanes were then thrown multiple times in order to “weed-out” the less fit species until only one species dominated. The teacher can

then explain what strategies were the best in having their airplanes make it into the circle and what ones did not necessarily work. Other questions related to how a species' number plays a role in surviving a disturbance may also be asked.

Safety:
Ensure that airplanes will not hit anyone in the face.



Components of Blood

Lindsey Passantino, Post Bac- Biology

Materials:

1 clear container at least 2 Liter in size
Red marbles/glass rocks
Buttons (5 different colors)
Small pebbles/rocks
Water
Food coloring

Procedure:

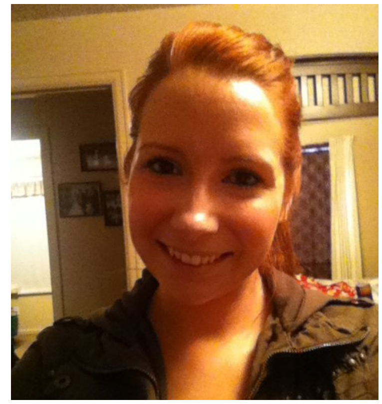
1. Explain the four components of blood.
   -Red blood cells (red marbles): 44% of blood volume
   -Plasma (water with food coloring): 55% of blood volume
   -White blood cells (buttons): 0.5% of blood volume
      -Neutrophils (green): 62%
      -Lymphocytes (purple): 30%
      -Monocytes (orange): 5.3%
      -Eosinophil (blue): 2.3%
      -Basophil (white): 0.4%
   -Platelets (small pebbles): 0.5% of blood volume
2. Measure and combine all four components.
3. Explain to students that plasma is not just made up of water. The food coloring is added in order to show that there are other molecules in the plasma such as organic (fibrinogens, globulins, and albumins) and inorganic solutes (salts, dissolved gases, etc.).
4. Mix the blood!

Explanation:

In this demonstration students will identify the four components of blood and their relative amounts. Explain to students that 55% of our blood volume is plasma, 44% of is red blood cells, 0.5% is white blood cells, and 0.5% is platelets.

Safety:

Watch out for spills.



Lava Lamp Density Demonstration

Lindsey Passantino, Post Bac- Biology

Materials:
Clear container
Water
Vegetable oil
Alka-Seltzer tablets
Funnel
Food coloring

Procedure:
1. To create the system, fill the container ¼ of the way with water.
2. Use the funnel to fill the container the rest of the way with vegetable oil.
3. Add 10 drops of food coloring to the mixture.
4. Wait for oil and water to separate. (Brief discussion of oil and water densities/properties could be inserted here.)
5. After the two layers separate, add two broken Alka-Seltzer tablets into the container.
6. Watch as the bubbles rise and fall.

Explanation:
Oil floats on water because a drop of oil is lighter than a drop of water the same size. Another way of telling students this is to say that water is more dense than the oil. Density is a measurement of how much a given volume of something weighs. Items that are less dense than water will float in water. Items that are more dense than water will sink. These two substances do not mix together because oil is non-polar and is hydrophobic. When you drop the Alka-Seltzer tablet into the solution, the citric acid and sodium bicarbonate react in the water, causing the release of carbon dioxide. The carbon dioxide bubbles rise to the top, pulling the water/food coloring with them. When the bubbles reach the top of the container, the carbon dioxide releases into the air and the colored water sinks back down to the bottom of the container. This is because the colored water's density is greater than the oil's.

Safety:
Watch out for spills.

Cooking up a Comet

Andy Potts, Biology Major

Materials:

Bowl	Window cleaner
Trash bag	Charcoal
Dry ice	Whoopee-cushion
Water	Sand

Procedure:

1. Place the trash bag in the bowl
2. Add the ingredients to the bowl one at a time, explaining what they represent
3. Crush up the dry ice and place it into the bowl
4. Squeeze the air out of the bag and work the ingredients around in the bag
5. Once it has frozen solid you are finished

Tips:

- Add more dry ice if it is taking too long to freeze
- Do not actually add the whoopee-cushion, simply squeeze air from it into the bowl to represent methane being added

Explanation:

We often think of comets, and refer to them, as balls of ice, but there is more than frozen water in comets. This demo adds all the common components of comets into a bowl so you can make your own comet for the students to see and feel. The window cleaner represents ammonia, the charcoal carbon, the sand silicates, and the whoopee-cushion methane.

Safety:

Dry ice should be handled with gloves

Warped Gravity

Andy Potts, Biology Major

Materials:
5 gallon bucket
1 yard of spandex
Various weighted spheres (bocce balls, marbles, and ball-bearings)
Elastic cable
Ruler

Procedure:
1. Stretch the spandex tightly over the top of the bucket and secure it with the cable
2. Place a large, heavy ball in the center of the spandex
3. Observe how the fabric is stretched and warped by the ball
4. Note the slope of the curve is greater nearer the ball, using the ruler to extend the slope

Tips:
- Play around with the different balls to see how they are affected by the warping

Explanation:
We can think of large masses as actually warping space to cause gravity wells. This explains why two objects of different mass will fall at the same speed, because they are both, in effect, slipping down the same slope.

Safety:

The balls represent a slipping hazard should they become loose

Color and Temperature of Stars

Andy Potts, Biology Major

Materials:

Filament lamp
Variable resistor
Wires
Power supply

Procedure:

1. Wire the lamp to the resistor and power supply
2. Set the resistor to its lowest voltage setting and observe the reddish color of the lamp
3. Move the resistor to a higher voltage and observe the yellowish color of the lamp
4. Continue to the highest voltage setting and observe the white color of the lamp

Explanation:

Students often struggle with the idea that the color of a star is related to its temperature. This demo shows how at lower temperatures stars will appear more reddish and at very high temperatures stars will appear white. We can therefore use observations about the color of stars to make inferences about their temperatures.

Safety:

Make sure the devices are wired correctly and use caution when touching them to avoid electrocution

How Massive?

Andy Potts, Biology Major

Materials:

10lb bag of potatoes
5 gallon bucket
Smaller bucket
Cutting board
Knife

Procedure:

1. Place the smaller bucket upside-down inside the larger one, then place the potatoes on top of the smaller bucket to give the appearance that the 5 gallon bucket is full of potatoes
2. Explain that the "100" potatoes in the bucket represent all the mass in our solar system
3. Take one potato and cut it into seven pieces, placing all but one of those back into the bucket
4. Explain that the 99 and 6/7^{ths} potatoes represent the mass of the sun
5. Cut the remaining 1/6th of the potato into ten pieces
6. Explain that seven of these represent the mass of Jupiter and two the mass of Saturn
7. Cut the last piece in two now, explaining that these represent the mass of Uranus and Neptune.
8. Explain how the tiny specks of potato left behind represent the mass of the remaining planets Mercury, Venus, Earth, Mars, dwarf planets, moons, asteroids, and comets

Tips:

- Play around beforehand with the bucket to get it to look like it is completely full of potatoes

Explanation:

It can be difficult to describe just how massive the sun really is to students. This demo shows how the sun makes up 99.8% of the mass of the solar system, and shows how the remaining mass falls amongst the rest of the bodies of the solar system

Safety:

Use caution not to cut yourself when using the knife

Why is the sky blue?

Andy Potts, Biology Major

Materials:

500mL beaker of water
Bright light source
White paper or board
10 mL of milk
Dropper

Procedure

1. Align the beaker of water with the light source such that it projects a vertical beam of light on the paper placed behind it
2. Add a small amount of milk to the beaker and stir it
3. Observe that the color of the water will now appear slightly blue
4. Observe that the color of the beam of light will now appear slightly yellow or orange

Tips:

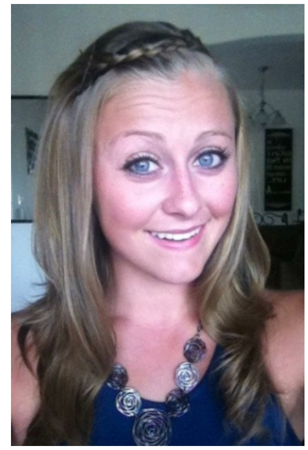
- Too little milk will have no effect on the color, but too much will smother the effect

Explanation

The milk particles scatter light much the way particles in our atmosphere do, creating the appearance of the sky as blue. When this occurs the remaining light transmitted will contain less blue light, causing the sun to appear yellow and sunsets to appear red. This effect is known as Rayleigh scattering, and occurs when light is scattered by particles smaller than the wavelength of light.

Safety:

Take care using the light source near water



Floating Paper Clip

Kayla Schinke, Biology

Materials:

Clean paper clips
Tissue paper
Bowl with water
Pencil with eraser

Procedure:

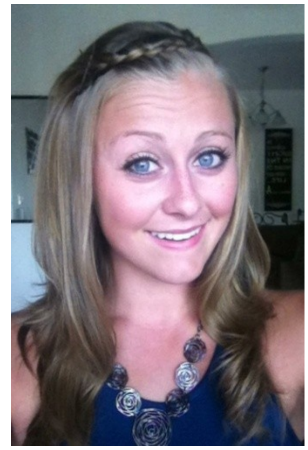
1. Fill the bowl with water
2. Try to make the paper clip float...not much luck, huh?
3. Tear a piece of tissue paper about half the size of a dollar bill
4. GENTLY drop the tissue flat onto the surface of the water
5. GENTLY place a dry paper clip flat onto the tissue (try not to touch the water or the tissue)
6. Use the eraser end of the pencil to carefully poke the tissue (not the paper clip) until the tissue sinks. With some luck, the tissue will sink and leave the paper clip floating!

Explanation:

This lab is demonstrating surface tension. If the conditions are right, water molecules can hold tight enough to support your paper clip. The paper clip is not truly floating, it is being held up by the surface tension.

Safety:

Paper clips should not be tampered with. They should not be used by students as a stabbing device.



Slime

Kayla Schinke, Biology

Materials:

1/4 cup of water	1/4 cup of white craft glue
1/4 cup of liquid starch	Food coloring (optional)
Mixing bowl	Mixing spoon

Procedure:

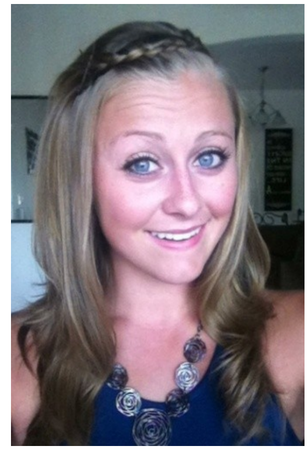
1. Pour all of the glue into the mixing bowl.
2. Pour all of the water to the mixing bowl with the glue.
3. Stir the glue and water together.
4. Add your food color now - about 6 drops should do it.
5. Now add the liquid starch and stir it in.
6. It should be nice and blobby by now. As you play with your slimy concoction, it will become more stretchy and easier to hold.
7. Explore your slimy creation and store it in a zip bag when you are not using it.

Explanation:

The glue is a liquid polymer. This means that the tiny molecules in the glue are in strands like a chain. When you add the liquid starch, the strands of the polymer glue hold together, giving it its slimy feel. The starch acts as a cross-linker that links all the polymer strands together.

Safety:

The water, liquid starch, and glue should be used for lab purposes only. The food coloring will dye clothing and skin.



Bursts of Color

Kayla Schinke, Biology

Materials:

A flat tray (cookie baking tray)
Whole milk
3 colors of food coloring
Liquid dish-soap

Procedure:

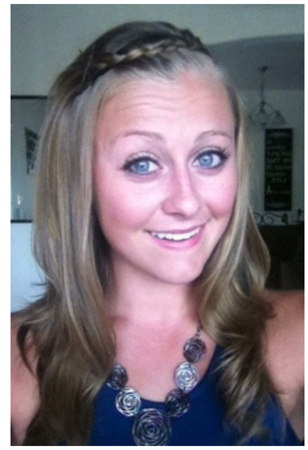
1. Carefully pour the milk into the tray so that it just covers the bottom
2. Add about 6-8 drops of different colored food coloring onto the milk in different spots
3. Add about 5 drops of the liquid soap onto the drops of food coloring and watch the show!
4. To clean up, simply pour the colored milk down the drain. (don't drink it!)

Explanation:

The main job of dish-soap it to go after fat and break it down. Usually the fat is on dishes from the food we eat, but fat is also in whole milk. When you drop the liquid soap onto the tray, it tried to break down the fat in the milk. While it was doing that, it caused the colors to scatter and mix creating a very colorful display.

Safety:

The whole milk and dish soap should be used for lab purposes only. The food coloring will dye clothing and skin.



Rubber Chicken Bone

Kayla Schinke, Biology

Materials:

A jar large enough to fit a chicken bone
Two chicken bones (leg or "drumstick")
Vinegar

Procedure:

1. Have a nice chicken dinner and save a bone. Leg bones work best.
2. Rinse off the bone in running water to remove any meat from the bone.
3. Notice how hard the bone is - gently try bending it. Like our bones, chicken bones have a mineral called calcium in them to make them hard,
4. Put the bone into the jar and cover the bone with vinegar. It might be a good idea to put the lid on the jar or cover it - let it sit for 3 days.
5. After 3 days remove the bone. It should feel different. Now can rinse it off and try bending it again.

Explanation:

Vinegar is considered a mild acid, but it is strong enough to dissolve away the calcium in the bone. Once the calcium is dissolved, there is nothing to keep the bone hard - all that is left is the soft bone tissue. Now you know why your mom is always trying to get you to drink milk - the calcium in milk goes to our bones to make our bones stronger. With some effort and you can really get the bone to bend.

Safety:

The vinegar and chicken bones should be used for lab purposes only.

Can Compaction

Paige Taylor Biology UNC

MATERIALS:
Ice Water
Hot plate
Tongs
Aluminum can
Water

PROCEDURE:

1. Place a half-inch of water in an aluminum can
2. Heat the water in the can on hot plate until the water is boiling
3. Using tongs quickly take the can and flip upside down into ice water

EXPLANATION:
This demonstration shows how the volume of a gas changes with temperature change. The hot water vapor fills the can. When the gas comes in contact with the ice water, it will cool rapidly causing a vacuum in the can.

Ice/String Magic

Paige Taylor Biology UNC

MATERIALS:
1 large ice cube
1 piece of thin string
NaCl (table salt)
Plate
Cup of water

PROCDURE:

1. Place the large ice cube on the plate
2. Dip the string into the cup of water (ensure one inch of string is wet)
3. Lay the wet part of the string on top of the ice cube
4. Place a good portion of salt over the string, making sure to cover all of the string that is touching the ice cube.
5. Wait 20 seconds
6. Pick the string up and the ice cube should be attached to the string

EXPLANATION:
NaCl (table salt) lowers the melting point of water. When salt is placed on the ice it causes the melting point of the ice to lower slightly. This lets the string that was placed on the top of the ice cube to sink into the ice cube slightly. The water then re-freezes itself around the string pretty quickly. The ice cube then lifts up with the string. In winter salt is sprinkled on the street in order to keep the ice from forming (the salt lowers the melting point of the ice and it doesn't ice up the streets) and to also cause the ice to melt.

Mass Never Changes

Paige Taylor Biology UNC

MATERIALS:
Clay
Paper
Triple Beam Balance

PROCEDURE:

1. Set the triple beam balance to zero
2. Place the clay on the sale and measure its mass, record mass
3. Take the clay and rip it in smaller pieces, record the mass
4. Place the paper on the sale and measure its mass, record mass
5. Take the paper and rip it in smaller pieces, record the mass
6. This can be repeated with different objects

EXPLANATION:
This demonstration shows how the mass of an object never changes no matter how the object is altered.

Air Takes Up Space

Paige Taylor Biology UNC

MATERIALS:
Mason jar
Water
Tub
Plastic tubing – three times the length of the mason jar

PROCEDURE:

1. Fill the tub of water deeper then the mason jar
2. Put the plastic tubing in the jar
3. Flip the jar (with the tubing) upside down and place straight down in the water
4. Tilt the jar sideways and air bubbles will rise
5. Place the jar straight again and blow air into the tube, the air should fill the jar again and the water will exit the jar

EXPLANATION:
This demonstration shows that air takes up space. When the jar is placed upside down in the water, the jar will not completely fill with water because it contains air. When the jar is tilted sideways the air is released and the jar is filled with water. When air is blown into the tubing that is in the jar, the air refills the jar and the water exits.

Happy/Sad Balls

Paige Taylor Biology UNC

MATERIALS:
Happy Ball made of Neoprene (polychloroprene)
Sad Ball made of Norsorex (polynorbornene)

PROCEDURE:

1. Place a container a small distance away
2. Bounce the happy ball and try and make a basket
3. Ask a student to try
4. Switch the balls giving him/her the sad ball (without his/her knowledge)
5. Student tries
6. Switch the balls back and the teacher tries again (without students knowledge)

EXPLANATION:
Happy Ball: It has high resilience and dissipates little of its kinetic energy as heat or sound when bounced. An important use for this product is that it is used for swimwear. If you are a swimmer, scuba diver, or water skier, it is used for wet suits because it tends to hold heat. The Happy ball is common neoprene and rebounds very well.

Sad Ball: It has low resilience and tends to absorb the kinetic energy of the bounce. It produces a small increase in its temperature and the characteristic "thud" sound upon impact. This is the only material suitable for making body armor. It is dense, closed cell foam that has the ability to spread impact forces over a wide area. The Unhappy ball is norborene polymer rubber and possesses excellent impact absorption properties that allow it to hit the floor like a rock.

Laser Microscope

Danny Thistle, Physics

Materials:
1 laser pointer
1 eye dropper
Fresh pond water
2 Ring stands with clamps
Surface to project image on

Procedure:

1. Fill eye dropper with pond water (the fresher the better)
2. Clamp the eye dropper with the tip pointing down, and with a drop suspended from the tip
3. Clamp laser so it can be shined perpendicular to the drops spherical surface
4. Shine the laser through the suspended droplet
5. Observe the image projected on the wall/screen

Explanation:

The water droplet has spherical surfaces. Water and air have different indices of refraction. The spherical surfaces form a bi-convex lens. The micro-organisms in the pond water block some of the light, and this creates shadows on the viewing screen.

Safety:

Lasers can damage the human eye, and should not be shined directly into anyone's eyes.

Burn Paper with Ice

Danny Thistle, Physics

Materials:

Sodium peroxide - Na_2O_2
Easily combustible material (tissue paper, sawdust, starch)
Small ice chips
Fire proof surface
Fire extinguisher

Procedure:

1. With some showman ship pose the question, can ice be used to burn this tissue paper?
2. Shred and pile the tissue on top of the fire proof surface (5cm in height)
3. Place ½ teaspoon sodium peroxide on top of the tissue paper
4. Showing the kids you are just adding the ice chip, place it on top of the tissue paper and sodium peroxide
5. Stand back and observe the reaction

Explanation:

The reactants create an exothermic reaction (energy exits the system) that releases enough energy to ignite the tissue paper. The tissue paper is just a fuel source once the flame is lit. It is not a component of the reaction.

$$Na_2O_2 + H_2O \longrightarrow 2NaOH + O_2$$

Safety:

The reaction happens between sodium peroxide and water, so the two must be kept separate.
Fire must be contained to the fire proof surface.

Smoke Ring Gun

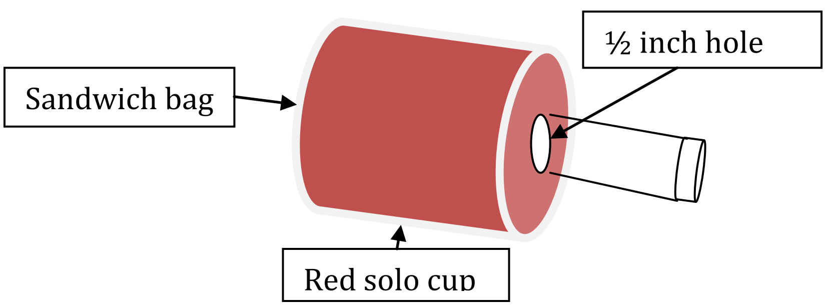
Danny Thistle, Physics

Materials:

Red Solo cups with hole cut in bottom (approximately ½ inch)
Plastic sandwich bags
Rubber bands or duct tape
Dry ice
Water
Candle or Styrofoam cup
Optional (trashcan version for demo and kids make one out of cups)
Optional the easiest and cheapest way I found to make a smoke ring gun is by sealing a cardboard box with duct tape. Then cutting a round hole on one end. Just slap the sides and a vortex is formed.

Procedure:

1. Cover the open end of the cup with the sandwich bag.
2. Stretch it tight and use rubber bands or tape to hold it in place.
3. Add dry ice and a small amount of water
4. Light the candle
5. Tap the sandwich bag while aiming at the candle
6. Blow the candle out with smoke ring gun
7. Optional bring out the trash can version and knock cups off the kids heads



Explanation:
A vortex is formed when air is forced through the small opening. The air near the edges is impeded due to friction, while the air in the center is unimpeded. This creates areas of reduced pressure in front of the ring around the edges, and behind the ring in the center. The air will circulate from high to low pressure areas.

Safety:
Dry ice is very cold and must be handled with gloves
If the dry ice contained pressure will build up and explode

Fiber Optic Water

Danny Thistle, Physics

Materials:
2L plastic bottle w/ hole in the side near the bottom
Water
Bucket
Laser pointer

Procedure

1. Fill 2L bottle with water
2. Let the water run in a parabolic path into the bucket
3. Play with the angle shining the laser up the water stream until it totally internal reflects up the stream
4. The water still in the bottle will glow from the light
5. Hint the better the hole, the better the effect. Small defects in the hole will create a turbulent stream of water. The more laminar the flow the better the effect.

Explanation
The water and the air have different indices of refraction. When the critical angle is found all the light will reflect, and travel up the stream of water. This is how fiber optic cables work, but air and glass is used as the second media.

Safety:

Lasers can damage the human eye, and should not be shined directly into anyone's eyes.

Electromagnetic Induction

Danny Thistle, Physics

Materials:

PVC pipe
Copper Pipe
Neodymium magnet

Procedure:

1. Drop the magnet down the PCV pipe and time how long it takes to come out
2. Drop the magnet down the copper pipe and time how long it takes to come out
3. Flip the copper back in fourth with the magnet inside of it, keeping it inside

Explanation:

The PVC pipe is not a conductor, so the magnet is pulled to earth by the force of gravity. The copper pipe is a conductor. As the magnet moves, there is a changing magnetic field. A changing magnetic field induces a current in the copper pipe. The magnetic field and the induce electric field must oppose each other.

Safety:

Don't swing pipes around
Don't throw the magnet at people