Fall 2015 Science Demonstrations

The following science demonstrations were prepared and presented by the teacher candidates in the University of Northern Colorado's SCED 441/541 (Methods in Teaching Secondary School Science) in Fall 2015. Dr. Rob Reinsvold was the instructor for the course. Most of the demonstrations were presented at the 2015 Colorado Science Conference as "*30 Demos in 50 Minutes*". This continued the tradition started by Dr. Courtney Willis over a decade ago.

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

You are free to use these demos if you like.

Speaker System for a Music Box

Lauren Hoots – Physics Senior

MATERIALS:
Small music box with hand crank
White board or piece of wood

SETUP:
For added effect, draw speakers on whiteboard beforehand so you can say to students that you have a special speaker system.

PROCEDURE:
1. Crank the music box while holding it up in the air, so everyone gets an idea of how loud it sounds
2. Hold music box up against the board and crank it, so everyone can hear the difference in how loud it sounds

EXPLANATION:
Longitudinal waves, like sound waves, need a medium to travel through. When the music box is in air, it sets the air particles into vibrational motion, but the sound is not loud because it has a small surface area and does not send many air particles into motion. When the music box is set on the whiteboard or a similar large surface, it forces the surrounding white board particles into motion. The vibrating whiteboard now forces surrounding air particles into motion and the result is an increase in the amplitude and thus the loudness of the sound because the whiteboard sends more air particles into motion than the music box alone due to its increased surface area. This is the same principle behind why a guitar needs a sound box and why a piano string is attached to a sounding board. A louder sound is always produced when an accompanying object of greater surface area is forced into vibration at the same natural frequency.

Law of Inertia with Toilet Paper Rolls

Lauren Hoots – Physics Senior

MATERIALS:

PVC pipe
2 Toilet Paper rolls – one full and the other almost empty (¼ to ½ in. thickness)

PROCEDURE:

1. Place toilet paper rolls on PVC pipe
2. Tear off some paper from the full roll by pulling rapidly
3. Do the same thing with the empty roll – the whole roll will turn and a lot of paper will unroll

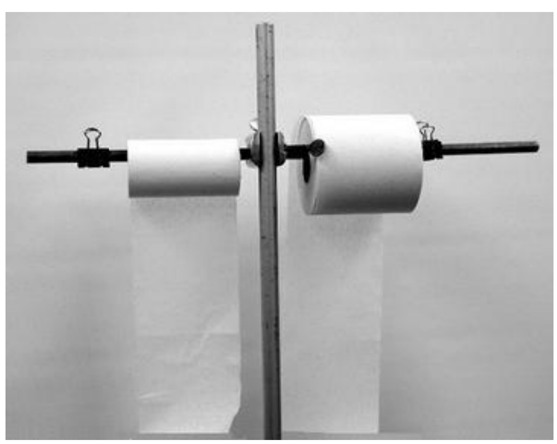
TIPS:

A little practice may be necessary to get the feel of it

EXPLANATION:

The larger mass (and thus moment of inertia) of the full toilet paper roll prevents its acceleration before the paper breaks because it wants to stay at rest. The smaller mass, and thus moment of inertia, of the smaller roll allows the roll to accelerate before the paper tears because once it begins moving, it does not want to stop.

Diagram



Copper Pipe and Magnet

Lauren Hoots – Physics Senior

MATERIALS:

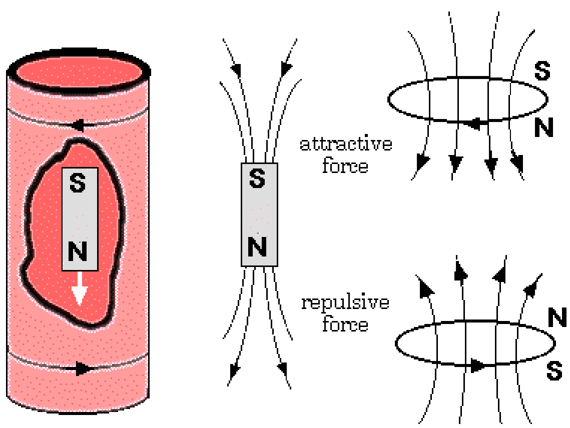
Copper pipe (about ¾ in. in diameter)
Neodymium magnets (a strong magnet)

PROCEDURE:

1. Show students the magnet and how strong it is as well as how it is not attracted to the copper pipe itself
2. Drop the magnet through the copper pipe and show what happens
3. Now drop another magnet from the same height in air at the same time you drop it through the copper pipe

EXPLANATION:

Changing magnetic fields induce electric currents, which then generates a magnetic field with an opposite orientation with respect to the original magnetic field. The magnetic field induced in the copper pipe attracts the falling magnet, creating resistance. This resistance slows the magnet down, but as the magnet slows down, it stops generating as much current, which reduces the resistance acting on the magnet's movement. Gravity then speeds the magnet back up and the same thing happens again.



Cartesian Diver

Lauren Hoots – Physics Senior

MATERIALS:
2-liter bottle
Water
Ketchup packet that floats or an eye dropper partially filled with water

SETUP:
Fill the 2-liter bottle with water. Place ketchup packet or eyedropper in water. Seal the bottle with cap.

PROCEDURE:
1. Squeeze the sides of the bottle
2. As you squeeze, the ketchup packet should sink
3. When you let go, the packet should float back to the top

EXPLANATION:
As you squeeze the bottle the pressure increases and the volume of trapped air decreases. This changes the density of the packet, and at some point it will become denser than the water and sink. Releasing the pressure on the bottle allows the air inside the packet to expand back to its normal size so that it floats.

Soda Can Jump

Lauren Hoots – Physics Senior

MATERIALS:
Empty Soda Can
2 mugs

PROCEDURE:
1. Place one mug in front of the other
2. Place the empty soda can in one of the mugs
3. Blow air between the soda can and the mug to make it "jump" into the empty mug
4. Adjust the distances between the mugs if necessary

TIPS:
It will take a little practice to get the empty soda can to jump directly into the empty mug
Steady, unforceful airflow tends to work best
Do not blow directly down on the can or it might bounce up into your face

EXPLANATION:
Blowing air between the empty can and the first mug creates an area of high pressure between the bottom of the can and the bottom of the coffee mug. The harder you blow, the more rapidly the air pressure increases. As the air pressure between the can and the mug increases, the pressure above the can remains constant, creating a large difference in pressure. This difference pushes the can up and out (lift). The principle behind this is Bernoulli's law, which is the same law that helps airplanes fly.

Diagram

Diffusion

Andrea Drennan – Earth Science Senior

MATERIALS:

Water
Beakers
Food Coloring

PROCEDURE:

1. Pour food coloring in water and observe diffusion taking place.

EXPLANATION:

Diffusion is the movement of molecules from high concentration to low concentration. The food coloring diffuses from a high concentration to a lower concentration throughout the water.

Traveling Water

Andrea Drennan – Earth Science Senior

Materials:
White cloth string
Two cups
Water
Food Coloring
Scissors
Tape

Procedure:
1. Using the scissors, cut a length of string roughly two to three feet long.
2. Tape one end of the string to the bottom of one of the cups. Any type of tape will work, just make sure the bottom of the cup is dry when you tape the string down.
3. Fill another cup with water and put the other (not taped) end of the string in the water.
4. Hold the cups with one above the other, but not directly over each other. Hold the cups far enough apart that the string is as close to taut as you can make it. Be careful not to pull the string out of your top cup.
5. Slowly begin pouring the water out of the top cup. Pour the water out of the side of the cup with the string.
6. You'll begin to see the water travel down the string towards the other cup. At first, the water won't make it all the way down, but eventually you'll be able to pour the water straight from your top cup to your bottom cup.

Tips:
Be sure to try out a few different types of string. It can take a few tries to find the right one!

Explanation:
The bonds in this case are called hydrogen bonds and are quite strong. These strong hydrogen bonds make water molecules stick together very well. While performing this experiment, you are able to see these hydrogen bonds in action. Through a physical property called cohesion, the action of like molecules sticking together, water molecules are able to stick to other water molecules on their way to the lower cup. But what about the water that poured out at first? It didn't have any water to stick to. Molecules aren't only able to stick to like molecules (water to water). Molecules of water can stick to other materials, too. This is a property called adhesion. In this case, water molecules are able to stick to the string. The reason you see some water fall off the string is because adhesion is not as strong as cohesion.

Safety:
N/A

Strawberry DNA

Andrea Drennan – Earth Science Senior

MATERIALS:

Strawberry
Isopropyl alcohol (15mL)
Dish soap (10mL)
Salt (1/4 tsp)
Zipper-lock bag
Sieve
Water (90mL)
Measuring utensils
Beakers or small containers
Tweezers
Pipette (optional)
Spoon

PROCEDURE:

1. Put a bottle of isopropyl alcohol in a freezer. We'll come back to it later.
2. Measure 90 mL of water into a beaker or similar container.
3. Pour 10 mL of dish soap into the 90 mL of water.
4. Add 1/4 tsp of salt to the liquid in the beaker.
5. Mix it all up and now you've got a homemade extraction solution!
6. Place one strawberry in a plastic zipper-lock bag.
7. Pour your extraction solution into the bag with the strawberry.
8. Remove as much air from the bag as possible and seal it.
9. Use your hands to mash, smash, and mush the strawberry inside of the bag until there are no large pieces remaining.
10. Pour the resulting strawberry and extraction solution mixture through a sieve and into a beaker or similar container.
11. Use a spoon to press the strained bits of strawberry against the sieve, forcing even more of the solution into the beaker.
12. From the container it is currently in, transfer the solution into a smaller beaker or similar container that holds around 50-100 mL of fluid.
13. Add 5 mL of your chilled isopropyl alcohol to the solution and hold the mixture at eye level.
14. Can you see how there is a separation of white “stuff” atop the rest of the solution? That's the DNA of the strawberry.
15. Gently remove the DNA from the solution using tweezers.

EXPLANATION:

The long thick fibers you pull out of the extraction solution are strands of strawberry DNA. While other fruits are soft and just as easy to pulverize, strawberries are the perfect choice for a DNA extraction lab for two reasons: they yield more DNA than any other fruits, and they are octoploid, meaning that they have eight copies of each type of DNA chromosome. These special circumstances make strawberry DNA easy to extract and see. (Human cells are generally diploid, with only two sets of chromosomes.) To extract the DNA, each component of the extraction solution plays a part. The soap helps to dissolve the cell membranes. The salt is added to break up protein chains that hold nucleic acids together, releasing the DNA strands. Finally, DNA is not soluble in isopropyl alcohol, and even less so when the alcohol is ice cold.

Egg Diffusion

Andrea Drennan – Earth Science Senior

MATERIALS:

3 eggs
Vinegar
Distilled Water
Corn Syrup/Water Solution
3 Beakers

SETUP:

1. Place 3 eggs in vinegar 2 days before demonstration.
2. Prepare beakers of distilled water and corn syrup/solution water.

PROCEDURE:

2. Show students the shell-less egg. Ask questions to prompt them that all that is left is the membrane.
3. Place one egg in the distilled water and one in the corn syrup solution, the third egg is the control.
4. Let the eggs sit at least over night.
5. One egg will have swelled and the other will have shrunk. Discuss what happened and apply to diffusion and osmosis.

TIPS:

The longer the eggs sit, the more pronounced the changes will be.

EXPLANATION:

This demonstration shows a larger scale example of osmosis. It demonstrates how water moves from a high concentration, outside of the egg, to a lower concentration, inside of the egg. Or how water moves from a high concentration, inside of the egg, to a lower concentration, outside the egg in the corn syrup solution.

SAFETY:

Be sure the students aren't left alone with the eggs, otherwise they may poke them until they pop!

Pop Rocks Expander

Andrea Drennan – Earth Science Senior

MATERIALS:

Pop Rocks (try to find multiple flavors)
Balloons
Funnel
12-16 oz bottles of soda (variety is good!)

PROCEDURE:

1. The first item of business is to get an entire package of Pop Rocks into a balloon. You might be able to carefully pour the candies into the balloon's mouth, but we have found that it's much easier if you use a small funnel. Place the narrow end of the funnel into the mouth of the balloon and empty the Pop Rocks packet into the funnel. Make sure all the candies are in the balloon by giving the funnel a few firm taps.
2. Place the balloon over the mouth of a bottle of soda. Careful! You don't want the Pop Rocks to drop into the soda before you're ready. Stretch the mouth of the balloon over the mouth of the bottle, but make sure the valuable candy content of the balloon doesn't dump into the soda.
3. Are you ready? Grab the balloon and dump the Pop Rocks into the soda. Make sure to observe what's happening inside the soda as the liquid reacts with the candies. The balloon should be inflating, even if the change is only very slight.

TIPS:

- Use the funnel!
- Test whether the temperature of soda makes a difference in the amount of carbon dioxide released.
- Try testing different types (or brands) of soda to see which releases the most carbon dioxide gas.
- Test different Pop Rocks flavors to see if the flavor changes the amount of carbon dioxide in the balloon.

EXPLANATION:

The secret behind the famous "popping" of Pop Rocks candy is pressurized carbon dioxide gas. Each of the tiny little candy pebbles contains a small amount of the gas. These tiny carbon dioxide bubbles make the popping sound you hear when they burst free from their candy shells. So what causes the balloon to inflate? The carbon dioxide contained in the candy isn't enough to cause even the small amount of inflation you observe in the experiment. That's where the soda comes into play. The soda also contains pressurized carbon dioxide gas (it's why we call soda a carbonated beverage). When the Pop Rocks are dropped into the soda, some carbon dioxide is able to escape from the high fructose corn syrup of the soda and, because the carbon dioxide gas has nowhere to go in the bottle, it rises into the balloon.

Modeling Crust Deformation using Silly Putty

Michael Mazik - Post-Baccalaureate, Teacher Candidate

MATERIALS:

Item 1: Several eggs of Silly Putty
  Alternate: Borax and glue
Item 2: Small fan

SETUP:

1. Plug in small fan
2. Remove Silly Putty from its egg

PROCEDURE:

1. Stretch Silly Putty slowly, noting observations
2. Recombine
3. Stretch Silly Putty quickly, noting observations
4. Demonstrate the above two experiments after the Silly Putty has been chilled by the fan
5. Were any differences noticed?

TIPS:

To show the effects that heat has on the fluidity of the Silly Putty, you can warm another up in your hands, or have students do this.
Having multiple sources of Silly Putty is beneficial; maybe two eggs per station, in order to model both cold and warm deformation.

EXPLANATION:

Heat affects viscosity. This can be modeled using Silly Putty, as a stand-in for Earth's lithosphere. Moreover, heat helps liquify the material, making it more susceptible to stretching and bending. Earth's crust can either snap or stretch, depending on the heat in the area around the break, along with the speed at which pressure is applied.

SAFETY:

Do not ingest large quantities of Silly Putty.

Modeling Crust Deformation

using Fruit roll-Ups and Graham Crackers

Michael Mazik - Post-Baccalaureate, Teacher Candidate

MATERIALS:
Several boxes of Fruit Roll-Ups.
Box of Graham Crackers.

SETUP:
Pass out Fruit Roll-Ups and Graham Crackers.
Explain that the items can be eaten after doing the experiment.

PROCEDURE:
Remove Fruit Roll-Ups and Graham Crackers from their packaging.
Distribute to groups of students.

TIPS:
It is recommended that the procedure is modeled by a teacher prior to handing out the snacks.

EXPLANATION:
Earth's crust can deform in two ways: Brittlely or Plastically. Brittle deformation results in portions of the lithosphere breaking, whereas plastic deformation involves the molding of the crust. This is largely due to temperature differences; the warmer crust stretches, although this can also be attributed to the speed of the stretching.
Fruit Roll-Ups stretch, and are then associated with the plastic deformation associated with more of a flowing motion.
Graham Crackers snap instead of stretching, and this is also indicative of the temperature of the Earth.

SAFETY:
Be aware of possible instances of allergic reactions to either item.

Modeling the Difference Between Revolution and Rotation

Michael Mazik - Post-Baccalaureate, Teacher Candidate

MATERIALS:
Space to move around.
Volunteers.

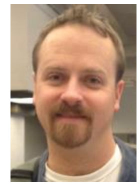
SETUP:
Clear a space for students to move, if this activity is done in the classroom.
If going into the hallway or outside is a possibility, do so.

PROCEDURE:
Explain the difference between revolution and rotation.
The teacher can be the Sun, or volunteers can be selected.
Whoever is the Sun just stands there, while the other volunteer whirls around (rotating) as they slowly orbit the stationary volunteer.

TIPS:
Rotation and revolution can be tricky concepts to understand, especially for ELL students.
Advise students from spinning too quickly.

EXPLANATION:
"Rotation" is analogous to a day on Earth, and "Revolution" is analogous to a year on Earth. Both terms mean that something is spinning; Earth rotates on its axis to make days and revolves around the Sun once in a year.

SAFETY:
Be watchful of students who are rotating too quickly.



Showing incident sunlight using fruit and a pencil

Michael Mazik - Post-Baccalaureate, Teacher Candidate

MATERIALS:
Round fruit; orange or grapefruit preferred.
Pencil.
Sharpie.

SETUP:
Mark the equator on the fruit with sharpie.

PROCEDURE:
Explain that the pencil represents a ray of sunlight striking the Earth.
Hold the fruit at an angle, mimicking Earth's tilt.

TIPS:
Other writing utensils may be used, in the event that a pencil is not available.

EXPLANATION:
The pencil intersecting the Earth is a good stand-in for the way sunlight enters our atmosphere, and that this is not straight-in, which is due to the planet's tilt.
This causes the planet to undergo different heating at different locations across the globe.

SAFETY:
No safety concerns.

Cooling Processes as Air Rises

Michael Mazik - Post-Baccalaureate, Teacher Candidate

MATERIALS:
Cans of canned air.

SETUP:
Pop safety off of the can(s) or air.

PROCEDURE:
Instruct class that they are about to witness an amazing attribute of gases and how they respond to changes in pressure, temperature, and volume.
Instruct the class not to release air from the cans in anyone's general direction.
Once the coast is clear, have people holding onto the cans to do so near their bottoms.
Release air from the can.
Note observations.

TIPS:
This experiment works best when using multiple cans of air, because the can reaches its coldest temperature before too many experiments.

EXPLANATION:
$PV = nRT$. As the volume of the gas inside the can decreases due to the exhalation of air, the temperature of the remaining air inside the canister is doing to decrease.

SAFETY:
Be sure to explain proper safety measures to the class; no pointing the released air toward anyone, especially their faces.

Broken Bone Demo

Kenneth Dunn – Post Baccalaureate, Biology

MATERIALS:
Item 1: three feet of ½” clear poly tubing
Item 2: three feet of 3/8” dowel rod
Item 3: small hand saw
Item 4: utility knife
Item 5: two pairs of pliers or vice grips
Item 6: two hard boiled eggs
Item 7: one seven inch green branch that will fit into the poly tubing
Item 8: hammer

SETUP:
Step 1: Hard boil the eggs.
Step 2: Cut the poly tubing into 6” pieces.
Step 3: Cut the dowel rods into 6” pieces.

PROCEDURE:
-Compound Fracture: Cut plastic tubing halfway through in middle of tube. Insert dowel rod into the tubing and bend the rod until it breaks at the location of the cut in the tubing.
-Simple Fracture: Using a utility knife, make a small cut in the middle of a dowel piece. Insert the dowel into a piece of tubing.
-Impacted Fracture: Diagonally cut one of the dowel segments in half. Place the cut dowel into a piece of poly tubing with cut ends facing each other. Use a hammer to drive the ends past one another.
-Spiral Fracture: Place several diagonal scores around the middle of a piece of dowel. Insert the dowel into a piece of poly tubing. Grip both ends of the dowel with a pair of pliers and slowly rotate the ends in opposite directions. Stop when the dowel breaks along the scored marks.
-Comminuted Fracture: Using a saw, cut halfway through the middle of a piece of dowel in several locations leaving a ¼” gap between cuts. Place the dowel into a piece of poly tubing and use a pair of pliers to break up the dowel.
-Compression: Place one of the HB eggs on a flat surface and lightly strike it with a hammer. Both sides should show cracks but not the top or bottom.
-Depression: Hold one of the eggs in the palm of your hand and lightly strike it with a hammer. Only make one small depression in the shell.
-Green Stick Fracture: Place a freshly cut green stick inside of a piece of poly tubing. Slowly bend it until it develops an incomplete break and then stop.

EXPLANATION:

-Compound Fracture: This open break causes a lot of trauma to the tissue involved. It should have pieces of dowel sticking out of the cut in the polytube to show how messy this kind of break can be.
-Simple Fracture: This is a closed fracture and produces less trauma to the tissue surrounding the bone. However, this type of fracture can range from a hairline fracture to a spiral.
-Impacted Fracture: This type of fracture occurs when a bone is broken and the two ends are driven past each other.
-Spiral Fracture: This fracture occurs when bones are twisted.
-Comminuted Fracture: This fracture commonly occurs in bones that are not healthy. Old, brittle bones may break into many small pieces when too much force is applied to them.
-Compression: This type of fracture happens to a bone when it is crushed. Some bones have a less dense core like long bones, bones with a spongy core, or the skull and can experience a crushing injury.
-Depression: The bones of the skull can be pushed inward on one side to form a depression.
-Green Stick Fracture: Children and infants can experience bending of their bones because they have more cartilage in their bones than do adults. Because of this, they are more likely to have green or incomplete fractures.

SAFETY:

Use caution with knife, saw, and hammer. Wear safety goggles.

Common Types of Fractures

Fracture type	Illustration	Description	Comment
Comminuted		Bone breaks into many fragments.	Particularly common in the aged, whose bones are more brittle.
Compression		Bone is crushed. (i.e., osteoporotic bones).	Common in porous bones
Depressed		Broken bone portion is pressed inward.	Typical of skull fracture.
Impacted		Broken bone ends are forced into each other.	Commonly occurs when one attempts to break a fall with outstretched arms
Spiral		Ragged break occurs when excessive twisting forces are applied to a bone.	Common sports fracture.
Greenstick		Bone breaks incompletely, much in the way a green adults.	Common in children, whose bones are more flexible than those of

Blood Immunity

Kenneth Dunn – Post Baccalaureate, Biology

MATERIALS:

Item 1: six 5” Styrofoam balls
Item 2: eight bamboo skewers
Item 3: several sheets of paper
Item 4: red and blue markers
Item 5: glue stick

SETUP:

Step 1: Cut the sheets of paper into four pieces
Step 2: Fold over the short end of the pieces of paper by half an inch.
Step 3: Place one flag on the end of each skewers and glue it down using the glue stick.
Step 4: Draw the letter A on four of the flags using a blue marker.
Step 5: Draw the letter B on the four remaining flags with a red marker.

PROCEDURE:

Ask for six volunteers to come to the front of the class. Hand each one a Styrofoam ball representing one of six red blood cells (RBC). Place an A flag in one RBC and a B flag in another. Describe to students what cell markers are as they relate to blood type. Next, place two A flags into a new RBC and two B flag into another RBC. Describe to the students how an individual might express these cellular markers. Then, place the remaining A flag into one RBS followed by the last B flag. The sixth ball is left void of flags. Explain to students what this means.

TIPS:

Paint the Styrofoam balls red using spray paint so the balls look more like red blood cells.

EXPLANATION:

A and B red blood cell markers are cell surface markers made of sugar molecules. Each RBC has more than a million of these surface markers, if present. O indicates that neither A or B markers are present. During development, our bodies learn to recognize these markers as “self.” Each cell has a possibility of expressing, at most, two different markers. One comes from our mom and the other comes from our dad. When we receive a blood transfusion, other blood products or organ transplant (or have a child, in the case of pregnant women) we need to take RBC markers into consideration. If we put cells into our bodies that are not similar to our own, our bodies will destroy the new tissues and possibly make us very sick and could even lead to death. In order to determine what our blood type is, we need to have a medical professional type our blood. Individuals with only A or B can receive blood from A or B donors, respectively, or from O donors. Individuals with A and B blood can receive blood from A, B, or AB donors. Individuals with O can only receive blood from other O donors and never from anyone with any A or B combinations. However, O individuals are considered universal donors because their blood will not elicit an immune response in anyone’s body. AB individuals are called universal recipients because they can receive any possible RBC marker combination without eliciting an immune response.

SAFETY:

While placing the skewers into the Styrofoam, be careful not to push the skewer all the way through it and into the hand holding the ball.

Adenosine Triphosphate

Kenneth Dunn – Post Baccalaureate, Biology

MATERIALS:

Item 1: one Mason jar and lid
Item 2: two pieces of colored paper
Item 3: glue
Item 4: scissors

SETUP:

Step 1: Print out three letter P's onto one of the colored sheets of paper and cut them out.
Step 2: Glue two of the P's in a row on the outside of the jar, held on its side.
Step 3: Glue one P on the lid so that it lines up with the other P's when the lid is on.
Step 4: Print out the word "ENERGY" on the other colored paper and cut it out, leaving a tab at the "Y" end.
Step 5: Glue the "ENERGY" paper to the underside of the lid so that it hangs down into the jar when the lid is on.

PROCEDURE:

First, holding the jar with the P's glued to the outside, place the lid on top of the jar with the colored strip of paper hanging down inside of the jar. Tighten the lid until all three P's line up on one side = stored ENERGY. Remove the lid showing the removal of the third phosphate (P) as the ENERGY is used.

TIPS:

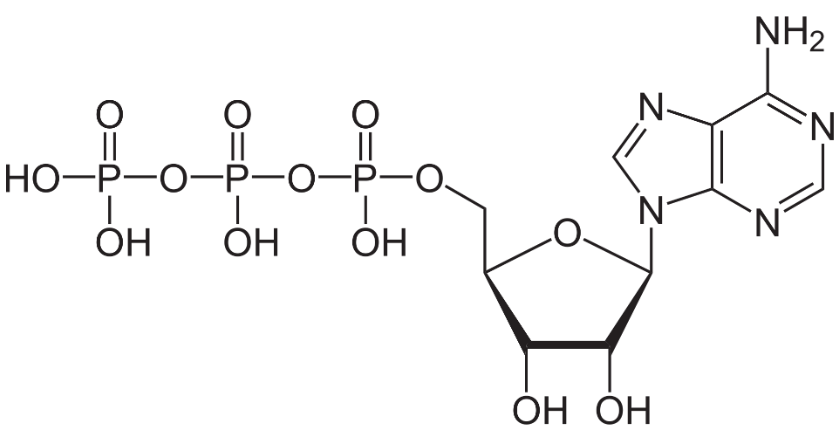
Use two different colors of paper for the P's and the ENERGY.

EXPLANATION:

Adenosine triphosphate (ATP) is used in cells as the molecule that transports chemical energy for metabolism. One molecule of ATP contains three phosphate groups. When the outermost phosphate group is removed, energy is released. In the process of "oxidation," our bodies use energy from glucose that we have consumed to convert ADP to ATP with the addition of a phosphate, thereby trapping the energy for later use.

SAFETY:

Handling glass in a classroom should be done with caution. Always know where a broken glass box is and proper procedure for the clean-up of glass.



https://en.wikipedia.org/wiki/Adenosine_triphosphate

Inertia Demo

Kenneth Dunn – Post Baccalaureate, Biology

MATERIALS:
Item 1: uncooked eggs for x number of student groups
Item 2: hard-boiled eggs for x number of student groups
Item 3: two mason jars with lids
Item 4: one cup of sugar
Item 5: one cup of water
Item 6: one table spoon of glitter
Item 7: One diagram of the inner ear

SETUP:
Step 1: Hard-boil the eggs before class and let them cool.
Step 2: Place the water in one of the jars along with the glitter and place lid on jar.
Step 3: Place sugar in one jar and place lid on top.

PROCEDURE:
First, have the students stand up in groups and take turns spinning in a circle five times before stopping. Let the students discuss what happened and their thoughts about why they get dizzy. Have the groups of students return to their desks and give them two eggs; one raw and one hard-boiled. Tell the student that they are going to spin each of the eggs on a hard flat surface like a desk. Instruct them to stop the egg while it is still spinning and release it immediately. Have the students discuss and write down a prediction for each of the eggs before spinning them. Then, after the students have spun the eggs, have them reflect on their predictions; were the correct. Have the students write down what they observed.

Once the students have completed their observation, the teacher will bring out the two mason jars. The teacher will ask the students to share some of their observations about both eggs with the class. The teacher will bring the students attention to the jar with sugar in it and holding the jar by the top, swirl the sugar five times then set it down. The teacher will ask the student to use what they just observed to make a prediction about the jar with water in it. The teacher will then swirl the jar with water and glitter in it five times and them set it down.

TIPS:
Have materials for egg clean-up handy.

EXPLANATION:
The liquid in the raw egg resists the sipping of the egg initially. After just a moment the fluid in the egg begins to spin at a rate similar to the egg. As the student stops the egg and quickly let's go of it, the fluid inside the egg is still moving with an inertial force and causes the stopped egg to begin to spin again.

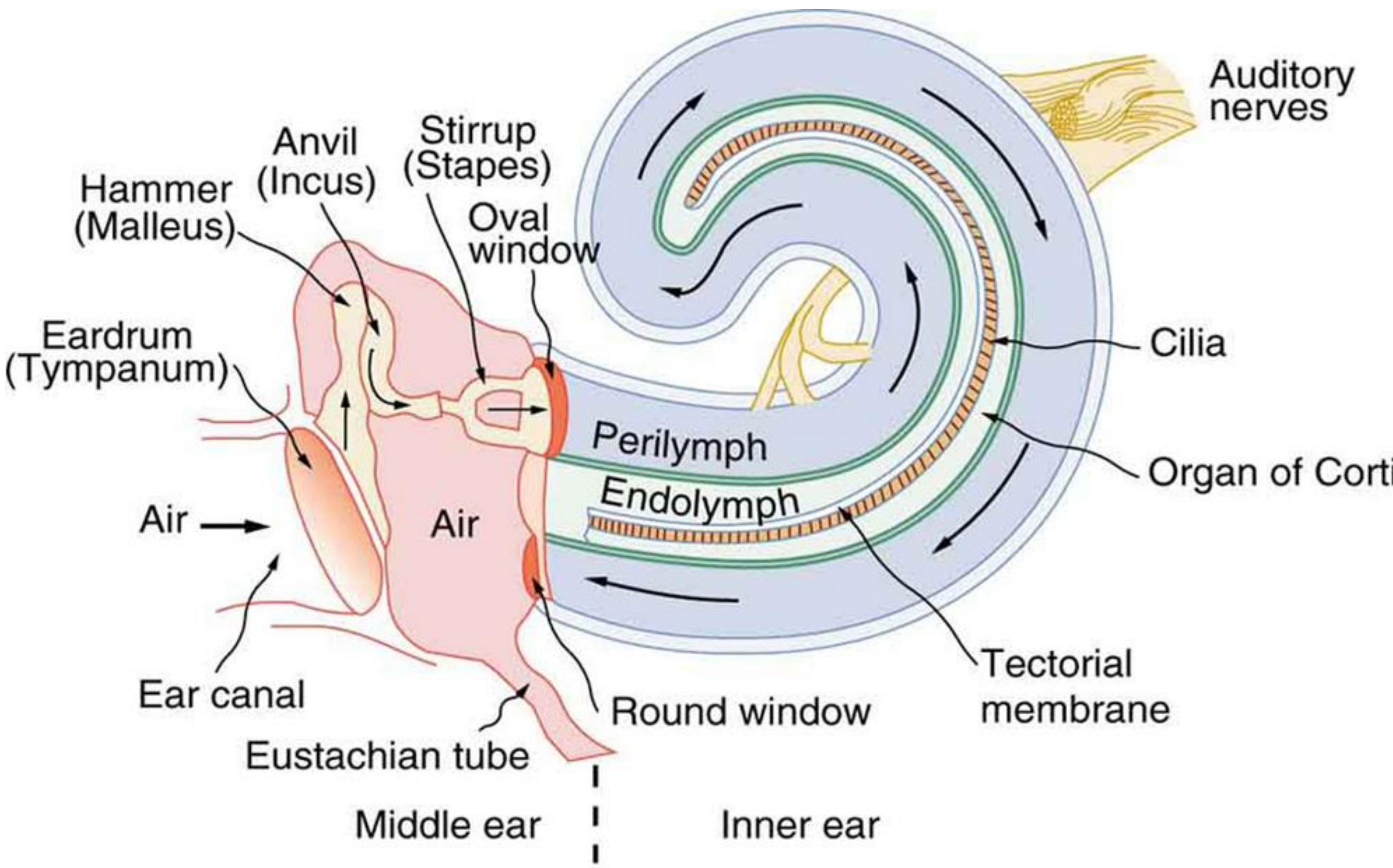
In the labyrinthine of the inner ear, there are three semicircular canals. They are arranged to senses the movement of your head along a different axis and collaborate to orient your body. The canals are filled with a fluid that sloshes around as you move. Your ears sense motion by detecting the way tiny strands of hair lining the canals wave back and forth in this moving liquid.

When you spin in a circle, inertia initially causes the fluid (endolymph) to move in the direction opposite to your head's motion. It resists the movement of your head. The sensory hairs suspended inside the ear bend against the direction in which you're spinning. However, within moments, the fluid adjust to the movement of your head, and start going with the flow. This causes the hair cells to straighten, and your brain no longer receives the message that you're spinning. Your perception has become normalized to the rotation of your head, giving you the sense that you are still, and the world is rotating around you.

When you stop, you have halted the rotation of your body, head, and ears (semicircular canals). However, because of inertia, the fluid (endolymph) keeps spinning, resisting change yet again. As the fluid continues to move, it once again deflects the hails in the ears (this time in the direction in which you were spinning moments before) and a signal of movement is transmitted to the brain. That is dizziness.

SAFETY:

Make sure that as the students have a safe space to spin. Try going outside to a grassy area, wide hallway or more desks and chairs aside.



http://hearinghealthmatters.org/hearinprivatepractice/files/2013/12/Figure_18_06_07.jpg

Bones Resist Bending

Kenneth Dunn – Post Baccalaureate, Biology

MATERIALS:
Item 1: four white tube socks
Item 2: one piece of colored felt
Item 3: one poster board
Item 4: two pieces of white paper
Item 5: ten 12-inch dowel rods

SETUP:
Step 1: Cut the ends off of each sock and roll them up into doughnuts so they are easy to roll out.
Step 2: Cut the colored piece of felt into eight osteoblasts.
Step 3: Draw a large osteon on the poster board and label the central canal, lacuna, lamella, and the canaliculi.
Step 4: Cut a large circle from both of the pieces of paper at the same time.
Step 5: Using one of the circles, draw an osteon with five lamella and carefully cut them out.

PROCEDURE:
First, begin by describing the microscopic anatomy of compact bone using the poster board you have created. Make sure to point out that on a two dimensional image the structure looks like a circle but in three dimensions it would look like a column. At this point, the teacher will ask for one volunteer and have him or her come to the front. The teacher will then place the white circle on the poster board and tell the students that in order to create an osteon, osteocytes move into the compact bone and create a remodeling cavity. Have the volunteer stick out his or her hand and roll one of the tube socks onto it. This socked arm represents the remodeling cavity that the teacher has just made by placing the white circle on the poster board. Next, the teacher will place two osteoblasts onto the students now covered arm and describe to the class that the next lamella is produced by these cells. The teacher then rolls another sock onto the arm of the volunteer, trapping the osteoblasts in place. The teacher will then place one of the cut out lamella onto the poster board. The teacher will repeat this process until the all of the lamellae are placed onto the poster board osteon and all the tube socks are used up. Finally, the teacher will have the student remove the tube sock osteon. The teacher will hand the volunteer a dowel rod and ask him or her to try and bend it (or break it). Then the volunteer will get the option to bend ten dowel rods at one time.

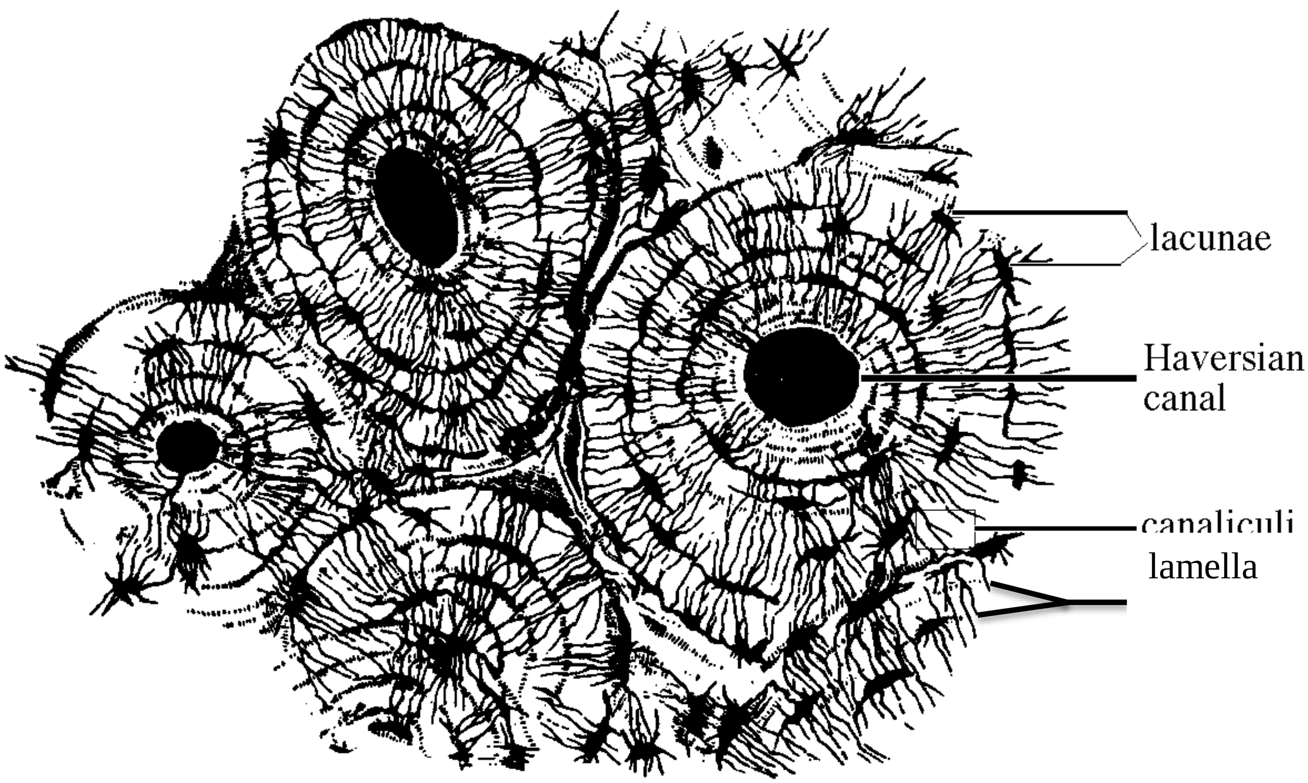
TIPS:
Compact bone is added from the outside of the remodeling cavity moving inward. However, the socks for this demonstration are added in the middle first and then move out. Students may notice this discrepancy and require the teacher to clarify that for the purpose of understanding the microscopic anatomy of an osteon, this sock demo was used. However, compact bone is remodeled from the largest lamella in.

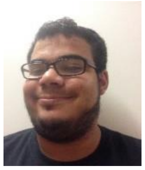
EXPLANATION:

The point of this demonstration is to show students that the microscopic structure of an osteon is directly related to the role of the compact bone in the body; to resist bending and provide a rigid structure for muscles. To achieve this, compact bone is made of thousands of columns attached to one another.

SAFETY:

Make sure that as the volunteer bends the dowel rode that they face the bend/break down and away from other students. Safety goggles are advised.





Disappearing Glass

Patrick Morales-Physics Senior

MATERIALS:

Glycerin
Water
Beakers (1 large and 1 small)
*Pyrex Tupperware also may be used in instead of beakers
*Wesson Oil also may be used instead of glycerin

PROCEDURE:

1. Fill a large beaker with water
2. Submerge small beaker in the water and show to audience
3. Remove glass and water from large beaker
4. Pour glycerin into large beaker
5. Submerge small beaker in glycerin and once again show to audience

EXPLANATION:

We as human see objects by having light reflect off objects and travel to our eyes. However, light travels at different speeds in different materials, which causes light to bend. How fast and how much light bends depends on the index of refraction of the two mediums in question. The smaller the difference in wave speed between two mediums, the less that reflection and refraction will occur. Since the index of refraction of the small beaker almost matches the index of refraction of glycerin, light travels through the small beaker and glycerin undisturbed and un-reflected thus making the beaker invisible.

Will the Egg Break?

Patrick Morales - Physics Senior

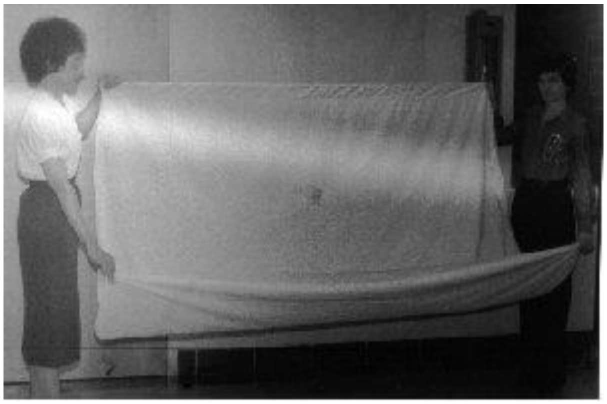
MATERIALS:
Table Cloth
*Bed Sheet also may be used
Raw Egg

PROCEDURE:
1. Have 2 volunteers spread and hold the sheet as seen below
2. Have another volunteer throw the raw egg into the sheet

TIPS:
Have volunteers throw at different speeds and different distances.

EXPLANATION:
This demo displays impulse. When an object experiences a change in momentum, the object experiences a force for a given amount of time otherwise known as impulse. The amount of force experienced depends on the time in which the momentum is changed. Small times result in larger forces while extended time result in smaller forces. Since the sheet has give, it extends the time of impact thus lessening the force experienced, allowing the egg to survive.

SAFETY:
There will be fast moving projectiles. Be sure to conduct demo in open space and choose volunteers wisely.



Singing Rod

Patrick Morales - Physics Senior

MATERIALS:

Aluminum rod (Hollow or solid)
Bee's wax (Rosin cake may also be used)

PROCEDURE:

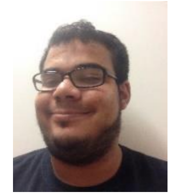
1. Rub the bee's wax over the rod
2. Hold the aluminum rod with one hand at the dead center of the rod
3. Use other hand's fingers to rub from the center of the rod to the end

EXPLANATION:

The bees wax creates friction between the fingers and the rod. By stroking the rod, we create longitudinal waves in the rod that travel along the rod. Some of the waves reflect when they reach the end and interfere with incoming waves. If the waves are driven correctly by stroking the rod, the interference result in standing waves where oscillations intensify and are self-sustaining. This is what we call resonance. As the rod vibrates at its resonant frequency, it causes the air to vibrate resulting in the intense sound.

SAFETY:

Sounds ranges and intensities are based on the size of the rod and the intensity of stroking. Beware of students with hearing sensitivities.



Buoyancy

Patrick Morales – Physics Senior

MATERIALS:

Hollow, clear plastic pipe
String
Beaker
Water
Sink cap

SETUP:

Tie string to sink cap. Make sure to leave enough string to go through whole pipe. Also fill up a beaker with water. Setup shown below

PROCEDURE:

1. Begin by showing that releasing the string will allow the sink cap to fall
2. Pull on string and accommodate sink cap in pipe
3. Now holding the sink cap, submerge the sink cap in water
4. Release string

EXPLANATION:

____When an object displaces volume in a liquid, the liquid pushes back with what is known as the buoyant force. Since the weight of the sink cap is smaller than the buoyant force, it doesn't sink. The buoyant force holds the sink cap in in place. The reason the cap remains for a long time is because this force is constant as long as the cap is in the liquid.

When an object displaces volume in a liquid, the liquid pushes back with what is known as the buoyant force. Since the weight of the sink cap is smaller than the buoyant force, it doesn’t sink. The buoyant force holds the sink cap in in place

Faraday Cage

Patrick Morales - Physics Senior

MATERIALS:

Small Bluetooth Speaker
Glass Beaker
Chicken Wire Container (example provided below)
Steel/Metal Container (either open or closed)
*Can also use phone or portable radio in place of Bluetooth speaker

PROCEDURE:

1. Turn on Bluetooth speaker and increase volume so everybody can hear it
2. Place speaker in glass beaker
3. Remove speaker and place in chicken wire container
4. Remove speaker and place in sold metal container

TIPS:

Thick, closed metal containers work best.

EXPLANATION:

Electromagnetic waves consist of electric and magnetic components that can travel through many objects and materials. However, when a hollow conductor such as a metal cup is hit by an electric field, the charges of the conductor redistribute so that field inside cancels out. The negating of the electric field results in the loss of radio and Bluetooth signal in the conductive container in what is called the Faraday Cage effect. This is why we have poor reception in certain buildings.

Carbon Dioxide Extinguisher

Karie Farland – Biology Senior

MATERIALS:

4-5 Candlesticks of descending heights
1 Narrow, clear walled container sized to fit candles
1 Flame source (lighter)
Several cubes of solid carbon dioxide (dry ice)
Plastic pitcher with lid

Tea lights can be used in place of candles and Alka-Seltzer tablets can be used in place of dry ice to produce CO_2 gas.

SETUP:

In advance, place candles in container so that they are in descending size order. Secure them to the bottom of the container with either hot glue or clay. Place dry ice in sealed pitcher and agitate periodically to speed the sublimation process. Ensure all safety equipment is ready and available.

PROCEDURE:

Light each of the candles within the container. Agitate solid carbon dioxide a final time to ensure CO_2 gas has sublimated. Finally, pour the CO_2 gas over the candles slowly in order for students to observe the candles extinguishing from the bottom up.

TIPS:

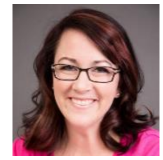
None.

EXPLANATION:

Solid carbon dioxide (dry ice) is used to demonstrate that carbon dioxide gas is denser than oxygen gas. Dry ice will sublime at approximately -79°C and the CO_2 gas has a density of 1.56 g/L at this temperature, whereas oxygen gas has a density of 1.31 g/L at 25°C. As the CO_2 gas is poured into the container holding the lit candles, the oxygen gas is slowly replaced with the more dense CO_2 gas beginning from the bottom of the container. This is demonstrated by the candles being extinguished from the lowest to the highest.

SAFETY:

Dry ice should be handled with tongs and protective gloves. Safety goggles should be worn at all times.



Teabag Convection

Karie Farland – Biology Senior

MATERIALS:
1 teabag
1 flame source (lighter)
1 clear cylindrical container (at least 1 meter high)

If a clear cylindrical container is unavailable, a large fish tank could be used as a replacement.

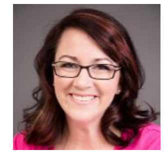
SETUP:
In advance, trim the teabag just below the fold that seals the top of the bag. Then empty the contents of the teabag and shape the remaining material into a cylinder. (Consider reserving the tea from the emptied bags for use as a dye for diffusion demonstrations and experiments.)

PROCEDURE:
Place the hollowed and cylindrical teabag at the bottom of the container. Then, using a flame source, light a corner of the bag and allow it to burn out on its own.

TIPS:
As the teabag burns it will begin to float, be prepared to contain the embers with a covering for the container.

EXPLANATION:
This demonstration illustrates the concept of heat transfer through convection currents. As the teabag burns, heated gas is created within the bottom of the container. The cold, dense gas of the container falls into the warmer areas as the warm, less dense gas rises to the top of the container. This process creates a convection current beneath the teabag, which subsequently causes it to rise.

SAFETY:
Use standard safety precautions (fire extinguisher nearby, safety goggles, available water source, flame properly contained) whenever dealing with a flame.



Instant Snow – Water Absorbing Polymers

Karie Farland – Biology Senior

MATERIALS:

¼ teaspoon Sodium polyacrylate powder (available from Flinn Scientific, Inc. or found in super absorbent diapers)
Clear plastic cup
Distilled water
Container of known volume
Spoon or other stirring device

SETUP:

If obtaining sodium polyacrylate powder from diapers, extract and set aside prior to the demonstration.

PROCEDURE:

First add ¼ teaspoon sodium polyacrylate powder to the clear plastic cup. Next slowly add distilled water to the powder and stir in between until the consistency of fluffy "snowflake" type crystals are formed.

TIPS:

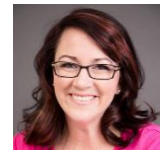
Sodium polyacrylate can absorb 800 times its weight in distilled water, however, due to the presence of sodium, calcium and other mineral salts in our tap water, it can only absorb 300 times its weight in tap water.

EXPLANATION:

In this demonstration, the concept of osmosis is addressed by showing the movement of sodium molecules. When in contact with water, the sodium molecules in the Sodium polyacrylate cross-linked polymer network have a tendency to distribute equally between the water and the network. As a result, the sodium molecules that leave the network are replaced by water molecules. The water molecules "swell" the polymer network in order to maintain sodium concentration equilibrium. The cross-linked structure of the network prevents the chains from dissolving in the water. This results in the appearance of the powder growing into "fluffy" snowflakes.

SAFETY:

Established safety procedures should be maintained.



The House Guest - Fermentation

Karie Farland – Biology Senior

MATERIALS:

1 Small clean, dry plastic bottle (16 oz or less)
1 Picture of a bad house guest/relative
2.25 teaspoons active dry yeast
1 teaspoon sugar
Warm water
1 Small balloon
1 Small funnel

This can be done without the plastic bottle by placing all the ingredients directly into the balloon and tying it closed. Additionally, if funnels are unavailable waxed paper squares can be rolled into a funnel shape and used as an alternate. Finally, if short on time fast-acting or rapid-rise yeast can be used to decrease reaction time.

SETUP:

If using a bulk container of yeast, pre-measure the amount of yeast and place it in a sealed container. Do the same with the sugar. Place a picture of your relative/bad house guest on the front of the plastic bottle ensuring it extends above the opening enough to conceal the funnel used to pour in the ingredients.

PROCEDURE:

(This demonstration, as written, is based on having house guests at the holiday season, it can be adapted to suit anytime of the year. The set-up is based on a quote from a famous local brewer explaining fermentation, "What does yeast do? It's like your worst house guest, it eats all your food from top to bottom, pees out alcohol and farts CO_2!")

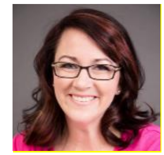
To begin, explain that relatives are visiting and that you have a particular relative that is a horrible house guest. Then show the students the plastic bottle with the picture. Explain that the house guest/relative is rude and eats and drinks everything in sight from the top of your house to the bottom of your house and winds up occupying the bathroom and farting all the time and blaming it on the dog. While giving this verbal explanation, put the warm water, yeast and sugar into the bottle using the funnel. Then tell the students you will prove to them how rude your guest is and tell them that by the end of 20 minutes, he/she will have filled the balloon that has sealed off the bottle (place a balloon over the opening of the bottle, ensuring that it is completely sealed.)

EXPLANATION:

Fermentation is a metabolic process that converts sugar to gases, alcohols and acids. Yeast is a single celled fungi that utilizes alcoholic fermentation as its primary means of ATP production with alcohol and carbon dioxide as byproducts of the process. Chemically, the sugar glucose is broken down to smaller molecules. Specifically, glucose ($C_6H_{12}O_6$) is broken down to the alcohol ethanol (C_2H_6O) and carbon dioxide (CO_2). As a glucose molecule is broken down, some of the energy stored in the chemical bonds of glucose is transferred to energy stored in the chemical bonds of ATP molecules. In this demonstration, students will observe the accumulation of CO_2 as the balloon inflates.

SAFETY:

Established safety procedures should be followed at all times.



Reaction Time

Karie Farland – Biology Senior

MATERIALS:
1 Meter stick
Chair and table

A regular classroom 12 inch ruler would work as a replacement, as long as measurements can be made in centimeters.

SETUP:
None necessary.

PROCEDURE:
Have a volunteer sit in a chair with good upright posture and place their forearm so it extends over the edge of the table. Next, hold a meter stick vertically at the end with the highest measurement in centimeters. Ensure the bottom of the meter stick will be approximately 2 cm higher than the volunteers' fingers. Then the volunteer should place their thumb and index (pointer) finger on either side of the meter stick at the lowest centimeter measurement end.
Have a volunteer sit in a chair with good upright posture and place their forearm so it extends over the edge of the table. Explain to the volunteer that the meter stick will be released unexpectedly, (there will be no countdown.) Their job will be to catch it with the thumb and forefinger as soon as they sense it dropping. Drop the ruler. When the volunteer catches it, record the number on the meter stick displayed just over their thumb. The lower the number, the faster their reaction time.

TIPS:
To clarify connections between reaction times, practice and muscle memory, conduct several trials (5-7) in rapid succession with the same volunteer.

EXPLANATION
This demonstration introduces neural pathways and the amount of time for information from outside the body to travel through the nervous system and cause the human body to react, otherwise referred to as reaction time. The neural pathway begins as the meter stick is dropped and the volunteer's eye registers the movement as a stimulus that says "the meter stick is dropping, I need to catch it." The stimulus triggers the optic nerve to send the command, via neurotransmitters to the cerebrum within the brain, which then sends the command (again via neurotransmitters) to the cerebellum at the base of the spinal cord. Finally, the command to catch the meter stick reaches the nerves connected to the muscle cells of the volunteers arm and a reaction occurs. The lower the centimeter measurement the volunteer catches the meter stick, the better their reaction time.

SAFETY:

Standard safety procedures should be observed.

Sher Wiedeman

Guided Student-Centered Diffusion Demonstration

Sherelyn Wiedeman – Biology- Post-Bac

MATERIALS:

10 Student Volunteers
Masking Tape or rope

SETUP:

Using the masking tape, make an outline of a square on the floor in the front of the classroom.

PROCEDURE:

Have the 10 students stand in the square outlined by the masking tape. Start your lecture for the day. After some time passes the students should start to get uncomfortable and will want to diffuse out of the boundaries. Ask the students if they are uncomfortable. Then ask, "Why are you uncomfortable?" Tell the students they may diffuse to a more comfortable area. Tell the students that molecules react the same way. They move around and if allowed, will move from a higher concentrated area to a lower concentrated area.

TIPS:

Adjust the size of the square to make it uncomfortable for the number of volunteers standing in the square. If you would like, use a rope, lasso style, to gently guide your students to an increase in concentration. Let the rope loose on the floor when giving the students the ok to diffuse.

EXPLANATION:

Diffusion is the random movement of particles from an area of high concentration to an area of low concentration. The 10 students represent particles. Naturally, they will move to a place with a greater amount of space. They will move from the highly concentrated area in the square to an area with a lower concentration of volunteers.

SAFETY:

Remind the students-No ruff-housing.

Sher Wiedeman

Guided Student-Centered Enzyme Demonstration

Sherelyn Wiedeman – Biology- Post-Bac

MATERIALS:

20 playing cards
3 Student Volunteers
 1 Timer
 1 Reactants
 1 Enzyme
1 Timing device-Cell Phone or Stop Watch

SETUP:

Randomly spread one deck of 20 cards on a desk in front of the classroom.

PROCEDURE:

Call on a student volunteer to join you at the desk with the cards on it. Tell student # 1, he/she represents "reactants" and will stack the cards on desk # 1. The cards represent starch. The stacking represents breaking down the starch into a simple sugar, glucose..

The rules for "reactants":

1. He/she can only stack the cards with one hand
2. Can only stack one card at a time.

Have the timer time student #1 stacking the cards. Record the time.

Call on student #2 to volunteer. Tell student #2, he/she represents the enzyme, "amylase" and will help water break down the starch.

The rules for "Amylase":

1. Can use both hands
2. Can only stack one card at a time.

Reactants and the enzyme will race as a team to stack their cards as fast as they can. Record and announce the times to the class. With the enzymes help, the process of stacking the cards should be quicker. It took less time and energy with the help of an enzyme to break starch down into glucose.

EXPLANATION:

An enzyme speeds up chemical reactions. They can either break down or build up material. In this case, the water and amylase are breaking down starch (by making one glucose molecule-the stack representing one.) Reactants can eventually break down starch in the right conditions but amylase will speed up the reaction in certain conditions. Student #2 should be faster than student #1 in completing the jobs.

Sher Wiedeman

Model Demonstration

How We Use Our Food: Maintaining the Cell Membrane

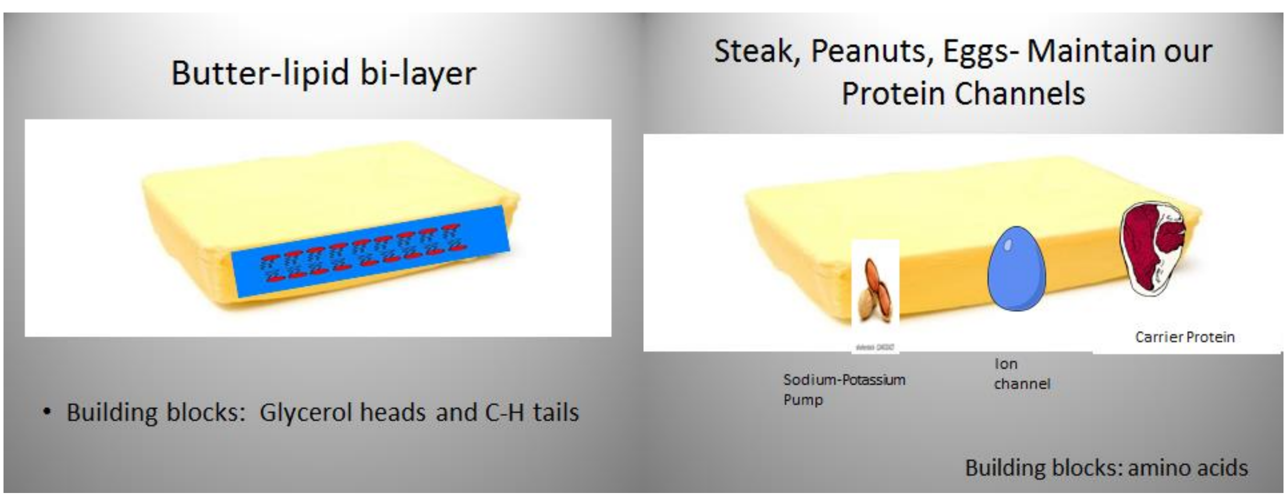
Sherelyn Wiedeman – Biology- Post-Bac

MATERIALS:

Calzone Box
Clip Art
Tape
Paper
Yellow Marker

EXPLANATION:

Different biomolecules found in our food help maintain bodily structures, even at the microscopic level. Our cell membranes are maintained by the fats and the proteins we eat; their building blocks glycerol and amino acids respectively. With this simple representation, one can provide a solid visual to help remind students of the different biomolecules found in food as well as the parts of the membrane they maintain.



Sher Wiedeman

Water Convection Demonstration

Sherelyn Wiedeman – Biology- Post-Bac

MATERIALS:

Chamber
Thermos of hot water
Thermos of cold water
Food coloring

SETUP:

Pour the hot water treated with red food coloring into the left side of the chamber. Pour the cold water treated with blue food coloring into the right side of the chamber.

PROCEDURE:

Remove the divider separating the hot and cold water. Observe the movement of the water.

EXPLANATION:

Convection is the movement caused within a fluid or gas by which hotter, less dense material rises while colder, denser material sinks under the influence of gravity. This results in the transfer of heat. In this demonstration the red water should rise to the top as the blue water sinks to the bottom. This is a good demonstration that shows how currents develop in bodies of water such as the oceans or in the "fluid" mantle beneath the earth's crust.

SAFETY:

Take care in transferring the hot water into the chamber. Avoid splashing.

Sher Wiedeman

An Inexpensive Way to Understand the Glucose Molecule and Atomic Bonding

Sherelyn Wiedeman – Biology- Post-Bac

MATERIALS:

1 Glucose Marsh Mellow Kit

- 6 Big White-Carbon Atoms
- 3 Big Pink-(break each in half for a total of six)-Oxygen atoms
- 12 Small White-Hydrogen Atoms
- 24 Toothpicks
- 1 Baggie

1 Glucose Molecule Map

SETUP:

Hand the student 1 Glucose Molecule Map and 1 Glucose Marsh Mellow Kit.

PROCEDURE:

Have the student build a glucose molecule out of marsh mellows using the map as a guide and the marsh mellow kit.

TIPS:

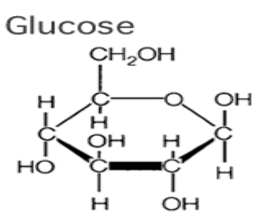
Make marsh mellow kits ahead of time to save class time. Split a class of 32 into groups of 4 and have them work in groups; make 8 kits. In each baggie place the number of marsh mellows stated above and 24 toothpicks.

Model the Carbon Ring. Have the students follow your lead. Then have students finish on their own.

EXPLANATION:

Many Molecule kits are expensive. This is an inexpensive way to provide the class with the opportunity to work with manipulatives while learning about molecular structure and bonding.

SAFETY: Remind students to be careful of the toothpicks



Glucose Molecule Map