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Margrett Davis-Chemistry Senior

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Margrett Davis-Chemistry Senior

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Radioactive particles vary in size and energy which allows them to pass through more materials if they are smaller and higher energy.

MATERIALS:

A coffee straw
A regular straw
A toilet paper or paper towel tube
Three cylindri:

Margrett Davis-Chemistry Senior

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

As the radius of a circle linearly increases, its area increases exponentially.

Luke Engelbert - Biology Senior

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Convection currents in the of magma in the Earth's mantle drive tectonic plate movement.

MATERIALS:

Hot plate
Large clear bowl
Ice cube tray
Red food dye
Blue food dye
Water

SETUP:

Water poured into bowl. Ice cubes already made and standing by. Bowl placed on hot place. Hot plate turned on to high temperature.

PROCEDURE:

1. Pour water into ice cube tray.
2. Dye water blue with blue food coloring.
3. Place ice cube tray in freezer to freeze.
4. After water is frozen pull out of freezer.
5. Place large clear bowl onto hot plate.
6. Pour water into large clear bowl. Let water calm.
7. Drop 2 drips of red food coloring into bowl.
8. Turn on hot plate.
9. Let water heat up.
10. Once red food coloring begins to rise place small piece of blue ice into bowl

EXPLANATION:

As liquids heat up they become less dense and travel upward towards their surface where it cools. While this is

Luke Engelbert - Biology Senior

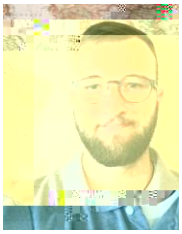
BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Life requires the use of energy to create more energy.

MATERIALS:

Snake in a Can

SETUP:



Kevin Heise-PTEP Student

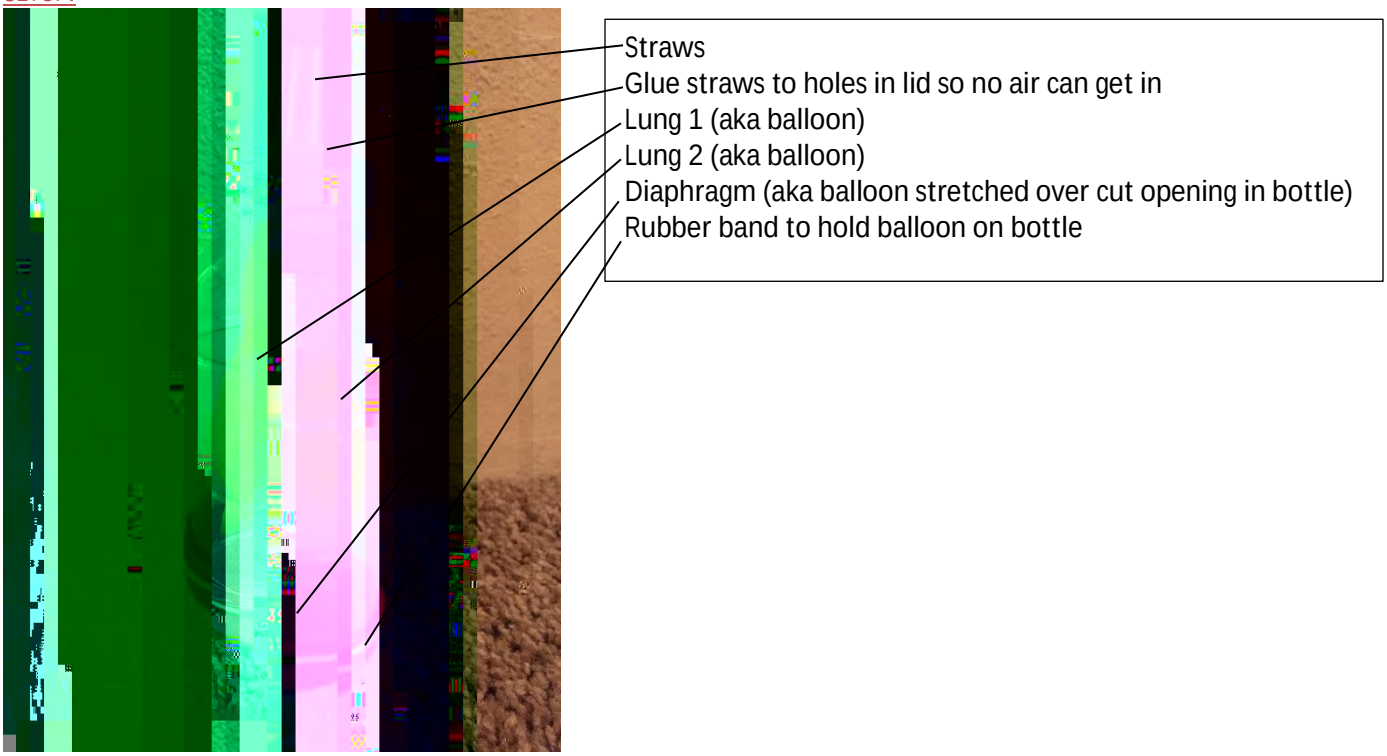
BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

The design of human lungs and the chest cavity can be used to predict the relationships between gas volume and pressure as described by Boyle's Law.

MATERIALS:

3 balloons
1 rubber band
1 straw
Hot glue gun
Plastic water bottle

SETUP:



PROCEDURE:

1. Hold the bottle in one hand
2. Pinch the center of the pink balloon (diaphragm) with the other hand
3. Pull down on the pink balloon (aka contracting the diaphragm)
4. Push up on the pink balloon (aka relaxing the diaphragm)

TIPS:

Exaggerate the diaphragm movement to better display air movement into and out of the lungs.

Kevin Heise-PTEP Student

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

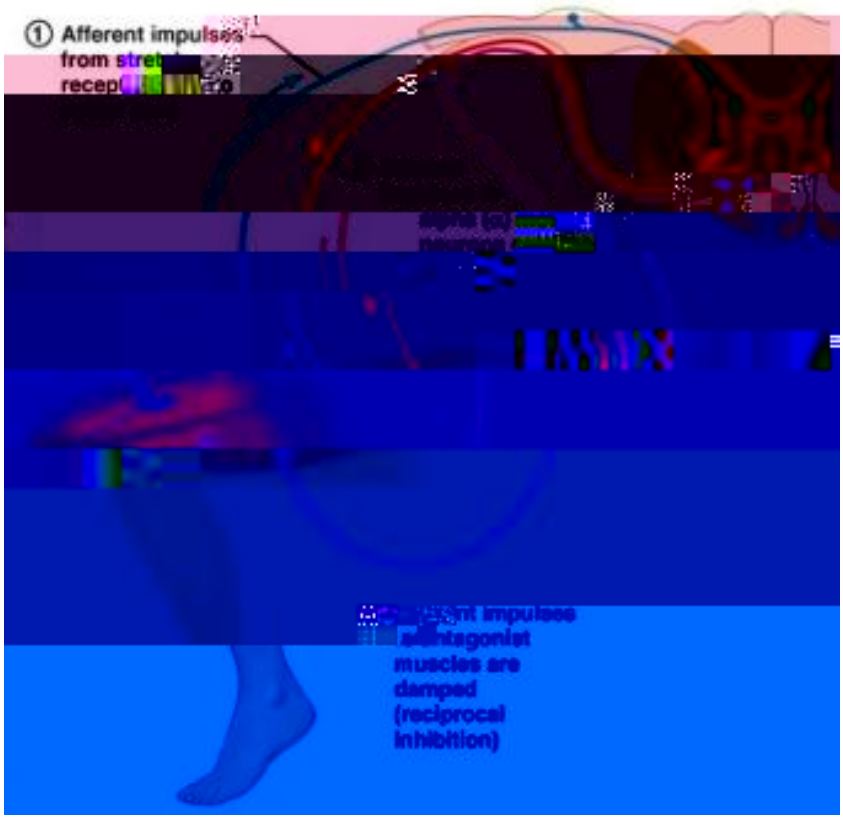
Investigating system interactions gives us an indication of how information flows and delivers negative and/or positive feedback to stabilize a system. Analyzing these relationships can reveal the function of a tissue based on its structure.

MATERIALS:

Reflex hammer (also called neuro hammer)

SETUP:

Sit upright where the femur is supported by a chair or table. Allow the distal aspect of the leg to hang off the



SAFETY:

Do not do this on someone who has patellar tendinitis, osgood schlatter knee, frequent patellar dislocations, or a recently replaced knee joint.

References

Floyd, R. T. (2015) *Manual of structural kinesiology* (19th ed.). New York: NY. McGraw Hill Education

Kevin Heise-PTEP Student

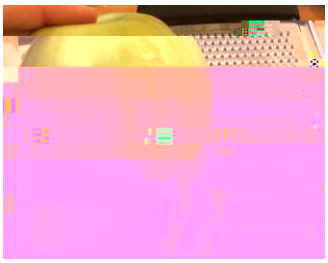
BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Body systems differ when in a state of health and disease.

PROCEDURE:

Make the following wounds in an apple by using the following (may be fun to make up some story for each wound)

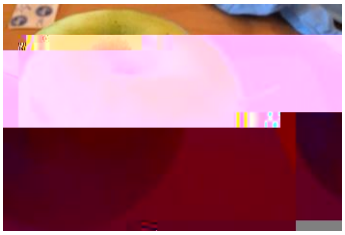
Abrasion-Cheese grater



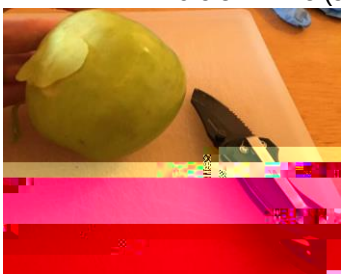
Laceration-Pen

Incision-knife (scalpel)

Puncture-nail



Avulsion-knife (scalpel)



Once the wounds are made, allow the students to irrigate the wound with the syringe, and clean the area with a sterile pad. Then, they can apply Neosporin, and create a way to cover the wound by using a bandage of some sort (gauze and athletic tape or band-aid).

TIPS:

You can do 1 wound per apple, or all wounds in 1 apple. You can vary the apples used by the class size you have. Since this does include sharp objects, it may be best for the teacher to tell a story and make the wound types. Then, have the students take the apple, sterilize the wound, and bandage it.

EXPLANATION:

Primary injuries are mainly unpreventable apart from altering behaviors beforehand. Thus, the damage to the tissue is directly due to the trauma during the initial moments of injury. Secondary injury results from any damage, injury, or death that occurs as a result of the physiological process that occurs in response to primary damage. This happens as a result of the healing process due to the interplay between the internal and external environment. Thus, external dressing acts as a middle ground between internal and external environment and allows the healing process to take place. This is a good "engage" activity as an introduction to the functions of the circulatory system. The main idea to stress here is the cascade of events and interactions which determines how organism response to disease (or in this case, wounds).

SAFETY:

This demo requires the use of sharp objects. Students must be aware of the rules for using sharp objects to ensure no one is harmed.

P ROCEDURE :

Have students use the remaining yellow and orange paper to cut out circles of different sizes. Then have them glue the circles on the orange peel.

It should look something like this:

Finally, have students come up with a mathematical way to represent this. Through the use of guided questioning, they should decide that the surface area of the sphere (in this case, the orange) = $4 \pi r^2$

TIPS:

Possibly have students

Andrew Mattivi - Biology Senior

Big Scientific Idea supported by this Demo

Different objects have different specific heats, which is the amount of energy a substance must absorb to raise its temperature by 1 degree.

When a substance is heated, it expands, this is called thermal expansion.

Materials:

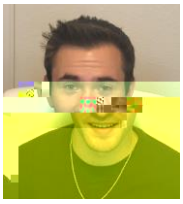
2 balloons
Lighter
Access to a sink for water

Setup:

Inflate one balloon with air. Inflate a second balloon after first filling it with water until it will not hold any more.

Procedure:

Hold the balloon only inflated with air in your hands. Light the lighter, and hold the lighter to the bottom of the balloon. After a very short time, the balloon will pop. Now repeat the same p



Andrew Mattivi - Biology Senior

Big Scientific Idea supported by this Demo

Polymers are long chains of molecules. Each polymer has its own unique properties.

Pressure varies in a system, and different parts of a system feel more stress than others.

If Polymers are supported, they will retain their shape

Materials:

2 Balloons
2 Wooden Food Skewers
Vegetable Oil
Clear Tape

Setup:

Draw small dots with sharpie, around 2cm each all over the surface of the balloon before inflation. Place clear tape on both sides of one of the balloons. Place 2-3 drops of vegetable oil on the skewers and coat the outside of the skewer.

Procedure:

Show students that both balloons are uninflated, have them take note of the size of the dots on each balloon. Inflate balloons to about 2/3 full. Tie knot at bottom of balloon. Have students take note of the size of the dots after inflation. Ask students what they think will occur if you poke the balloon with a wooden food skewer. Poke the balloon near the bottom (by the knot) and run the skewer through the top of the balloon. Now try and do the same but on the side of the balloon (it will pop). Do this same procedure again, but this time with the taped balloon. This time for the second poking, run the skewer through the tape on both sides, this should support the balloon enough not to pop. Ask students why they think the second one didn't pop on the side.

Tips:

Don't tell students about the tape until after they have guessed how the second balloon did not pop.

Explanation:

The pressure inside the balloon is mainly supported by the sides of the balloon. The bottom and top have an excess of rubber polymer, which is not under much stress. The lubricated skewer slides right through both sides of the balloon, since the pressure is not enough to tear the balloon on these areas. The side is much more stressed, and a slight tear causes the balloon to pop. The tape on the second balloon supports the polymer enough that even on the sides, it retains its shape, and does not pop.

Safety:

Possible to get splinters from lubricating the skewers.

Andrew Mattivi - Biology Senior

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

The combination of two metals forms an alloy.
These alloys can have different properties than either of the starting metals, or a combination of them both.

MATERIALS:

Aluminum Can
Sand Paper
Gallium
Knife

SETUP:

Puncture the side of the can with a sharp object a few times. Drain the liquid from the can.

PROCEDURE:

Scratch the surface of the top of the aluminum can with the sandpaper. Make sure to cover the whole surface you

Andrew Roth - Physics Senior

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Standing waves appear to not move in space because of the unique properties of their constructive and destructive interference.

MATERIALS:

Speaker with exposed diaphragm
Glue
Small metal bar
2-3 m of bright string with loops tied on both ends
2 C-clamps
Signal generator

TIPS:

-Some smartphones can download a frequency generator app, which can be used to run the speaker if a signal generator is unavailable
-The speaker frequency should generally be set at less than 50 Hz
-Most handheld strobe lights have short charged times—make sure to keep the strobe plugged in when not in use
-A good rule of thumb is t set the strobe light at a frequency about 200x that of the speaker frequency

EXPLANATION:

The wave looks frozen in mid-air! The strobe light projects light onto the string at the exact same point during its journey every time. Since standing waves interfere very predictably, "taking a picture" of the string at the exact same point over and over returns the exact same result every time. This "same point" refers to the frequency of the wave, which needs to match the frequency of the strobe light (or be an integer divisor of it).

SAFETY:

Andrew Roth - Physics Senior

BIG S

Andrew Roth - Physics Senior

Big Scientific Idea supported by this Demo

Free-body diagrams visually represent the net force on an object.

Materials:

Styrofoam poster board
String
Pin
Fishing weight, bolt, or other small, heavy object
Tape
Protractor
Markers

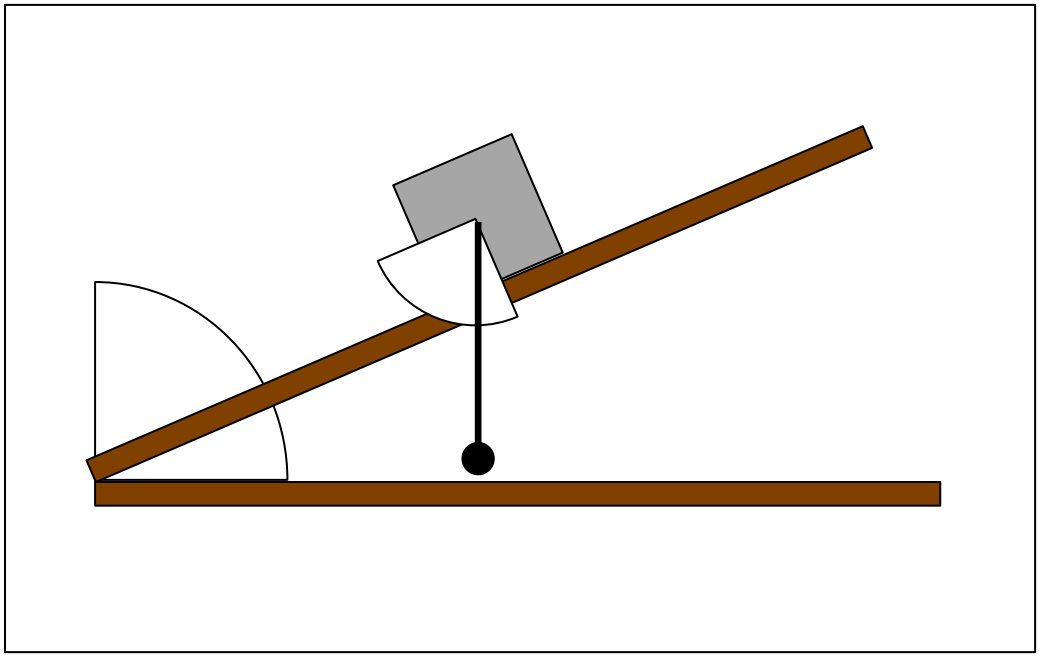
Setup:

TIPS:

Make the plumb line clearly visible against the background of the protractor—this can be accomplished with thick or colored string.

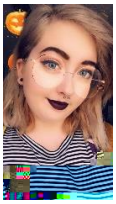
EXPLANATION:

The angle between the weight vector and the perpendicular is always the exact same as the angle of incline of the ramp the object rests on. This is due to the geometry of the situation, and can also be proved mathematically.



Andrew Roth - Physics Senior

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO



Erin Sporl - Biology Senior

Big Scientific Idea supported by this Demo

You can use this to a comparison of a star's life cycle. Adding the two chemicals are the birth of a star and adding the dish soap to make it brighter simulates the star growing and getting brighter. When you keep the soap, it simulates the star dying out and losing its light and becoming a dwarf.

Materials:

Glow sticks
Dish soap
Glass jar for hydrogen peroxide (color)
Glass Jar for diphenyl oxalate compound (activator)
Stirring rod

Setup:

Cut open the glow sticks and separate the two liquids into two separate containers. One liquid will be in the plastic tube (the activator) and the other liquid will be in a glass tube (the color).

Procedure:

1. Crack one glow stick as a control to compare brightness levels to.
2. Pour the activator into the cup with the color.
3. Watch it glow for a few seconds, get an idea of how bright it is.
4. Add a small amount of dish soap, enough to make it brighter.
5. Keep adding soap until it the brightness decreases.

Tips:

Make sure to use enough glow sticks. Amazon sells a box of 300 for $20.

Explanation:

The glow sticks have two chemicals in them, in the plastic casing there's a diphenyl oxalate compound (the activator), in the glass vial there's hydrogen peroxide (the color). When the two mix it makes a glowing reaction, and when a weak base is added (dish soap) the reaction occurs faster and produces a brighter light. However when you keep adding it, the energy in the system is converted into CO_2.

Safety:

Make sure not to cut yourself while breaking open the glass vials.
The chemicals in glow sticks can be a mild irritant, wearing gloves to avoid it is advised.
The chemicals will eat through plastic cups, make sure to use glass jars.

Erin Sporl - Biology Senior

Big Scientific Idea supported by this Demo

Substances that are hydrophobic will not mix with water, and any object that they are coating will keep the object completely dry even when dunked in water and taken out of water.

Materials:

Scotchgard
Craft sand
Water
Container big enough to hold the sand and water

Setup:

Spray the sand with Scotchgard, mix it around on a baking sheet, repeat about 3 times.

Procedure:

1. Fill the container with water.
2. Take a handful of sand and slowly pour it in and allow the sand to build up any shape.
3. Grab the sand from the bottom and bring it up to air to show that it's still sand.
4. You can even do this where you put the sand inside of a mold and put that underwater, and pull the mold out leaving a shape.

Tips:

Colored sand will show best, and it will also allow people to see the barrier the Scotchgard makes between the sand and the water.

Explanation:

Things that are hydrophobic will not mix with water, and anything that they coat will be kept dry when underwater. This can be related to cell membranes and the phospholipid bilayer to show what it means to be a hydrophobic tail.

Safety

Erin Sporl - Biology Senior

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

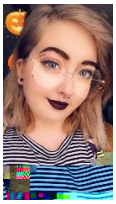
When a liquid that is denser are on top of a less dense liquid, the less dense liquid will eventually move on top of the denser liquid.

MATERIALS:

Plastic wine glasses
Red wine
Water
Clear vinyl big enough to cover the glass

SETUP:

Fill one wine glass with water and the other with red wine, make sure to find2 792nitef*9all w4(ith)aer mo findohJETQq0.00



Erin Sporl - Biology Senior

Big Scientific Idea supported by this Demo

Acids dissolve parts of things leaving them intact, but structurally weak.

Materials:

Vinegar
Chicken bones (leg bones work best)
Container

Setup:

Let chicken bones soak in vinegar for 3 days.

Procedure:

1. Have one chicken bone for reference of how hard a chicken bone is normally.
2. Try and bend it, even bend it until it snaps if you want.
3. Pull the prepared bone out of the vinegar bath and bend it to show that it's become "rubberized".

Tips:

Normal white vinegar is the best to use.

Explanation:

A mild acid will strip away at the hard calcium of bones and leave them structurally intact, but they will be more flexible than before. The calcium in the bone is what's keeping the bone hard.

Safety:

Vinegar can irritate eyes.

Diagram

Allison Teichman - Biology Senior

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Organisms use matter and energy to live and grow.

Peter Woodley

Peter Woodley – Biology Post Bac – Pre-service Teacher

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

The behavior of an object is the result of the forces applied to it, as well as any other subsequent interactions.

MATERIALS:

Hula-hoop(s)

SETUP:

The presenter practices the maneuver in an open space to achieve consistency.

PROCEDURE:

The hula-hoop should be tossed forward with back spin. It should hit the ground sliding in the opposite direction of the spin until it catches and roles right back to the instructor.

TIPS:

The hula-hoop maneuver should be practiced.

EXPLANATION:

Rolling resistance is the resistance to rolling that occurs when a round object, such as a ball, wheel, or cylinder rolls on a surface. It is caused primarily by deformation of the object, deformation of the surface, or both. Kinetic friction refers to the frictional force of a moving object. If a force is being applied on a stationary object, friction is considered a static force until movement occurs. Friction is a force that occurs between two or more surfaces of objects that is typically in the direction opposite to the force being applied on an object. It can be calculated by multiplying the coefficient of friction by the normal force, which takes into account gravity and any other forces perpendicular to the surfaces in contact. The static coefficient of friction is used when the object is stationary and is usually larger than the kinetic coefficient of friction, which is used during movement.

SAFETY:

This demonstration is fairly safe. The risks involved are centered around spatial awareness. We don't want to hit anyone or knock anything over. Again, independent practice outside is a great way to start.

Peter Woodley

Peter Woodley – Biology Post Bac – Pre-service Teacher

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

A genetic bottleneck occurs when the genetic diversity of a species is reduced due to a random catastrophe. Genetic drift is also a loss of genetic diversity but is due to improved fitness. The founder effect leads to less diversity due to isolation from the larger population. All of these reductions in genetic diversity leave the existing populations with less genetic potential to survive in an ecosystem that is in flux.

MATERIALS:

Four Clear Beakers
Water
Oil
Stirring utensil
Tray for spills
Food coloring

SETUP:

The water with food coloring (for contrast) and oil are placed into two beakers at a one to one ratio. The other two beakers will remain empty.

PROCEDURE:

Half of the liquid is slowly poured into an empty beaker, which leads to a different ratio of oil and water in the new container (Genetic drift due to fitness). Then, follow the same procedure again but instead stir the water and oil carefully and vigorously immediately prior to half of the contents into the other empty beaker. This should lead to the same ratio of water and oil as the original container (Genetic Bottleneck due to catastrophe).

TIPS:

The goal is to show how fitness is selective and bottlenecks due to catastrophe are not. This means that the water and oil should be settled as it is poured first beaker. The second beaker should be mixed vigorously to achieve a homogenous condition as it is poured.

EXPLANATION:

Genetic diversity can be impacted by a variation in fitness due to traits that are favorable to survival. The oil in the first beaker represents the segment of the population that showed greater fitness. The mixing of the liquids represents a catastrophic event that randomly reduced the genetic diversity that is similar to the original.
*This can also include various sediments that would represent even more genetic diversity in the populations.

SAFETY:

This demonstration is safe but potentially messy. The tray is used to isolate the mess and there should be rags on hand to deal with messes.

Peter Woodley

Peter Woodley – Biology Post Bac – Pre-service Teacher

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

When an EMF is generated by a change in magnetic flux (the conductor passing by the magnet) according to Faraday's Law, the polarity of the induced EMF is such that it produces a current whose electromagnetic field opposes the change that created it.

Demonstrations
1) Magnet falling through a copper tube
2) Aluminum ruler falling between magnets

Peter Woodley

Peter Woodley – Biology Post Bac – Pre-service Teacher

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

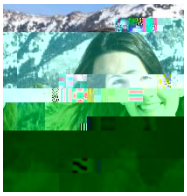
The carbon dioxide in the air is incorporated into the structure of a plant in the form of carbon. Carbon makes up ~96% of the dry mass of a producer.

MATERIALS:

Two balloons
A balance

SETUP:

Place the balance on a table so that it can be seen as balanced with nothing on it. Have both balloons uninflated.



Jennifer Goddard - Biology Senior

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Germs, or viral and bacterial infections can be easily transmitted from person to person via physical contact.

MATERIALS:

Luminous powder (mine is called art glow and was found on amazon)
A UV light source

PROCEDURE:

For this demo, a luminous powder is used to represent germs, or a specific viral infection such as the flu. Place some of the powder on your own hands in advance. As opportunities arise, make contact with students though high fives or shaking of hands to spread the powder. To make the germs visible, turn off the lights and use the UV light on the classes hands to check for infection, or spreading of the powder to others.

EXPLANATION:

As physical contact is made, powder from the teacher is transferred to students who then transfer powder to peers. This exponential increase in glowing, infected individuals demonstrates how rapidly harmful viruses and bacteria can be spread. Major outbreaks can be initiated by one sick individual.

SAFETY:

Participants should wash their hands after the demo. Although the powder is non-toxic, it should not be inhaled.

Jennifer Goddard - Biology Senior

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Because water is polar, molecules that contain mostly nonpolar bonds are hydrophobic and will not mix with water. Water can dissolve many polar molecules. Hydrophobic and hydrophilic interactions are the basis for cell membrane structure as cell membranes are composed of phospholipids that contain hydrophobic and hydrophilic components.

MATERIALS:

Large clear container full of water
Vegetable oil
Liquid food coloring
Toothpick
Dish soap

Jennifer Goddard - Biology Senior

Big Scientific Idea supported by this Demo

Circuits must be both closed and grounded. The human body is capable of conducting electricity.

Materials:

Makey Makey kit
Six volunteers
A computer of laptop
Speaker

Setup:

Make sure your computer is connected to the speaker and to the internet.

Procedure:

1. Go to https://apps.makeymakey.com/piano/
2. Connect the Makey Makey board to your computer
3. Use alligator clips to connect wires to the board.
4. Have each volunteer hold the end of one wire connected to the board
5. Play the human piano by touching each person (shoulder or hive five free hand

Explanation:

This system can be used to replace a keyboard with any items that can conduct electricity by creating open and closed circuits.

Safety:

Michael Walp – Post Bac Secondary Science

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Newton's second law and the conservation of momentum can be used to predict changes in the motion of macroscopic objects.

MATERIALS:

Item 1 -Washers, 15 count. -Any objects with a 14:1 weight ratio will work
Item 2 -Cotton string, 25-30 inches. -

Michael Walp – Post Bac Secondary Science

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

The density of a regular Pepsi id significantly greater than that of a Diet Pepsi, enough that it will sink in fresh water compared to the Diet Pepsi which will float.

MATERIALS:

Large clear basin.
1 can of Pepsi, 1 can of Diet Pepsi (Coke and Diet Coke will work just as well.)

Michael Walp – Post Bac Secondary Science

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Wave Properties: The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.

MATERIALS:

1 sonic football. -A foam football with a substitute noise making device implanted in the foam and taped over would work.

PROCEDURE:

Get two people comfortable passing and catching the football, and throw it around so each member of the audience can experience the sound passing by them.

TIPS:

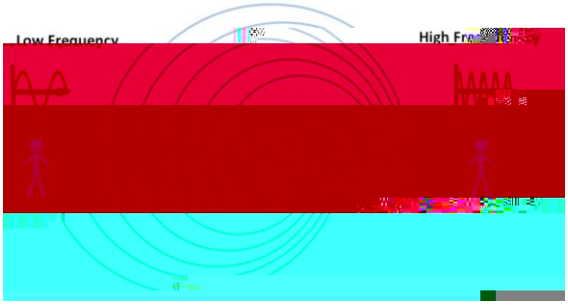
This will not work in a small room.

EXPLANATION:

As the source of the moving sound waves approach the listener, the wavelength condenses and the pitch increases. As the sources of the sound waves passes by and move away from the listener, the wavelength elongates and the pitch decreases.

SAFETY:

Be careful not to hit anyone in the face.



Michael Walp – Post Bac Secondary Science

BIG SCIENTIFIC IDEA SUPPORTED BY THIS DEMO

Waves have characteristic properties and behaviors.

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

1 Red laser pointer.
1 Green laser pointer.
1 Violet laser pointer
3 Glow in the dark masks. -Glow in the dark plastic works best (i.e. not painted solids)

SETUP:

Turn out the lights. Preferable to have no windows. Set up the glow in the dark masks where the audience can see each.

PROCEDURE:

One at a time, shine each laser on the mask in a swirling motion. Start with the red laser, then the green laser, and end with the violet laser.

TIPS:

Make sure the phosphorescent masks/stars have not been exposed to light. They need to be as dark as possible.

EXPLANATION:

The wavelength of each laser is different. The red laser appears brightest and is the easiest to see, but has the