Demonstrations by Jack McCloud

Additional Baccalaureate - Biology

"Boiling Water with Ice"

Scientific Principles:

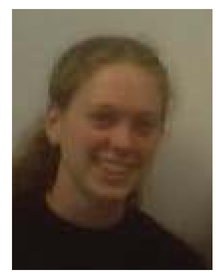
- States of Matter
- How heat and pressure can affect the states of matter

Materials:

- Pyrex flask – 500ml or larger, with rubber stopper
- Heating unit (Bunsen burner or heat plate)
- Heavy duty safety gloves
- Water
- Ice in strong zip-lock bags (2)

Procedure:

- Heat approximately 200 ml of water in flask over heat. Boil for a couple of minutes.
- Using gloves, take flask off heat, wait 5 seconds and cap with rubber stopper (firmly).
- Turn off heat.
- Place flask on sturdy surface for class to see, using a safety glass is highly recommended.
- Wait for flask to cool enough so it is clearly not boiling anymore from the heat (30 seconds).
- Turn flask upside-down and place bags of ice on the sides of the flask. As the steam inside cools, a mini-vacuum is created and water will start boiling due to lack of pressure on top of it.



Demonstrations by Hannah Wilson

Junior – Elementary Education (Physics)

"Sympathetic Resonance"

If you blow air across the top of one empty bottle (making a lovely sound) another bottle (also empty) of the same kind located near the first bottle will also vibrate. This is because of resonance.

"Burning Candle in a Jar"

Principles

air pressure
expansion of air as it heats
exothermic reaction of burning

Materials

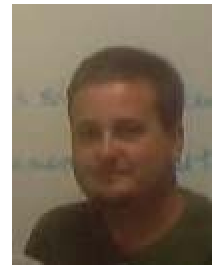
-clear shallow dish
-two clear drinking glasses
-candles
-matches
-water
-something to color the water with
-rubber band

Procedure

Pour water into the shallow dish. Place the candle in the dish. Light the candle and place the drinking glass upside down over the candle. Before it burns out, the candle will heat the air inside the glass causing it to expand and bubble out of the drinking glass. The candle will eventually burn out due to lack of oxygen. After the air in the drinking glass cools (and contracts) the pressure in the glass will be less than the pressure outside of the glass. Therefore water will be pushed into the glass. This should be repeated with more than one candle lit. To do this, rubber band several candles together and repeat the experiment. Because there are more candles, the air will get warmer forcing more to escape the glass. This will cause a greater pressure difference and more water will be pushed into the glass. This also shows that the result is due to the heating of the air rather than the candle "burning-up" the oxygen in the glass. If it was due to the "burning-up" of the oxygen then the water level should be the same no matter the number of candles.

Demonstrations by Anthony Scott

Graduate – Biology



"Acid Breath"

Materials:

- Test tube
- Bromthymol Blue
- Balloon

Procedure:

You exhale into a balloon (or have a volunteer do it) making sure to get air from the lungs and not just taking in air and blowing it straight into the balloon. Then, you put enough Bromthymol Blue (diluted to a light blue color) to fill 1/3 to ½ of the test tube. Next, you place the inflated balloon over the end of the test tube and show the audience the color of the Bromthymol Blue (which should be a light blue.) Then, you turn the test tube upside down and dump the Bromthymol Blue into the balloon and shake it around. When you turn the test tube back right side up, the Bromthymol Blue will return to the test tube and be a pale yellow color, indicating the presence of an acid.

Explanation:

The two main components of exhaled air are carbon dioxide (CO_2) and water vapor (H_2O). The CO_2 will dissolve in the H_2O and form Carbonic Acid (H_2CO_3).

The Reaction is:

$CO_2 + H_2O \rightarrow H_2CO_3$

When to use:

This would work great for a unit on respiration, pH, finding the pH of a gas, or in a chemistry of life unit.

"Where the Dominos Roam"

Materials:

- Dominos
- Overhead projector or ELMO

Procedure and Explanation:

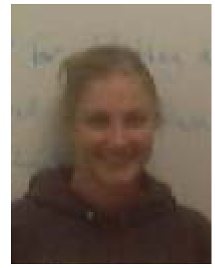
To demonstrate a density-dependent factor that effects a population such as a disease, you set up 20 dominos in close proximity to each other. Then, you “infect” one domino and when it falls into another domino it “infects” that one and so on. Then, you set it up again with only 10 dominos and spread them out more. The second time only 1 or 2 dominos should get “infected” showing how the higher density of a population increases the effects of disease in the population.

To demonstrate a density-independent factor that effects s population such as an earthquake, you set up the 20 dominos in close proximity to each other. Then, you simulate an earthquake by bumping or moving the overhead projector (hopefully all the dominos will fall.) Then, you set it up again with only 10 dominos and spread them out more. Once again, you simulate an earthquake by bumping or moving the overhead projector (hopefully once again knocking all the dominos down.) This shows that no matter how many organisms are in the population of a given area all will be affected by the earthquake and density does not increase the effect of the earthquake on the population.

When to use:

This is a great way to show the difference between density-dependent and density independent factors that effect populations in an ecology unit.

Demonstrations by Amanda Bauldridge



Senior – Biology

"Invisible Test Tube"

It's a test tube leaning in a beaker of corn oil. The tube is actually "invisible" in the oil! Put any amount of **corn oil** in a beaker. Place three clean Pyrex test tubes into the beaker. Fill one will corn oil, one with water, one with whatever substance (I used yellow die in water so it would look the same as the corn oil). You should see the following: The two without the corn oil will look bent, and the one with the corn oil will be invisible. How come? The index of refraction of the Pyrex tube is virtually the same as that of corn oil and they make the light bend by the same amount so there is no "boundary"" between the tube and oil!

Original Source: http://www.darylscience.com/Demos/InvisibleTT.html

"The Fireproof Balloon"

Balloons are rather fragile things. They need to be kept away from sharp objects and flames. However in this experiment you can hold a flame directly under a balloon without it breaking. Inflate a balloon and tie it shut. In a second balloon fill it (not inflated) with water, and then blow it up about the same size as the first balloon and tie it shut. Hold a match directly under the first balloon. What happens? The balloon breaks. Light another hold it under the second balloon. What happens? It doesn't break.

Why does the balloon with water in it resist breaking in the flame? When water inside the balloon is placed in the flame, the water absorbs most of the heat from the flame. Therefore, neither the air in the balloon, nor the rubber gets hot enough to weaken and break the balloon. Water is good heat absorber. It takes a lot of heat to change the temperature of water.

Original Source: http://scifun.chem.wisc.edu/homeexpts/FIREBALLOON.html

Demonstrations by Brad Burk

Senior – Biology

"Jumping egg"

Scientific principles:

The egg leaped out of the glass due to an updraft of air pressure created by blowing into the cup at an angle. Because of the angle at which you blew into the cup, the air flowing over the egg formed an area of low air pressure, which caused the egg to move upward into the air in the room. The air current from the cup met the air current in the room and caused a low pressure flow, which, in turn, caused the egg to travel downward into the second glass.

Materials:

- Two shot glasses
- One large egg

Procedure:

Place the egg in one of the glass and then place that glass on a smooth surface (table top). Place the second glass next to first leaving little if no space between the two. With great force, blow directly down on the egg and move it from one glass to another.

"Marker on a hoop"

Scientific principle:

This demo illustrates the force of gravity as well as Newton's first second law of motion. The marker is the object at rest that tends to stay at rest. When the hoop is removed, the marker "falls" as the force of gravity takes over. The hoop is the object in motion that tends to stay in motion (forward moving). When this demo does not work, 1) the hoop is pulled too slowly or in a crooked fashion so as to "pull" the marker into a forward motion or 2) the marker or coin is too large or not aligned with the bottle hole.

Materials:

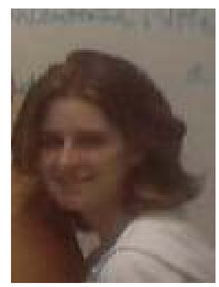
Embroidery hoop
Bottle
A marker or coin that has a smaller diameter than the opening of the bottle

Procedure:

Place the embroidery hoop on the opening of the bottle. Stand the marker or lay the coin on the top of the hoop. (Hint: Align the object so it is placed directly over the opening of the bottle.) Pull (snap!) the hoop away and the marker will drop in the bottle.

Demonstrations by Nikki Smith

Senior – Biology



"Natural Life Jackets"

Materials:

2 oranges, 1 clear container of water

Directions:

Peel one orange ahead of time allowing as much of the peel as possible to remain in one piece.

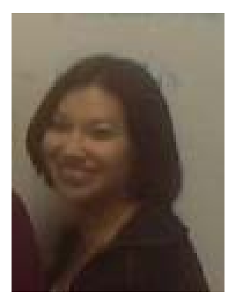
Safety Concerns: None.

Questions:

Does an orange float or sink? Does the peeled fruit float or sink? Does the peel float or sink? What explanations can you offer? Concepts: The fruit is denser than the peel. The air in the peel actually buoys the fruit up. Some people think this is why life jackets are orange.

Demonstrations by Brenna Haley

Senior – Chemistry

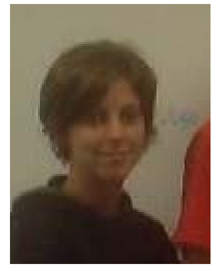


"Frozen Tight"

Put approximately 20g of barium hydroxide [$Ba(OH)_2$ * $8H_2O$] crystals in a 50mL beaker. Add any of the following (ammonium thiocyanate 10g, ammonium chloride 7g, ammonium nitrate 10g). Stir the two solids together with a wooden splint. Place the beaker on a small wooden block with a small pool of water between the beaker and the block. After a few minutes the beaker will freeze to the block.

Demonstrations by Lindsay Eklund

Senior – Biology



"The Collapsing Can "

Materials

1. One empty aluminum can (354 ml)
2. A Hot plate or burner
3. Large bowl of water
4. Tongs to hold pop can

Procedure

1. Put about 5 ml of water in the pop can (just enough to cover the bottom).
2. Heat the can over the hot plate or burner.
3. Let the water boil vigorously.
4. In a single motion, remove the pop can from the burner and INVERT it in the bowl of water.
5. Submerge the opening to the pop can in to the water. The can will IMPLODE instantly.

Questions

1. What was in the can besides water?
2. What happens when water is boiled?
3. What do you think will happen if the can is inverted in the bowl of water?
4. What happens to the air in the can as water vapor is formed?
5. What force is working on the outside of the can?

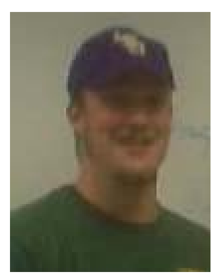
Rationale

Before heating, the can was filled with water and air. By boiling the water, it changes states, from liquid to gas (water vapor). The water vapor (steam) pushes the air that was inside, out of the can. By inverting the can in water, we are cooling the vapor very quickly and constraining the potential for rapid flow of air back into the can. The cooling condenses the water vapor back to water. All of the vapor, which originally took up the interior space of the can, is now turned into a few drops of water, which take up much less space. This causes the pressure to drop and the atmospheric pressure is therefore pushing on the can and crushing it.

The total force working on the outside of the can is the total of the can's surface area in square inches multiplied by atmospheric pressure (about 14.7 pounds/in^2).

Demonstrations by Adam McBride

Senior – Chemistry



"(Safe) Thermite Reaction"

Scientific principles:

-Redox reactions

-energy associated with exothermic reactions

Materials

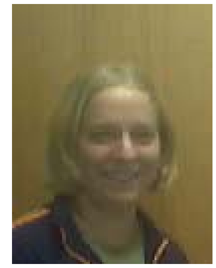
-two rusty iron spheres

-aluminum foil

Procedure

-Bang the two spheres together w/o the foil to demonstrate that nothing happens -wrap the two spheres with the aluminum foil -bang together again, there will be a loud popping noise and (in a darkened room) a visible spark -show the class that at the point of impact, the sphere no longer contains rust and the aluminum has been oxidized.

Demonstrations by Sandra Macklin



Senior Biology

"A Piercing Experience"

Materials:

A 10 or 12 inch balloon for each participant
A bamboo skewer 10 -12 inches long

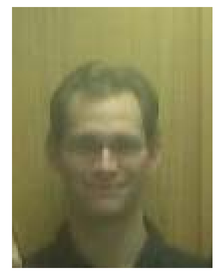
Description:

Inflate a balloon to about 6 inches.
Gently twist and push the skewer through the thick nipple end of the balloon, until it penetrates the surface of the balloon
Continue to twist and push until the skewer penetrates the knot end of the balloon.

Background information:

Balloons are made of thin sheets of rubber latex, which are made from many long intertwined strands of polymer molecules. The rubber is stretchy because of the elasticity of the polymer chains. A sharp, lubricated object (bamboo skewers have a natural lubrication) can be pushed through tie and nipple ends of the balloon because the polymer strands will stretch around it.

Demonstrations by Dash Almedia



Senior Physics

"Fun with angular momentum"

Supplies needed:

filled bicycle tire
string.

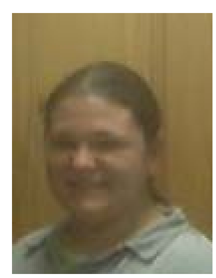
Procedure:

For this demonstration its more about playing with the tire than a structured routine however it is helpful to first play with the tire yourself so you know what does and doesn't work, things you can show are how a top works, or that a spinning tire will rotate not drop when held with one hand.

Background information:

The unusual effects are due to the fact that angular motion involves three dimensional vectors. Angular momentum is a vector along the axle of the tire and gravity produces a torque in the horizontal plane. Since the torque changes the angular momentum, the tire moves in a circle rather than falling down.

Demonstrations by Sarah Larcher



Senior - Biology

"Traffic Light Reaction"

Upon stirring then shaking a solution, you will see the colors of a traffic light!

Directions:

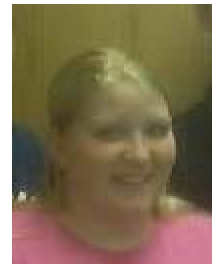
Mix Two Solutions: A=0.6g Dextrose +1g NaOH in 50ml DI water
B=0.1g Indigo carmine indicator in 9.9 ml DI water
Mix A+B in a 250ml Flask with a rubber stopper,

Allow some time for the reaction to settle, it is ready when it is yellow. When it is ready gently swirl the solution and you should get a red color, shake it violently and green color should appear! Upon sitting, the solution will turn back to yellow; this reaction can be repeated for over an hour.

WHY????

Redox reactions (oxidation/reduction) of a chromophore, in this case indigo carmine. The alkaline dextrose reduces the indicator and turns it yellow, swirling adds oxygen and oxidizes the solution to red, shaking oxidizing it even more and turns the solution red. Upon sitting the alkaline dextrose reduces the solution back to yellow.

Demonstrations by Elizabeth Meece



Junior – Elementary Education (Physics)

"Convection Rocket"

Materials Needed:

Scissors
Tea Bags
Matches

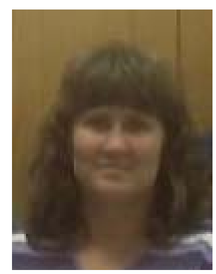
What to do:

Cut off the top off of the tea bag.
Dump the tea leaves.
Open and place the tea bag standing up on a table.
Light the top of the tea bag with a match and watch it go!

Background information:

The burning paper forms a small convection current near the burning paper. Since the air is hot near the paper it rises and carries with it the very light ash of the burned paper.

Demonstrations by Shari Schneider



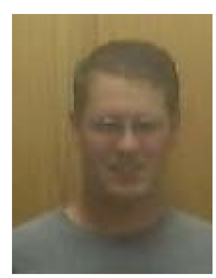
Senior - Chemistry

"Boiling Butane"

Take any kind of butane (I just used a refill bottle for lighters purchased at the hardware store) and place it in a zip-lock baggie. Then just touch the baggie and you will see the butane boil. The sack will begin to fill with butane so you don't want to put too much butane in the baggie otherwise the sack will pop.

This demo can be explain by the fact that butane has such a low boiling point (0.5C) This is also an endothermic reaction because the baggie gets cold because the butane is absorbing the heat. Likewise, when you touch the baggie the butane absorbs the heat from your hand which is higher then the boiling point. Therefore the butane will boil.

Demonstrations by Geoff Hagerman



Senior Chemistry

"Firefly Reaction - Chemiluminesence"

Scientific Principles:

- Chemiluminesence
- Exothermic Reactions
- Energy

Theory: Exothermic reactions yield energy. This energy usually appears in the form of heat, with some reactions producing heat and light. Chemiluminescent reactions produce mostly light energy with little to no heat. Chemiluminescent reactions are responsible for the flashes of light that fireflies produce.

Materials:

- 1L Graduated Cylinder
- 2 500mL Erlenmeyer Flasks
- 1L Distilled Water
- 2.0g Sodium carbonate, Na_2CO_3
- 12.0g Sodium bicarbonate, $NaHCO_3$
- 0.1g Luminol, 3-aminophthalhydrazide
- 0.2g Cupric sulfate pentahydrate, $CuSO_4 \bullet 5H_2O$
- 0.25g Ammonium carbonate monohydrate, $(NH_4)_2CO_3 \bullet H_2O$
- 25mL 3% Hydrogen peroxide, H_2O_2

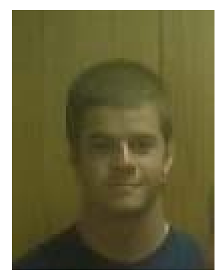
Safety: 3% hydrogen peroxide is very weak, but still an oxidizer and a skin and eye irritant. Always wear goggles when performing chemical work.

Procedure:

1. Prepare the following solutions:
    a. In a 500mL flask, dissolve 2.0g sodium carbonate in approximately 300ml distilled water. Add 0.1g luminol, stir to dissolve. Add 12.0g of sodium bicarbonate, 0.25g of ammonium carbonate and 0.2g and 0.2g of cupric sulfate, stir to form a solution. Dilute to 500mL.
    b. In a 500mL flask, add 25mL of 3% hydrogen peroxide, dilute to 500mL and mix well. Prepare this solution within one hour of performing the demo.
2. Dim the room lights and pour the contents of both flasks simultaneously into the 1L graduated cylinder. The solutions will react and produce a blue glow that persists for about 30 sec.
3. The solution can be disposed of with excess water, down the sink.

Adapted from Flinn Scientific Demo-a-day for high school chemistry.

<u>Demonstrations by Andrew Huntsman</u>



Junior – Physics

"Egg in Bottle"

Materials:

1 hardboiled egg
1 glass bottle with opening slightly smaller than a hardboiled egg
Paper and matches to light the paper

Procedure

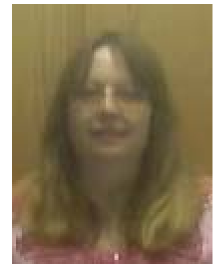
Remove the shell of the hardboiled egg
Light some paper and place in the bottle
Place the egg on the opening of the bottle
Watch the egg get pushed into the bottle

Explanation

The Fire in the bottle heats the air temperature. Placing the egg on the bottle cuts of any oxygen source to the Fire and smothers it. When the fire is out the air in the bottle cools and creates a lower pressure in the bottle than outside the bottle. The higher pressure out side the bottle pushes the egg in the bottle.

Demonstrations by Cynthia Arnett

Additional Baccalaureate – Biology



"Balloon Rocket"

Balloons can be use to demonstrate Newton's third law:
for every action there is an equal and opposite reaction.

Supplies needed:

Balloons (straight balloons work better than other shapes)
Drinking straw
String
Tape

Procedure

Blow up a balloon and hold it without letting air out.
Ask the students what will happen if you let go of the balloon neck while holding the neck.

Most students will answer that the air will come out. Ask them why?
The atmospheric pressure outside the balloon is applying force to the sides of the balloon. The force exerted on the balloon is squeezing the air out. The force of you holding the balloon is preventing it from moving.

Blow up the balloon again. Ask what will happen if you let go of the balloon. They will answer the balloon will fly away. Why? Have two students hold a string taunt across the room. Thread the straw onto the string. Tape the blown up balloon to the straw. Let go. The balloon will travel from one end of the string to the other.

Probe the students with questions about what happened and why.
Why did the balloon move?
Why did the balloon move in the direction it did?
What were the forces involved?
Which of Newton's law apply?

The air pushes against the sides of the balloon, the sides push back. The air is forced out of the balloon the balloon is forced in the opposite direction. Newton's Third law. This is how rockets work.

Variation.

Place the straw with the attached balloon in a bottle to make a bottle rocket.
For more information and variations visit:
http://www.brown.edu/Departments/Swearer_Center/Projects/PSO/Lessons/balloonrockets.htm
http://www.iit.edu/~smile/ph9608.html
http://www.at-bristol.org.uk/Newton/experiment.htm
http://www.intel.com/education/projects/wildride/learning/sciencelabs.htm
http://swift.sonoma.edu/education/newton/newton_3/html/newton3.html
http://www.brown.edu/Departments/Swearer_Center/Projects/PSO/Lessons/balloonrockets.htm

"Fire and Ice"

Supplies:

Sodium Perioxide (Na_2O_2)
Fire proof container
Fuel (shredded paper, sawdust, etc)
Small piece of ice
Fire extinguisher for safety

Caution: Make sure you read the MSDS on Na_2O_2 before using it.
Na_2O_2 is a hazardous substance and must be used properly.

Procedure:

Place the fuel in a pile about 2-3 inches high in the fire proof container.

Sprinkle about ½ teaspoon of Na_2O_2 on the fuel.

Tell the students you want to start a fire and all you have is a piece of ice. Ask them how you could use the ice to start a fire. After discussing it for awhile place the piece of ice on top of the pile. Watch the fire start. Have a fire extinguisher hand in case of mishap.

Discuss what just happened with the students.

What happened?
How did it happen?
What did the Na_2O_2 do?
What reaction occurred?
Was the reaction exothermic or endothermic?
Why was shredded paper or sawdust used instead of a whole piece of paper or wood?

Reaction:

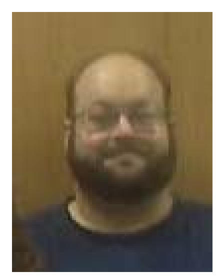
$Na_2O_2 + H_2O \longrightarrow 2NaOH + O + Heat$

As the ice melted the water combined with the sodium peroxide and released atomic oxygen and heat. The atomic oxygen is highly reactive and this and the heat released from the exothermic reaction started the fire. Shredded paper or sawdust was used to increase the surface area and make the fire easier to start.

See "Invitations to Science Inquiry" by Tik Liem for additional information.

Demonstrations by Brooks Williamson

Graduate - Chemistry



Demonstrations by Kimberly Mason

Sophomore – Elementary Education (Physics)