**University of Northern Colorado**
**SCI 441/541**
**Methods of Teaching Secondary Science**
**Fall 1998**
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**The following demonstrations were collected by the**
**secondary science methods class at the University of Northern Colorado**
**during the fall of 1998.**

**Participating students were:**
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**Mary-Anne Richards**
**Alan Nall**
**Joe Mock**
**Tara Moore**
**Cathy Bowles**
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**Andrew Caldwell**
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**Gerry Saunders – Biology**
**Courtney Willis – Physics**
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***We hope you will find these demonstrations and activities useful and enjoyable. However, safety concerns are the sole responsibility of the presenter and the above will not be responsible for Accidents arising from the inappropriate used of these demonstrations.***

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**Jeremy Newman**

**1. OIL SLICK**
**Purpose**- This demonstration is a designed to stimulate student’s thinking on humans’ ecological impact on the environment. It illustrates how an oil spill may not be able to be completely cleaned up. The oil disturbs the barb’s ability to hold the feather together. Even when the oil is cleaned off, barbs do not return to their normal state.
 **Materials**- 1-2 long feathers, motor oil,1 wide beaker, water, soap
 **Action**- The feather is shown to the class. Be sure to show the way the barbs hold the feather together. Dip the feather into a beaker 2/3 full of water. Show that the feather still holds its integrity. Then pour approx. 1 cm of oil on top of the water. Dip the oil into the oil/water mixture. Show that the barbs do not hold the feather together anymore. Wash the feather with soap and water. Then check to see if the barbs hold together. (they shouldn’t)
 **Questions**- Teachers can ask about other affects that an oil spill has on an ecosystem. Are there any ways to prevent human caused disasters? Can students take any action in their communities.

**Jeremy Newman**

 **2. FIELD CAPACITY**
**Purpose**- This demonstration is to show how different textures of soil can hold different amounts of water. Soil texture directly affects what can grow on top of it.
**Materials** 2-3 different soil textures (dry), Pots for each soil texture (with holes in bottom, Water, 1 liter flask.
 **Action**- Each soil is put into a separate pot and lightly packed down. Water is slowly poured over each of the soils. When the water runs through the bottom, stop immediately. Measure the amount of water that was added to each sample.
**Questions**- Teachers can ask about the relation of surface area to texture. What do students think can grow on each of the soils? What type of soil is in their areas? Discussion can also lead to the affects of "Fat Clays" such as betonite on the foundations of houses.

**Jacque Hill**

**3. THE COLLAPSING CAN**
**Purpose:** To demonstrate the effects of air pressure differences on an aluminum can
**Materials:** A clean pop can (not a large mouthed can like Mountain Dew) \*\* the best can for this is a Ruby Red Squirt pop can or a can made of thin aluminum., One Tablespoon of water, Hot plate, Clear pan filled with cold tap water, Hot pad, gloves, or tongs
**Methods:** Place one tablespoon of water in the empty pop can. Put the pop can directly on the hot plate. Allow the water to come to a boil (steam should be rising from the mouth of the can). Don’t boil for too long or the paint on the can will begin to melt. Once the water has boiled for about 15 to 30 seconds (listen for a popping sound), quickly turn the can upside down into the pan of cold water using a hot pad or tongs. The can should collapse with a "pop" sound due to the difference in pressures. The pressure difference is due to the steam from the boiling water pushing the air out of the can. When the can is put upside down into the cool water, the steam condenses which quickly decreases the pressure within the can. The air pressure on the exterior of the can will now be greater than that within the can and the can will collapse.

**Jacque Hill**

**4. THE EGG TRICK**
**Purpose:** To demonstrate the differences of air pressure on the system (this could be used in a lesson explaining how lungs work).
**Materials:** Large egg (hard boiled),Large mouthed jar (an Oceanspray juice jar is great for this), Paper (2 or 3 tissues or lens papers work best), Matches
**Methods:** Place a small pile of paper into the bottom of the clean jar. Twist another piece into a wick. Light the wick and as soon as it starts to burn tip the jar sideways and ignite the paper in the bottle (the hotter the fire, the better the results). Once the fire gets going (be sure not to wait too long so that it doesn’t use up all of the oxygen in the bottle), quickly place the hard boiled egg over the opening of the jar with the pointy end of the egg facing into the jar. The egg will be pushed down into the jar due to a difference in pressures. When the paper is lit within the jar, the air expands because it is heated and is pushed out of the jar. After the egg is placed on the jar, the fire goes out and the air inside the jar cools. Cooler air will condense in the bottle and the air pressure will decrease. Because the pressure inside the bottle is less than that outside of the bottle, the egg is forced in.
\*\* For a more dramatic effect, place the bottle into a tub of ice water after the egg is placed on top. The quick cooling of the air will cause the egg to be pushed down into the bottle with more force and at a quicker speed.

**Carrie Alexander**

**5. HOW DID SCIENCTISTS DISCOVER ATOMIC STRUCTURE?**
Take small toys that have some detail on them and place them, each in a bag. Get students into groups of three, and assign each student a role. One student will be the feeler, another student the recorder, and the third student will be the artist. The first student places his/her hand in the bag and feels around, while they are doing this they verbally describe what they are feeling. The reporter writes down the descriptions. Last, the artist draws their rendition of what the object in the bag looks like. This exercise demonstrates how scientists had to work together in order to discover atomic structure or anything that is smaller than the human eye can detect or things too large for one person to study. Students can use this demonstration to help understand the scientific process and understand why it is so important to work cooperatively.

**Mary-Anne Richards**

**6. THE NATURE OF BONES**
The objective behind this demo is to help students understand that it is the combination of soft connective tissue and mineral matrix that allow bones to function so well in support and movement.
**Materials**: Vinegar, Jar, Chicken or turkey bones (cleaned), Bar-b-Que. grill
**What to do:** Place some of the bone in the jar and cover with vinegar. Let the mixture sit for about one week. This will remove the minerals from the bones and leave only the soft connective tissues.
     The remaining bones place on the grill and bake until they are blackened. The high temperature cooking will denature the soft connective tissue and leave only the mineral matrix. Or if you are daring burn the bone in front of the students, in well ventilated area.
 **What happens:** The demonstration on bones starts with a general questioning of what bones are made of, and their function in the body. An intact bone can be used with the question/group discussion on the nature of bones. Then remove one of the demineralized bones and ask why the bone bends so much, and ask the possible causes of this flexible bone. The next step is the crumble one of the burnt bones. You can pass around the bits and ask the texture of the bits. Then ask the possible cause of this change in the bone.

**Mary-Anne Richards**

**7. GLACIER MELT**
**You need:** A small cup or yogurt container piece of board, to make an incline, Sand hammer and nail, Small rocks or pebbles thick rubber band, Water watch, Freezer
**Advanced preparation:** Place a one-inch layer of sand and gravel in the cup, followed by a few inches of water. Place it in the freezer. When frozen solid, repeat the process, adding sand and gravel, and some water. Then freeze. The cup should be filled to the top.
     Next, carefully hammer a nail partway into the middle of one end of the board. Place that end against something immovable to form an incline or slant. Now you are ready.
     An alternative to the large rubber band and top nail in very short picture frame nails in the area the glacier will sit. The nails will provide a rough texture to impale the ice on so it will not slide down the slope. The rubber band will not be needed, allowing a clear view of all sides of the melting ice and falling rocks.
**What to do for the students:** With the board flat- Spray the area below the glacier location and put some fine sand (I suggest bird gravel and grit). The sand will provide a surface for the water runoff to form an alluvial fan. If darker dirt was used in making the glacier you will observe the glacial runoff pattern against the lighter sand.

**IT IS BEST TO DO THIS OUTSIDE OR OVER A SINK OR DIP-PAN**

     Remove your model glacier from the freezer. Warm the sides of the container under warm tap water just enough to get your model glacier to slide out when tapped. With the rock/and-side down, place the glacier at the top of the incline and fasten the rubber band around its middle and around the nail. Now place your board at a slight incline, and brace to prevent board slippage. How long will it take your glacier to melt, move and leave rock and sand deposits? Time it
 **What happens:** As the glacier melts rock and sand deposits will fall off in clumps, some will slide down the board, while other separate bits and pieces will form along the board surface in strange patterns, much like moraine or glacial matter.

**Rachel Cooper**

**8. AN EXOTHERMIC REACTION**
**Grade level:** General Chemistry - Junior-Senior level
**Standards related to topic:** This demonstration relates to Standard 2.1,2.2 and 2.3. It show that the matter involved has characteristic properties and that the reaction taking place are a result or the composition and structure. They will also see how the energy of the system can be changed into heat.
**Chemical Reaction.**
**Materials - cost $5 to $8 dollars** Thermometer, A jar and lid ,. A Steel wool Pad,. Vinegar
**Time:** 25 minutes
**Experiment**
**1.** Put the thermometer inside the jar and put the lid on it. Wait five minutes.
**2.** Remove the thermometer from the jar. Record the temperature.
**3.** Pour the vinegar over the steel wool and let set for one minute. Squeeze out the excess vinegar. Then place the steel wool over the bulb of the thermometer and place back into the jar, put on the lid.
**4.** Wait 5 minutes.
**5.** Now take the temperature.
**Science behind the reaction:** This is a classic example of oxidation. The steel wool is being oxidized by the vinegar. This reaction gives off energy in the form of heat.

**Rachel Cooper**

**9. DEMONSTRATE THE GASES PRODUCED IN CHEMICAL REACTIONS**
**Grade level:** General Chemistry- Junior-Senior level.
**Standard:** The standards covered by this demonstration are 2.1, 2.2 and 2.3. This will show the students that interactions can produce changes in a system.
**Home made fire extinguisher**
**Materials – cost $8 - $15** Small dish, 1 or 2 candles (of different heights), Large metal bowl, Baking soda approx. 1/4 cup, Vinegar approx. 2 cups
**Preparation**
**1.** Put the baking soda on the small dish.
**2.** Place the candles on the small dish, in the baking soda.
**3.** Place the small dish with the candles on it into the large metal bowel.
**Experiment**
**1.** Light the candles.
**2.** Then pour the vinegar onto the baking soda, DO NOT get the candles wet.
**Safety tips:** Be careful of the fire and do not let the vinegar and baking soda reaction get out of hand.
**Science behind the demonstration:** The reaction between the baking soda and vinegar gives off Carbon dioxide. As the CO2 rises, it consumes the Oxygen and put out the fire in the shorter candle. As the heavier CO2 rises even more it will extinguish the taller candle.

**Jennifer Mathews**

**10. ENZYME ACTIVITY**
**Purpose:** Allows student to see an enzyme working
**Grade Level:** 9-12
**Colorado Standard:** 3.0 (3.2, 3.3)
**Materials:** potato (or liver), hydrogen peroxide, test tube
**Directions:** Fill a test tube about 3cm with hydrogen peroxide
                    Add 1cc of macerated potato or liver
                    The students should see bubbling.
**Why? (science behind the experiment)** Because an enzyme in the potato catalyzes the breakdown of the hydrogen peroxide, producing bubbles. The hydrogen peroxide breaks down to water and oxygen.
**Supplemental Activity:** To prove that the gas is really oxygen an indicator can be used. A smoldering piece of wood will also work. Put the end, which is still smoldering in the top of the test tube. The flame should reignite.
     This demonstration would be useful in a lecture about enzymes. Specifically what they are, what they do, denaturation, and shape.
**Safety:** If you decide to use a flame to test for oxygen gas, make sure you have a fire extinguisher present

**Jennifer Mathews**

**11. VISULATION OF pH**
**Grade Level:** 9-12
**Colorado Standard:** 3.0
**Materials:** Galaxy Gold paper from Kinkos, Windex, vinegar/lemon juice
**Directions:** Office supply stores and Kinko’s copy centers sell a type of paper called Astrobrights&trade; Galaxy Gold. It’s "goldenrod" in color, sort of a yellow/orange. Big deal! However, if ALKALINE SUBSTANCES HIT IT, IT TURNS MAGENTA! Spray it with Windex, and it instantly turns bright red! Cool!!
     Astrobrights Galaxy Gold paper is the worlds’ largest acid/base indicator strip. Dip it in a base solution (like ammonia cleaner, baking soda in water, etc.) and it turns bright red. Dip it in acid (vinegar, lemon juice, etc.) and it turns yellow again.
     The fact that an 8.5 x 11 sheet of goldenrod is enormously larger than your typical acid/base test strip makes numerous classroom demonstrations possible that never could be done before.
     This demonstration would be useful when talking about pH and cells. I would also talk about buffers and living organisms.
(William J.Beaty, 1996)

**Jennie A. Lundgren**

**12. THE IMPORTANCE OF CEREBROSPINAL FLUID TO THE HUMAN BRAIN!**
**Purpose:** To demonstrate the importance of Cerebrospinal fluid to the human brain.
**Grade Level:** This demonstration is applicable for second grade through twelfth grade. Because this activity can be used to spawn many discussions and topics about the human brain from simple to complex it can be used in all of these grade levels and many different classes. It would fit easily into human biology, physical education, health, and family living classes.
**Colorado Model Content Standard for Science Applicability: Standard 3.3** "Students know and understand how the human body functions, factors that influence its structures and functions, and how these structures and functions compare with those of other organisms." Is directly addressed in this demonstration since this demonstration directly shows how important cerebrospinal fluid is to the brain.
**Materials:** unbroken raw eggs, a clear plastic or glass container that will hold approximately 2-3 cups of liquid with a lid that will not leak when the container is shaken with liquid in it (a jar or Tupperware), a pitcher with tap water in it
**Directions:**
        1. Have available a number of unbroken raw eggs, the container with lid, and a pitcher with water in it.
        2. Explain to the students that the egg is representative of the human brain, the container with the lid is representative of the skull, and the water is representative of the cerebrospinal fluid which surrounds the human brain.
        3. Place one unbroken raw egg carefully into the container.
        4. Pour the water from the pitcher into the container. Be careful not to break the egg. Fill the container to the brim with water (This is important! You do not want air bubbles after you put the lid on)
        5. Ask the students to note how the egg rises as you pour in water. And how it seems to be lighter when supported by the water.
        6. Place the lid on the container and seal it. Make sure the lid is secure.
        7. Shake the container with the egg and water in it. Ask your students to note how the egg fared from the shaking.
**Optional:**
        1. Shake the container with the egg in it but no water as a contrast to shaking it when full of water.
        2. Show how the amount of water in the container affects the cracking of the egg by pouring some out or adding more which would increase the pressure on the egg.
        2. If it is a non-breakable container with a secure lid, drop the container with the egg to show how a sudden impact might affect the brain differently than shaking.
        3. Shake the container with the egg and water in it for different amounts of time to see how the egg/human brain fares after certain time period.
**Note:**
        A. The egg will almost always break if shaken long enough.
        B. Before performing this experiment try it out with the container you plan to use.
**Safety:** Precautions must be taken so that if the egg does break students do not ingest the raw egg purposefully or accidentally by touching it and then touching their mouths. The water should be kept off of the floor or promptly wiped up so no falling accidents will occur. Lastly, if the container (glass) should break the demonstrator should quickly and safely clean up the broken glass without student intervention.
**Science:** In an adult human skull there is at any one time 125-150 ml of cerebrospinal fluid and 150-180 mm water pressure. Four hundred to 500 ml of cerebrospinal fluid are produced daily since the fluid constantly leaves the brain with waste products. The cerebrospinal fluid of the human brain has four purposes; To distribute hormones to the appropriate part of the brain, to wash the brain and excrete the waste products, to buoy the brain up, and lastly to protect the brain. This demonstration deals mainly with the last two purposes, buoying the brain and protection.
        Step 5 illustrates the buoying effect. The human brain weighs 1300 g, however with the support of the cerebrospinal fluid its weight is reduced to 50 g.
        The next purpose demonstrated is the protection that cerebrospinal gives the brain as represented by the water and egg. This is especially effective if option A. is also demonstrated. However, the cerebrospinal fluid cushions our brains through our daily movements, even such rough times as riding a roller coaster or jumping up and down. If a violent hit or thrash occurs the cerebrospinal fluid will offer no protection and the brain will hit the skull and result in a concussion. A concussion bruises the brain and a large enough bruise or bruises can cause death or serious brain damage. Thus it makes sense to protect our head in risky situations by wearing a helmet which adds another layer of cushioning.
        The shaking of the egg in step 7 and option D. directly shows the affect on the brain of an infant who has been shaken. A baby who has been shaken is said to have Shaken Baby Syndrome which can cause brain damage leading to mental retardation, speech and learning disabilities, paralysis, seizures, hearing loss, or death. There are approximately 50,000 cases yearly of Shaken Baby Syndrome in the United States. Because a baby’s brain is underdeveloped a concussion occurs easier and with more serious consequences than an adult concussion. The undeveloped blood vessels on the outside of the brain are also very likely to tear which in turn causes blood to pool in the skull.
        One concept, which is demonstrated in option B, is the accumulation of cerebrospinal fluid in the skull resulting in additional pressure on the brain. This congenital disease is called Hydrocephalus. Normally cerebrospinal fluid is absorbed into the bloodstream in a one way direction away from the skull. In persons with hydrocephalus the fluid is not absorbed and accumulates, thus building up pressure in the skull. There are many causes of it including; spinal bifida, hemorrhage, meningitis, head trauma, tumors and cysts. It can be treated by a one way shunt which directs excess cerebrospinal fluid into the abdomen on heart chamber where it is absorbed with no problem. Untreated, hydrocephalus can cause physical, developmental and visual disabilities.
**Sources:** Silvia Helena Cardosa, PhD; Center for Biomedical Informatics; State Universtiy of Campinas, Brazil
Hydrocephalus Association; 8707 Market Street, Suite 955;San Francisco, CA 94102; (415) 732-7040
Shaken Baby Fact Sheet;http://www.biausa.org/shakenbaby.htm
Sports & Concussion Safety: http://www.biausa.org/sportsfs.htm

**Deanna Schrock**

**13. BALLOON RACES**
**Topic:** How temperature affects molecular movement, thus causing reactions.
**Purpose:** To investigate how temperature affects the rate of a reaction.
**Grade** Levels: 9-12
**Standards:** 2.1 - Students know that matter has characteristic properties, which are related to its composition and structure, using word and chemical equations; 2.2 – Energy appears in different forms, can be transferred, and transformed; 2.3 - Interactions can produce changes in a system, yet total quantities of matter and energy remain unchanged.
**Materials:** 3 medium-sized balloons; 3-250 mL Erlenmeyer Flasks; 15 g Sodium Bicarbonate (NaHCO31 (or 4 Alka Seltzer tablets crushed with a mortar and pestle); 90 mL Distilled Water; Ice Bath; 3 Thermometers; Hot Plate; Scoopula; Stopwatches; Balance; 50 mL Graduated Cylinder; I Long-stem Funnel
 **Directions:** (5-10 min)

1 . Stretch out 3 medium-sized balloons by inflating them and then releasing the air about 5 times. This promotes inflation during the reaction. NOTE: Make sure the balloons will fit over the flasks.
2. Measure 3 separate 5 g samples of sodium bicarbonate and pour into each of the 3 balloons. Be careful not to drop any of the NaHCO3 into the flasks at this time.
3. Pour 30 mL of distilled water into the three flasks, then do the following:
    A. Cool the first flask to 0 to 5 degrees Celsius.
    B. Leave the second flask at room temperature.
    C. Heat the third flask to 85 to 90 degrees Celsius with a hot plate.
4. Ask for 3 volunteers, who will place a balloon over one of the flasks. Do not allow the sodium bicarbonate to drop into the flask at this time. While the balloons are being attached to the flasks, have the class record the temperatures.
5. Each volunteer will simultaneously shake the sodium bicarbonate from each balloon into the flask. Observe.
6. Have timers in the room record the rates at which the balloons inflate. Stop the watches when the gas stops bubbling in the flasks. Graph Temperature vs. Time.
7. Pour the solution waste down the drain, flushing with copious amounts of water.

**Hazards:** Wear goggles.
**Science Behind the Demo:** In order for reactions to occur, two things need to happen. First, the molecules have to hit each other with a certain amount of energy. Second, the molecules have to hit each other at the correct angle. If both of these criteria are not met, the reaction may not occur. When heating any reaction, the amount of energy increases in the molecules, causing the molecules to speed up. This will cause the molecules to collide with each other at a more frequent rate, thus increasing the chances that the molecules will collide with each other with the correct amount of energy and at the correct angle.

**Deanna Schrock**

**14. BLOWING UP A BALLOON IN A FLASK**
**Topic:** Air Pressure
**Purpose:** To demonstrate air pressure by observing the properties of gases in the air when heated.
**Grade Levels: 9-12**
**Standards:** 2.1 - Students know that matter has characteristic properties, which are related to its composition and structure, using word and chemical equations; 2.2 – Energy appears in different forms, can be transferred, and transformed; 2.3 - Interactions can produce changes in a system, yet total quantities of matter and energy remain unchanged.
**Materials:** 8-inch balloons, 1-500 ml Florence Flask, Tongs (or gloves) for holding the flask Hot Plate, Water, Graduated Cylinder
**Directions: (15-30 min)**

1 . Place 10 mL of water into the 500 mL flask and heat the water until almost all of it is boiled off.
2. Remove the flask from the heat and place a balloon over the top of the flask as soon as the water stops boiling.
3 Place the flask into a container of cool water.
4. Observe the results. The flask should be cool enough to handle so that students can observe the balloon is filled, but the opening at the top of the balloon is still not tied.
5 Ask the students how to get the balloon out of the flask (reheat the flask).
6. Materials may be reused.

**Hazards:** Wear safety goggles, use tongs (or gloves) for holding the flask.
**Science Behind the Demo:** Heating the water in the flask causes the molecules to spread out so that eventually the water becomes water vapor. When the water is no longer heated, these water vapor molecules condense and return to their liquid condition, leaving an area void of any molecules. This lack of molecules creates a vacuum which is immediately filled by air from the outside of the flask., thus filling the balloon inside the flask.

**Alan Nall**

**15. NEWTONIAN HEADGEAR**
**Scientific Principle:** This demonstration can be used to demonstrate Newton's first law: Objects at rest tend to stay at rest, objects in motion tend to stay in motion.
**Preparation:** Headgear is formed from a coat hanger that has been bent into two C's that are joined in the middle. A mass is placed on either end. The mass could be two colors of clay. It is important that the two masses are below the point at which the headgear contacts the head. This is important because it improves the balance of the system.
**Demonstration:** To demonstrate, place the apparatus on top of the demonstrator's head. Have the demonstrator quickly turn ninety degrees in either direction. The balls of clay will remain motionless. A discussion can then follow on why the balls do not move with the demonstrator.


**Alan Nall**

**16. CONVECTION AMONG FRIENDS**
**Scientific Principle:** This demonstration is helpful in demonstrating how heat energy moves from one mass to another through convection.
**Demonstration:** Have the audience form groups of two. Next, have one member of each group hold their hands out with their palms facing up. The other group member then places their hands with palm down over their partner’s hands. Have the partners slowly move their hands closer together and farther apart. The partners should be able to notice a temperature difference. If the students do not notice a difference, have one of the partners rub their hands together briskly to generate extra heat. The magnitude of felt difference should also increase, as the hands become closer together.
**Further:** Conduction can also be quickly demonstrated by having the partners touch hands.

**Suzanna Percy**

**17. IS SAMMY ALIVE?**
**Objective:** Students will understand the scientific definition and the characteristics of life; moreover, they may explore characteristics of a quality life.
**Materials:** The Sammy Story; An open, exploring, inquisitive mind
**Procedure:**
1. Begin reading the "Is Sammy Alive?" story.
2. Whenever the story asks "Is Sammy Alive?" stop and ask the students their opinion. Students should be able to justify their answers.
3. At the end of the story, discuss Life based on the science definition.
**The Stage**
Sammy was a normal, healthy boy. There was nothing in his life to indicate that he was anything different from anyone else. When he completed high school, he obtained a job in a factory, operating a machine press. On this job he had an accident and lost his hand. It was replaced with an artificial hand that looked and operated almost like a real one.
*Is Sammy Alive?*
 Soon afterward, Sammy developed a severe intestinal difficulty, and a large portion of his lower intestine had to be removed. It was replaced with an elastic silicon tube.
*Is Sammy Alive?*
 Everything looked good for Sammy until he was involved in a serious car accident. Both of his legs and his good arm were crushed and had to be amputated. He also lost an ear. Artificial legs enabled Sammy to walk again, and an artificial arm replaced the real arm. Plastic surgery enabled doctors to rebuild the ear.
*Is Sammy Alive?*
 Over the next several years, Sammy was plagued with internal disorders. First, he had to have an operation to remove his aorta and replace it with a synthetic vessel. Next, he developed a kidney malfunction, and the only way he could survive was to use a kidney dialysis machine (no donor was found for a kidney transplant). Later, his digestive system became cancerous and was removed. He received nourishment intravenously. Finally, his heart failed. Luckily for Sammy, a donor heart was available, and he had a heart transplant.
*Is Sammy Alive?*
 It was now obvious that Sammy had become a medical phenomenon. He had artificial limbs, nourishment was supplied to him through his veins; therefore he had no solid wastes. All waste material was removed by the kidney dialysis machine. The heart that pumped his blood to carry oxygen and food to his cells was not his original heart. But Sammy's transplanted heart began to fail. He was immediately placed on a heart-lung machine. This supplied oxygen and removed carbon dioxide from his blood, and it circulated blood through his body.
*Is Sammy Alive?*
 The doctors consulted bioengineers about Sammy. Because almost all of his life sustaining functions were being carried on by machine, it might be possible to compress all of these machines into one mobile unit, which would be controlled by electrical impulses from Sammy's brain. This unit would be equipped with mechanical arms to enable him to perform manipulative tasks. A mechanism to create a flow of air over his vocal cords might enable him to speak. To do all this, they would have to amputate at the neck and attach his head to the machine, which would then supply all nutrients to his brain. Sammy consented, and the operation was successfully performed.
*Is Sammy Alive?*
 Sammy functioned well for a few years. However, a slow deterioration of his brain cells was observed and was diagnosed as terminal. So the medical team that had developed around Sammy began to program his brain. A miniature computer was developed: it could be housed in a machine that was humanlike in appearance, movement, and mannerisms. As the computer was installed, Sammy's brain cells completely deteriorated. Sammy was once again able to leave the hospital with complete assurance that he would not return with biological illness.
*Is Sammy Alive?*
 The End

 If Sammy is not alive at the story's end, exactly when did Sammy stop being alive?
**Questions:**
1. What are the characteristics of life?
2. Does life entail a quality life?
3. Is there a difference between living and life?
 **Standard:** 3. 1: Students know and understand the characteristics of living things, the diversity of life, and how living things interact with each other and with their environment.
**Works Cited** Biology Class Demonstrations: http://pc65.frontier.osrhe.edu/hs/science/demobio.htm

**Suzanna Percy**

**18. SPREAD OF DISEASE**
**Objective:** The students will understand and conceptualize how disease can rapidly spread through a population in epidemic form, and they will know key terminology about this issue: carrier, symptoms, pathogen, STD, and transmission.
**Introduction:** A disease spreads most rapidly and dangerously when a carrier, someone who can spread the disease, has yet to show symptoms of the disease and makes a few contacts. This lab will demonstrate how fast disease can spread with just a few contacts, or transmissions. By keeping track of the contacts, the original carrier can be identified through an elimination process.
**Materials:** Clear cups (# in class), Distilled Water, I% NAOH, phenolphthalein, pipette for indicator
**Procedure:**
                    1 . A population is started by each student acquiring a 1/4cup of distilled water (already filled). One person is infected; their cup contains the 1% NAOH.
                    2. Sexual contact is determined by combining the solutions into one cup. After the cups are mixed, each partner takes 1/2 the solution back. Each person will leave the contact with the same amount of fluid.
                    3. Only a few contacts are needed (3) for the point to be made. The teacher is encouraged to do the experiment several times with differing contact numbers.
                    4. When done, everyone will add 3 drops of indicator.
                    5. If your cup turns pink, you have been infected.
    \*\*This demonstration shows vast spread of disease in minimal contacts.
**Be Aware:**· NAOH can cause skin bums; a highly diluted solution is all you need.
                    · If the pH rises above pH IO, phenolphthalein will not indicate a basic solution (turn pink).
**Questions:** 1. How does this demonstration show the impact of disease carriers and the dormancy of certain diseases?
                    2. How can epidemics effect society?
                    3. How can a society's values and culture effect epidemics?
**Standard: 3. 1:** Students know and understand the characteristics of living things, the diversity of life, and how living things interact with each other and with their environment.

**Tara Moore**

**19. BALLOON LUNG**
**Topic Area:** Human Respiratory System
**Purpose:** To show students how volume and air pressure play a role in the inflation and deflation of the lungs (breathing)
**Grade Level:** Introductory Biology Class (freshman) or Human Anatomy and Physiology (sophomore-senior)
**Standards Covered:** Standard 3.3---introduces the idea of how the human body functions and the factors involved
**Materials**: plastic cup, 1 small balloon, 1 large balloon, straw, silly putty, rubber band
**Directions**

1. Cut a hole the size of a straw in the bottom of the plastic cup
2. Cut the straw in half and insert into the hole in the cup about half way
3. Slip the small balloon over the end of the straw within the plastic cup
4. Put a rubber band around the end of the balloon to hold it snug to the straw
5. Cut the large balloon in half and stretch the tied end around the open end of the cup
6. Mold an ample amount of silly putty around the straw to seal all holes around the plastic cup
7. To make work, pull down on the balloon attached to the bottom of the cup and watch the inner balloon fill with air
8. Return the bottom balloon to original position and watch the inner balloon deflate

 **Science behind what is happening**: The large balloon in this demonstration is used as the diaphragm. When the diaphragm is pushed downward, it creates a pressure gradient. The volume increases in the lung cavity (cup) causing less pressure in the cavity compared to the atmospheric pressure. This gradient causes air to rush in through the straw (trachea) and inflate the lung (small balloon). When the diaphragm returns to its original position the opposite happens. Volume decreases in the lung cavity causing more pressure in the lung than there is outside (atmospheric pressure). Finally, air rushes out of the lung (exhalation) and deflates the lung.


**Erinn Boyle**

**20. FERMENTATION TUBE**
**Materials:** Test tube ,Test tube rack, Bent glass tube, Rubber stopper with hole, Yeast, Glucose solution, Food coloring
**Purpose** This experiment is a visual that can really help students to better comprehend fermentation and basic cell- physiology. It utilizes materials found in every science class room and is a simple and rapid experiment. The CO2 produced by the yeast as a bi-product of fermentation will force the drop of food coloring to move outward and eventually out of the bent glass tube because the environment with the closed tube has a greater concentration of the gas than the outside. This can also be a demonstration of movement of free energy. High School level.
**Directions**

1. Put test tube in test tube rack
2. Warm glucose solution to about 400 Celsius
3. Put glucose in test tube
4. Add yeast to glucose solution
5. Mix the yeast/glucose mixture
6. Put the rubber cap with the bent glass rod on top of the test tube
7. Add a drop of food coloring to the tip of the bent glass tube and let it run back to near the rubber cap
8. Watch as the CO2 pushes the food coloring out of the tube

**Safety Issues** This is really not a toxic lab. The food coloring can stain skin and clothes, so watch out for that. Also, don’t ever put a rubber lid without a hole on top of the tube with the fermenting ingredients. This could cause an explosion.
**Something Went Wrong?** One area where it is easy to go wrong is the temperature of the water. The closer the temperature to the ideal for the enzymes involved, the faster the reaction will proceed. This is also a good lesson in rate of reaction if you vary the temperature of the glucose solution.
     Another area is age of yeast. If your yeast has been in the cupboard too long, this experiment may not work at all.
     One more idea is that this reaction occurs in a fairly short period of time. All parts must be completed in rapid succession.


**Erinn Boyle**

**21. FERMENTATION BREAD**
**Materials:** ¾ T Yeast, 2-3 C Flour, ½ T Table Sugar, 1 C Warm Water, Mixing Bowl, Large Sandwich Bag, 1 T Olive Oil,
OPTIONAL: Oven, Tomato Sauce, Mushrooms, Mozzarella Cheese, Pepperoni
**Purpose:** This is a great visual for teachers who are trying to get students to understand fermentation and what occurs. It is not a scientific, completely revealing lab, but it is a great visual lab that shows students what happens to bread as yeast divide and release CO2. It is also fun, because if you have a home economics room or any room with an oven of any kind, you can continue the lab and make pizza for all. It could be a reward that begins a new unit on cell physiology for good performance in a previous unit
**Level** This lab can be performed by students of any level from about 6th grade on. It is a fun lab that allows students to learn about science through association.
**Directions**

1. Mix warm water with table sugar until it dissolves.
2. Add yeast to mixture and mix
3. Wait 5 minutes for the yeast to begin fermentation
4. Add all other ingredients to mixture and kneed the bread for 5 minutes. (this is very active—students like the physical nature of this part).
5. Ask students to describe the bread (measure it and roughly figure out area and tell about consistency)
6. Put bread into plastic bag and place it underneath the bowl you used for mixing
7. Wait 30 minutes (in the mean-time you could ask students, depending on their level, about their expectations and how they formed their expectations. A short lecture on fermentation could be useful as well
8. Take bread out from underneath bowl and ask students to again make observations about the bread and the changes it went through. Ask them why they think it changed.
9. (optional) Roll out bread as pizza and add toppings.
10. Bake at 4250 F If possible, have students make observations through the oven door window (DON’T open door!) and have them make observations of what happens to bread.
11. EAT! While consuming, ask students why the bread stopped rising in the oven. This can begin discussion of enzymes…etc.

 **Something Went Wrong?**

1. The bag should be sealed…as little oxygen as possible should be in the environment in order for the bread to rise.
2. Old yeast?
3. Warm Enough Water?
4. Kneeded Enough?

**Erinn Boyle**

**22. CHROMOTOGRAPHY**
**Materials List:** Chromotography paper, Water, Test tube, Test tube cap with paper holder, Water soluble markers
**Purpose:** This lab can be used to teach students about pigments in plants and it can be used to teach students about proteins and molecular structure. Chromotography is most often done in the lab to determine pigments in leaves, but it takes time to find leaves (especially in the winter), make extracts of them and wait for the pigments to separate out. This lab substitutes markers for leaves and proceeds very rapidly (~10 minutes). It pertains to proteins as the lightest molecules will travel the furthest on the paper. You could talk about primary, secondary, tertiary and quaternary structure. Finally, this can be a lab to introduce students to PCR and genetics, which also proceeds along the idea that heaviest molecules (in DNA) travel slower.
 **Directions**

1. Fill test tube with 1" water
2. In one space, put the dots of as many colors as desired. This space should be 1 ½ inches above the bottom of the chromotography or filter paper.
3. Clip paper to lid of test tube and close the system.
4. Wait 10 minutes and see how colors have moved up the paper (by capillary action). Yellow will move the farthest. Ask students why

**Something Went Wrong?**

1. Make sure that the marker on the paper is never touching the water. This will color the water and ruin the experiment.
2. Are your markers water-soluble?
3. Make sure to wait long enough
4. Did you use FILTER or CHROMOTOGRAPHY paper?

 **Level** This is a fun inquiry-based experiment that works best with students who understand basic biology and chemistry.


**Andy Caldwell**

**23. IMPACT CRATERS: NOT JUST HOLES IN THE GROUND**
**Purpose:** To demonstrate the process by which impact craters are formed, and the morphology of the structures.
**Standard:** 4. 1, Bullet 3, Using evidence to investigate how Earth has changed or remained constant over short and long periods of time.
**Procedure:** Set out needed supplies.

· Fill a large tray with about 1/2" of white flour.
· Cover that layer with a thin layer of brown flour, just enough to cover the white layer.
· Cover the brown layer with just enough flour to hide it.
· Provide students with several different objects to drop into the flour.
    They don't need to be round.
    Students can measure the mass of the objects and calculate the Kinetic Energy of the impacts.
· Have students drop the objects from various heights to create craters.

**Questions:** · How is this experiment similar to how a real crater forms?
                        How is it different?
                    · What are the various parts of the crater called?
                        How could you tell?
                    · How is the flour like statagraphic layers on Earth?
                    · What happened to the stratrigraphy when it was impacted? \* What does this tell us about finding ancient craters?

**Andy Caldwell**

**24. LOOKING FOR LIFE ON MARS**
**Purpose:**To demonstrate a similar procedure to the one used by the Viking spacecraft when it looked for life on Mars in 1976.
**Standard:** 4.4, Bullet 5, Identifying and describing the everyday impact of recent space technology.
**Procedure:** Set out needed supplies.

· Fill three cups about 1/4 full of sand, or sandy soil.
· Add 1/2 tsp. of sugar to each of the cups.
· In one cup, place a crushed alka-seltzer tablet.
· In one other cup, pour 5-ml of dry yeast.
· Add hot tap water to each of the cups. 9 Monitor results

**Questions:** ·How is this experiment like the one Viking performed?
                       How is it different?
                    · Which of the cups contained life?
                       How could you tell?
                    · How long did it take for one of the samples to show that life existed in it?
                    · How could this demonstration be made more realistic?
                    · What does this tell us about finding life on Mars?

**Catherine Bowles**

**25. MAKING A SILLY-PUTTY LIKE MATERIAL**
**Materials:** Elmer’s All-Purpose Glue, Stirring Rod (plastic or wooden), Borax (Boraxo Hand Soap can be used), Food coloring, Water, Paper towel, Cups (Plastic or Paper)
**Pre-experiment preparation**- Make a saturated solution of Borax and water. Just add the Borax to the water until no more dissolves.
**Recommended:**

* Use paper cups with 20 ml marks to save time in measurement. When mixing the Borax with the glue mixture, to allow the audience to see more, do so in a clear plastic cup.
* Use a plastic spoonful of Borax solution it is thoroughly equivalent to 5ml.
* Use a plastic knife or a wooden splint to mix.

**Directions:**
1. Use 20 ml of Elmer’s all-purpose glue and mix with 20 ml of water. (***Physical Change***)
2. Add food coloring and pour into a clear plastic cup. Mix thoroughly. (***Physical Change***)
3. Add 5ml(spoonful) of Borax solution. Keep mixing as the solution thickens. (***Chemical Change***) Pull out putty with plastic ware and blot the excess liquid with paper towel. Remove from towel and enjoy!
\*4. To make more putty simply add 5 more ml to remaining solution. May repeat until all of the Glue solution is gone.
**Suggested questions**:
Pull the putty slowly. What happens?
Pull the putty quickly. What happens?
How do the structures of the Glue and the Glue and Borax mixture relate to the results of the pull tests?
**For AP Chemistry:**

Discuss polymerization and bonding.
To make a larger mixture multiply by each of the ingredients.

Example:  60ml of Elmer’s, 60 ml of Water and 15 ml of Borax



**Catherine Bowles**

**26. JINGLE ALL THE WAY?**
**Materials**: 1 jingle bell, glass bottle with lid, hot plate, some super glue
**Preparation**: Use a large glass bottle with a metal lid. Using a jingle bell that will fit through the mouth of the bottle glue the bell by some string to the lid. When the lid is on the bottle the bell should dangle down into the bottle.
**Demonstration:**
1. Shake the bottle to hear the bell. Remove the lid, put about 20 ml of water into the bottle, and heat it with the hot plate. Let it boil for at least one minute.
2. Carefully and quickly, put the lid onto the bottle. (CAUTION: the bottle will be HOT! Use a towel or hot pad.) Remove the bottle from the heat and cool. Shake again to hear the bell. Can you hear the bell as clearly?
     A partial vacuum is created the much lower air pressure inside the bottle does not carry the sound well. Since air carries the sound vibration, the smaller amount of air in the bottle carries less sound.
     If a perfect vacuum could be produced, no sound would be heard.

**Joe Mock**

**27. MAKING WATER RISE**
**Materials:** Clear container, water, food coloring or other dye, candle, match, jar big enough to cover candle
**Method:** Either melt the candle into the container or place on a candle holder. Add dye to the water to make it colorful and easy to see. (This can be done before class to save time.) Add the water to the container with the candle. Light the candle and allow it to burn. Cover the candle with the jar. The jar must reach the bottom of the container without coming in contact with the candle. Condensation will form on the jar as the candle slowly extinguishes. After the flame goes out, the water in the container will slowly move up the inside of the jar.
 **Why it works.** The heat from the candle causes the particles to move quicker in the jar than on the outside. This results in a decrease in the pressure inside the jar. With the decrease in pressure, the pressure exerted on the water from outside the jar pushes the water up into the jar.

**Joe Mock**

**28. MAKING A CLOUD**
**Materials:** Pop bottle with cap, Water, Matches
**Method:** Fill a pop bottle about half full with water. Ask questions regarding the pressure and temperature of the room and inside the bottle with the cap off. Light three or four matches and blow them out. Quickly place them in the bottle and tightly seal the cap on top. Ask the same question as earlier. Squeeze the bottle. It may take a couple of times before anything occurs, but a cloud will appear with the squeezing of the bottle. The cloud will disappear and reappear with subsequent squeezes.
**Why it works:** Squeezing the bottle forces the air particles together increasing air pressure and temperature (slightly). As the air expands back to its original volume lowering the pressure and temperature, the air can condense. The smoke particles from the match are necessary as they provide the material for the water to condense on. The cloud formed inside the bottle is the condensation.
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