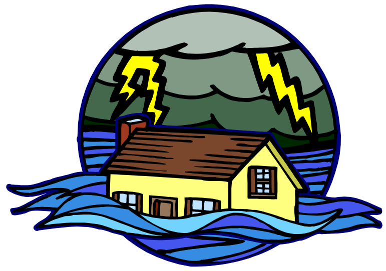
NEW MEXICO MESA, INC.

Mathematics, Engineering, Science Achievement, Inc.

2011-2012

Activity Kit Information

Natural Disasters



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The 2011-2012 NM MESA Activity Kit is being provided to all MESA programs for use during their MESA time to supplement the year theme of "Natural Disasters". Included in the kit are information, instructions and partial materials needed to conduct multiple activities throughout the school year. For assistance with this kit, please contact your NM MESA Regional Coordinator.

Included Activity Kit Materials

Water Filtration Activity:

- Plastic Tubing-5”, ¼” diameter
- Coffee Filters
- Carbon Stones (fish section at Walmart) - Approximately 1 oz.
- Play dough or Clay-Approximately 1 oz.
- Cotton Balls-6
- Heavy Duty Tape

Cabbage Activity:

- 1L Beaker
- Plastic Cups-6
- Plastic Spoons-6

Build a Seismograph Prototype:

- 2” Binder Clip
- Duct Tape
- Rubberbands-2
- Roll of Receipt Paper
- Dowel or Bamboo Skewer
- Plastic Ruler

Tornado in a Bottle:

- Tornado Tube

*Note: All activities may require additional recycled materials and or small amounts of household goods and building tools.

Available NM MESA Electronic Resources

Due to the nature of the resource or the size of the document there are multiple resources available for broadcast, distribution, or download on our NM MESA webpage. NM MESA has created and/or has received permission to distribute these items to use as part of our Activity Kit.

- NM MESA Website: http://nmmesa.org
- Activity Kit Materials Access: Advisor Section, Information and Resources, 2011-2012 Activity Kit

Available Items:

Earthquakes PowerPoint Presentation: Available for download

- Presentation will give background information on earthquakes and is to be used in conjunction with the seismograph and liquefaction activities.

Water Curriculum-Filtration: Provided by Oregon MESA and available for download

- This curriculum is an entire unit plan that provides a disaster scenario where a water filtration system is needed. This curriculum details out multiple activities and required background information. This curriculum is meant to be done as a unit. If used, all (5) sections of the program need to be utilized including background information, empathy activities, etc. Optional activities are located in the Introductory Activities and the Presentation of Inventions Sections. The formats for all are provided so they are encouraged to be used.

Web Links for "Extra" Section:

- EPA Virtual Tour of Drinking Water Treatment Plant: http://water.epa.gov/drink/tour/
- EPA Activities for Students and Teacher Information: http://water.epa.gov/learn/kids/drinkingwater/

This activity can be combined with the empathy activity provided in this activity kit.

Water Curriculum-Transportation: Provided by Oregon MESA and available for download

- This curriculum is an entire unit plan that provides a disaster scenario where a water transportation system is needed. This curriculum details out multiple activities and required background information. This curriculum is meant to be done as a unit. If used, all (4) sections of the program need to be utilized including background information, empathy activities, etc. Optional activities are located in the Introductory Activities and the Presentation of Inventions Sections. The formats for all are provided so they are encouraged to be used.

This activity can be combined with the empathy activity provided in this activity kit.

Tornado in a Bottle - Tornado Tube

(From the Website: http://www.stevespanglerscience.com/experiment/00000056)

How long does it take to empty a soda bottle full of water? You'll amaze your dinner guests and explore some of the scientific properties of air and water when you learn how to empty a full bottle of water in just a few seconds!

Materials

- Two plastic soda bottles (1 or 2 liter size)
- Pitcher of water
- Stopwatch or watch with a second hand to record your times
- Tornado Tube connector toy (Included in Kit): (http://www.stevespanglerscience.com/product/1226)

Experiment

1. Remove any label from the soda bottle so you have a clear view of the inside.
2. Fill the soda bottle to the top with water. If you do not have access to a sink nearby or you don't want to move the dinner party to the kitchen, use a large pitcher to fill the bottle.
3. Here's the challenge: How long will it take to empty all of the water in the bottle into the pitcher on the table? Record your prediction on a piece of paper.
4. Without squeezing the sides of the bottle, turn it over and time how long it takes to empty all of the water. You might want to repeat this

several times to validate your results. Do the test 3 times and average the results. Keep a table of your results and call this method the Glug-Glug Method. Be sure to use the same amount of water for each of the trials.

5. Fill the bottle to the top with water just as you did before. However, this time swirl the water by moving the bottle in a clockwise or counter-clockwise motion while the water is pouring out. Keep swirling the water until you see the formation of what looks to be a tornado! The water begins to swirl in the shape of a vortex and flows out of the bottle very quickly.
6. Time this method as you did before, only call it the Vortex Method. Repeat the test several times and average the results. Which method allows the water to exit the bottle more quickly?

The Tornado Tube is a very popular science toy that connects two soda bottles, one filled with water, the other filled with air. Simply swirl the liquid in the bottles and in seconds a twisting, turning, spiraling vortex appears.

Twist of Color - Try adding 2 ounces of colored lamp oil to the water. Lamp oil is available at most department stores where oil lamps are sold. The oil will float on the surface of the water since oil is less dense than water. When the oil and water swirl together, the less dense oil travels down the vortex first and creates a "colored tornado" effect.

How does it work?

If you've ever seen a dust devil on a windy day or watched the water drain from the bathtub, you've seen a *vortex*. A vortex is a type of motion that causes liquids and gases to travel in spirals around a center line. A vortex is created when a rotating liquid falls through an opening. Gravity is the force that pulls the liquid into the hole and a continuous vortex develops.

Swirling the water in the bottle while pouring it out causes the formation of a vortex. The vortex looks like a tornado in the bottle. The formation of the vortex makes it easier for air to come into the bottle and allows the water to pour out faster. If you look carefully, you will be able to see the hole in the middle of the vortex that allows the air to come up inside the bottle. If you do not swirl the water and just allow it to flow out on its own, then the air and water have to essentially take turns passing through the mouth of the bottle, thus the glug-glug sound.

Build a Seismograph Prototype

OBJECTIVE: Students will build a working seismograph prototype out of commonly found materials and will gain an understanding of how seismographs function to record earth movement as well as the engineering challenges with creating a sensitive and accurate instrument.

NOTE TO ADVISORS: Students may put seismograph together as instructed below or gather a variety of materials and design their own prototype (try: popsicle sticks, straws, springs, plastic bottles, cardboard, paperclips, wood, misc. hardware, etc…)

<u>MATERIALS (INCLUDED IN KIT)</u>
1 TWO INCH BINDER CLIP
1 ROLL DUCT TAPE
2 RUBBERBANDS
1 ROLL RECEIPT PAPER
1 DOWEL OR BAMBOO SKEWER (NARROW ENOUGH TO FIT THRU HOLE IN RECEIPT PAPER ROLL
1 PLASTIC RULER

<u>MATERIALS & TOOLS (NOT INCLUDED)</u>
1 FINE TIP MARKER
1 PAPERTOWEL TUBE
1 SHOEBOX OR BOX OF SIMILAR SIZE
SCISSORS AND/OR BOX CUTTER

<u>BUILD IT!</u>
STEP 1: Cut an opening on one of the short ends of the shoebox from the top edge to the bottom of the box, as wide as the receipt paper roll. It should be located in the center of that side of the box.

STEP 2: Tape paper-towel tube securely to the short end of the shoe box opposite from the opening that you just cut in step 1.

STEP 3: Using a rubber band, secure the marker perpendicular to the ruler, closer to one end of the ruler. Depending on size of rubber band you may have to make several loops to keep the marker from falling off.

STEP 4: Wrap a piece of duct tape several times around the other end of the ruler. This will help keep if from slipping later when it is attached to the binder clip.

Step 5: Tape the silver metal clasps on the binder clip securely to the paper-towel tube just above the top of the shoe box

STEP 6: On each of the long sides of the shoe box, about midway or less from the side with the cut-out window, cut a long vertical slit the width of the dowel/skewer. Make the slit deep enough so that the receipt paper will sit evenly on the dowel/skewer inside the shoebox and will roll easily when pulled

STEP 7: Place the dowel/skewer thru the receipt paper roll so that the loose end unrolls from under the roll, not over, and set dowel into the 2 slits on the cardboard box. Pull the loose end out the opening in the shoebox. *You'll need to wrap some tape on the dowel around each side of the receipt paper roll and on the dowel outside of the box to keep it from sliding when in use.

STEP 8: Insert the taped end of the ruler into the binder clip by squeezing the paper-towel tube where the metal clasps are taped to the tube. Adjust the marker vertically or horizontally along the ruler as needed so that the tip of the marker is lightly touching the strip of receipt paper in front of the roll.

GET SHAKING!

- Have one person pull the loose end of the receipt paper at a slow and steady rate while you shake the seismograph at different magnitudes. You can also tape the device to a desk or small table and shake that instead.
- NOTE: If the marker keeps sliding off of the receipt paper, try taping a piece of cardboard to each upper side of the cut-out opening on the box to make it narrower.
- NOTE: The weaker/slower the earthquake, the wider apart the wave crests are; the faster the shaking, the wave crests get closer.

FURTHER EXPLORATION:

- This is a horizontal seismograph (the arm swivels horizontally and it measures lateral movement. Try making a vertical seismograph that measures vertical movement.
- Design a device that rotates the receipt paper at a constant rate with a small motor.
- Create a device that will detect even smallest vibrations; try using paperclips, string, or springs to accomplish this. Look online for more ideas.
- Find a way to create different but consistent levels of shaking and use this to study and compare the accuracy and sensitivity of different seismographs students have built. Also using a consistent method of shaking the seismograph; determine what width of wave crest corresponds to a specific level of shaking.

Water Filtration

Lack of water sanitation

http://www.youtube.com/watch?v=skgZD_Bs5r4&feature=pyv&ad=8423691477&kw=water
In times of natural disaster, having access to safe and clean water is essential. Water polluted by faecal matter and water polluted by animal waste can spread a multitude of diseases. Natural disasters can also result in an increase in water-based insect vectors that can spread disease (such as malaria), and a lack of clean water for personal hygiene can result in an increase in diseases such as conjunctivitis and scabies. Reestablishing functioning water supply and sanitation systems are a critical component of effective and timely responses to natural disasters.

Hand out cards/pieces of paper:

Income Category:	10 pieces the income level is $10000
	10 pieces income is less than $100
Food Category:	8 pieces you have enough food
	8 pieces you don't have enough food
	4 pieces you are starving
Water Category:	10 pieces no water sanitation
	10 pieces you have water sanitation

Pass out each a piece of paper in each category to every student. Each student should have one piece of paper for income, one piece of paper for food and one piece of paper for water sanitation. Each student should join a group who has a similar selection of income, food or sanitation. Each team should be separated into five students per team. The purpose of the cards/pieces of paper is to get students to think about constraints when building their water system.

After each team is determined, each team will receive one of the following country assignments. When teams are building their device they are encouraged to take into consideration constraints of their assigned country and constraints of their pieces of paper (income, food, water).

Cameroon is having a problem with filtering rain water during harvest season and the community has no filtration set up. Usually bacterial builds up after the rain water is stored in water containers. The team mission is to filter the rain water before anyone drinks the water. The goal is to avoid the community to get diarrhea.

Nigeria is experiencing a high number of people getting sick from Coliform bacteria. Coliform bacteria live in soil or vegetation and in the gastrointestinal tract of animals. Coliforms enter water supplies from the direct disposal of waste into streams or lakes or from runoff from wooded areas, pastures, feedlots, septic tanks, and sewage plants into streams or groundwater. They need an improved water filtration system and to use carbon filters.

India is having issues with a large number of people becoming ill from Giardia Lamblia. Giardia is flagellated protozoa that are parasitic in the intestines of humans and animals. They have two stages, one of which is a cyst form that can be ingested from contaminated water. Once the cyst enters the stomach, the organism is released into the gastrointestinal tract where it will adhere to the intestinal wall. Eventually the protozoa will move into the large intestine where they encyst again and are excreted in the feces and back into the environment

Thailand is located in a heavy jungle area with lots of rivers and streams. There has been a high number of individuals who are becoming ill from Hepatitis A is an enteric virus that is very small. It can be transferred through contaminated water, causing outbreaks. Symptoms such as an inflamed liver, accompanied by lassitude, anorexia, weakness, nausea, fever and jaundice are common. Boiling the water will also inactivate the virus but when you're deep in a jungle this is hard to do. This team will come up with a water bottle filtration system. So individuals in the jungle can easily filter a bottle of water.

Materials

Students can bring from home or materials available in a class room.

School Supplies

- 2 Recycled containers 16 oz
- 1 Recycled water bottle 16 oz
- A screen that will fit a container: Another shifting material(s) socks or panty hose.
- Super Glue or Hot Gun (Attach tube to container)
- Collect coarse dirt from outside
- A shifter which separates coarse from the finer dirt
- Fine Sand
- Heavy Duty Duck tape
- Black Pepper: Each team needs only 3-4 shakes
- Baby Power or Baking Soda: Each team needs only 3-4 shakes
- Fruit coloring: Each team needs only 3-4 drops
- Clear Dish Soap: Each team needs only 3-4 drops

Supplies in kit

- Plastic Tube
- Coffee Filters
- Carbon Stones: Each group can use 1 ounce if needed
- Clay: Each group can use 1 ounce if needed
- Cotton Balls

Activity

All students are placed in a group as directed above. Have students research the viruses and bacteria assigned to the country they were given. The goal is to invent a filtration system in which the country can be able to use. Keep in mind the device has to be easy to maintain. Students will use the Engineering Process to Engineer the best water filtration system. Some notes on other materials"

- Baby powder will represent viruses

- Fruit Coloring will represent bacteria's
- Dish soap and black pepper will be represent Hepatitis A

Here are a few examples of filtration systems available. Make modifications based on supplies available. Essential goal is to improve the filtration listed below.

Example for a Filtration: http://pbskids.org/zoom/activities/sci/waterfilter.html

1. Put the top half of the soda bottle upside-down (like a funnel) inside the bottom half. The top half will be where you build your filter; the bottom half will hold the filtered water.
2. Layer the filter materials inside the top half of the bottle. Think about what each material might remove from the dirty water and in what order you should layer the materials. For an added challenge, use only two of materials to build your filter.
3. Pour the dirty water through the filter. What does the filtered water look like?
4. Take the filter apart and look at the different layers. Can you tell what each material removed from the water?
5. Wipe the bottle clean and try again. Try putting materials in different layers or using different amounts of materials.

Example Water Bottle Filter

1. Insert tube at the point where someone can use the piping as a straw.
2. You have an option to layer the material in the piping but when it comes to testing it will be difficult to test.
3. If the materials you put in the bottle have been effectively clean to where someone else can drink it.
4. In the testing phase you will make assumptions

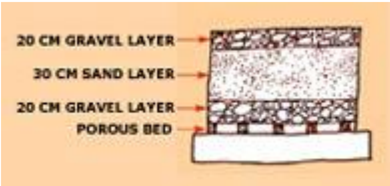
Example for a Rain Harvesting Filter

1. The filter is used to remove suspended pollutants from rainwater collected over roof.
2. A filter unit is a chamber filled with filtering media such as fiber, coarse sand and gravel layers to remove debris and dirt from water before it enters the storage tank or recharges structure. Charcoal can be added for additional filtration.

Source: A water harvesting manual for urban areas

(i) Charcoal water filter
a simple charcoal filter can be made in a drum or an earthen pot. The filter is made of gravel, sand and charcoal, all of which are easily available.

(ii) Sand filters
Sand filters have commonly available sand as filter media. Sand filters are easy and inexpensive to construct. These filters can be employed for treatment of water to effectively remove turbidity (suspended particles like silt and clay), and microorganisms.
In a simple sand filter that can be constructed domestically, the top layer comprises coarse sand followed by a 5-10 mm layer of gravel followed by another 5-25 cm layer of gravel and boulders.



Source: A water harvesting manual for urban areas

http://www.rainwaterharvesting.org/Urban/Components.htm

Teams follow the Engineering Process

1. Define the problem
2. Concept: Brainstorm ideas and think outside the box. Document everything and take photos

3. Feasibility: Are there enough materials? Is it possible to build?
4. Design a Constraint: Identify your constraints
5. Preliminary Design: Focuses on creating the general frame work to build the project on.
6. Final Design; Test requirements and operating parameters
7. Construction Plan;

http://en.wikipedia.org/wiki/Engineering_design_process

Begin working with supplies given. Each team keep a notebook to take notes of progress of activity. It is highly recommended that the team take photos of all changes they made and by doing this they make alterations and if this doesn't improve the device one can easily return it to how the device looked before the modification. When water filtration is completely designed, contaminates will be added and allow device to filter water. Give this testing at least an overnight filtration to ensure the water is filtered effectively.

Timeline for project is one week. Each team can then make a poster board to:

- List the Engineering Design Process.
- Draw the finished device
- List Strengths
- List Weakness
- Areas the team would like to make improvements and why

Follow-up

This activity can be combined with the Cabbage Activity. The Ph levels will vary from team to team because of the variety of materials added. There will have to be two Ph readings:

1.) With the clean filtrated water and
2.) The water with contaminates

This activity can provide students an opportunity to present their projects at a parent meeting.

Empathy Activity

Background

To show empathy is to identify with another's feelings, experiences, and emotions. It is to emotionally put yourself in the place of another. The ability to empathize is directly dependent on your ability to feel your own feelings and identify them.

If you have never felt a certain feeling, it will be hard for you to understand how another person is feeling. Reading about a feeling and intellectually knowing about it is very different than actually experiencing it for yourself. The ability to co-experience and relate to the thoughts, emotions, or experience of another without them being communicated directly by the individual http://www.diffen.com/difference/Empathy_vs_Sympathy

What, Me Care? Young Are Less Empathetic: A recent study finds a decline in empathy among young people in the U.S., The Scientific American Journal, By Jamil Zaki http://www.scientificamerican.com/article.cfm?id=what-me-care

Activity

Watch this video about ladies carrying water in India : http://www.youtube.com/watch?v=_x-Ei9HFuco

"Peanut butter River"

Background Information: 90% of the world population does not have clean water sanitation and even the basic need of enough food to eat. 10% of the world population do have enough food and clean water sanitation and running water. Each year 5 billion children die from diarrhea. The leading cause is poor water quality. Also with poor water sanitation there is no running water. So in order to get the water, the females in the household are the ones walking to get water at the river or community water well. A study shows water collectors are exposed to a high level of viruses and bacteria's from the water and results in more illnesses.

Activity Scenario: Imagine you are in a village in India and the closest water source is 2 kilometers to get water from a local river. Your task is to bring back enough water for a family of seven. Each member in the family drinks a liter of water a day. Average water use for cleaning and cooking is 6 liters a day. There are 33.8 ounces in each liter.

How much water needs to be brought back to the village in other to ensure there is enough water for everyone? Include water for cooking and cleaning.

The scenario the water collectors have is to cross a river in order to get to the well water. There are five stones which are placed across the river and you have no access to a bridge. Each team will be separated into five students per team. The activity will be timed and giving students 5 minutes to collect enough water for the family. It is up to team members decide how each member will contribute to the task.

Example: You can have one person standing at each rock stone and then as a group decide how to bring the water over the river.

Supplies:

- A bowl of 30 oz of water
- Empty bowl that can hold 30 oz of water
- 4 (1/2 c) measuring cups

The task is to bring back enough water for the entire family. You're responsible to make sure your family has enough drinking water. So each ½ cup, hypothetically holds 18 oz of water. The team will have to calculate how many times the team will have to fill up each measuring cup in order to meet the amount of water the family will need. Have fun, you have five minutes to load up on water.

<u>Debrief Questions</u>

Didn't retrieve enough water……what does that mean? Is this real?
If everyone participated would you have been more successful?
How did you figure out a strategy?
When were times that you would have been more successful?
Is this realistic, or not realistic? If so, why? If not, why?
What was frustrating about this?
Did you need to have a leader in order to succeed?
Did you feel successful? Why?

Demonstrating An Epidemic

©M. Beth Powel
1993 Woodrow Wilson Biology Institute

Introduction

Epidemiology is the study of disease origin and transmission. This experiment allows students to experience a small scale "epidemic," demonstrating the ease with which disease organisms are spread, and enables the student to determine the originator of the "epidemic." Students will transfer live bacteria by hand contact, then transfer an inoculum to a nutrient agar plate for 24 hour incubation. After incubation, plates are observed for growth of the microbial agent. By arranging the plates in the order of hand contact, it can be determined what individual received the original contaminant and started the "epidemic," which individuals transferred the organism yet did not grow it out (carriers), and how dosage, or amount of contamination, affects getting a disease. It must be pointed out that in an actual epidemic a contaminated individual could feasibly contact many others and not just one as demonstrated in this procedure and that the organism will multiply in each host before being passed on. Other means of microbial transmission (air, water, body fluids, fomites) may also be discussed. (Fomites are inanimate objects such as combs, pencils, etc. which may carry microbes on the surface.)

Target Group:

Regular to Advanced Biology Students

Class Time Required:

2 thirty minute periods

Teacher Materials:

(prices and item numbers are from Carolina Biological 93/94)

- 1 24 hour nutrient broth culture of Micrococcus roseus or Serratia marcescens (see teacher preparation guide)
- Sterile water
- Sterile serological pipette
- Piece of hard red candy per student (peppermints work well) $1.00
- Sterile Petri dish per student (74-1348 $7.84/pkg of 30)

Student Materials:

- 1 sterile cotton swab per student
  (70-3033 $14.30/box)
- 1 plate sterile nutrient agar per student
  (82-1860 $13.50/pkg of 10 or 82-1861 $109.00/pkg of 100)
- If you can prepare these yourself it is MUCH cheaper!
- 1 numbered Petri dish containing a piece of red candy treated with 2 mL of unknown liquid
- Disinfectant hand soap
- Disinfectant cleaner
- Disposable gloves (if desired, medical/surgical supply about $13.00/ 100)
- Laboratory marker
- Lab coats
- Incubator, 32-37degC

Safety Precautions:

All microbes should be handled as pathogens (disease causing) and therefore appropriate aseptic techniques should be followed. In particular, drips of candy liquid on any surface should be disinfected and all swabs, gloves, reusable items and used plates should be properly sterilized before placing in garbage cans or containers to be washed. (see appendix)

Teacher Preparation:

1. Broth culture: Both Serratia marcescens (15- 5450 $6.95) and Micrococcus roseus (15-5160 $6.95) are provided as agar/cultures from which a broth culture must be made. Sterile nutrient broth tubes (82-6120 $10.60/10) are available but it is much cheaper if you can prepare your own. To prepare a broth culture you will need a sterile tube of nutrient broth, a stock plate culture of Micrococcus roseus or Serratia marcescens, an inoculating loop and a Bunsen burner, alcohol burner or incinerator.

   a. Sterilize the inoculating loop by holding the wire portion in the flame until it glows red. Allow to cool briefly and test for coolness by stabbing the wire into an uncontaminated portion of the agar plate.
   b. Gently stroke across a colony to obtain a small amount of inoculum on the loop.
   c. While holding the contaminated loop in one hand, unscrew the top of the broth tube and pass the open mouth of the tube quickly through the flame to prevent air contaminants from entering.
   d. Place the loop into the broth and agitate to dislodge the inoculum. Again pass the mouth of the tube through the flame and screw the lid loosely in place. Sterilize the loop as previously described. Incubate the tube upright in a 32-37degC incubator overnight.

2. Unknown candy samples: Prepare at least 30 minutes prior to class to allow sufficient dissolving to occur.

   a. Carefully unwrap and drop a single piece of red candy into a sterile Petri dish, one per student. Avoid handling the candy directly to prevent unwanted contamination. Cover immediately.
   b. Treating only one plate at a time, lift the lid of the dish and pipette 2 mL of sterile water onto the surface of the candy. Reclose the dish. Treat all candy plates with water except one. On this final plate pipette 2 mL of broth culture.
   c. Number the plates, noting the number of the plate containing the bacterial contaminant. All the plates should appear to have identical contents.

3. Data collection: On the day of the experiment record the number of the students as they are called to shake hands. On the second day each student will record the number of red colonies counted on that plate so that the entire class may share data.
4. Sterilization of contaminated materials: All contaminated materials must be sterilized before discarding. This may be accomplished by steam sterilization at 15 psi for 15 minutes.

Student Instructions:

1. Obtain all materials. Lab coats must be worn whenever dealing with microbes. Label the sterile nutrient agar plate on the bottom portion with the experimenter's name, date, and the number indicated on the candy dish.
2. If gloves are being used, place glove on left hand. Alternately, spray both hands with disinfectant spray and wait one minute. Then wash hands with disinfectant soap and rinse in sterile water. Do not dry. Keep clean or gloved hand slightly closed to avoid outside contamination.
3. Carefully pour the liquid and the candy into the left hand. Roll the candy around until the hand is thoroughly moistened. Avoid allowing any liquid to escape. Return the candy to the original dish and close the hand.
4. When all experimenters are similarly exposed the instructor will direct a sequence for shaking left hands based on the numbered dishes. Making firm hand contact is essential to the success of the experiment. The first individual will shake hands with the next one called, then return to inoculate the nutrient agar plate. The second individual called will then shake hands with the third before inoculating. Each individual, except the first and last called, will shake with two others before inoculation.
5. Remove a sterile cotton swab from its package with the right hand. Thoroughly moisten the swab with candy liquid by rolling the cotton tip across the contaminated hand. Cover all of the cotton surface.
6. Carefully lift the lid of the agar plate to limit outside exposure. Using a rolling motion, gently rub the swab over the surface of the agar in a close zig-zag pattern; completely cover the face of the agar. Close the lid of the dish. Return the swab to the empty package and discard to be sterilized.

7. If a glove was used, place it in a container to be sterilized. If not, repeat the disinfection procedure described earlier.
8. Place the inverted agar plate into the incubator for 24 hours. Disinfect the areas used, taking particular care to clean any drops of liquid on tables or the floor. Remove lab coats. Record the sequence of contact for the entire group.
9. After 24 hour incubation, remove the plate from the incubator. Count the number of red colonies on the plate and record with class data. If there are a large number of red colonies, divide the bottom of the plate into 6 or 8 equal wedges. Count one half of the wedges, choosing those that have a representative distribution and multiply the total number counted by two. Arrange the plate with those of the other experimenters so that they represent the contact sequence and observe the general trend in numbers of red colonies. Prepare a data chart indicating the sequence of contact and the number of red colonies per plate for the entire class. Indicate those individuals who got the "disease" by a + and those who were disease free by a -. Place a = by the individual who started the epidemic.
10. Discard plates in sterilization containers and disinfect all areas used.

Questions:

1. Which individual began the "epidemic? How can this be determined from the class data?
2. Were there individuals who appear to have passed on the organism without having the disease? How does this appear in the data? Does this occur in an actual epidemic?
3. Describe at least two ways in which this model epidemic differs from a real one.

Reference:

This laboratory experiment was adapted from A Laboratory Manual for Microbiology by Richard A. Mangino.

Additional activity to simulate vaccination:

WHAT HAPPENS IF YOU VACCINATE SOME PEOPLE?
By: Pamela M. Peters, Ph.D.
Access Excellence

What would happen if some individuals had been vaccinated against this epidemic? You can simulate this situation by selecting some students to receive "vaccinations." These students simulate vaccination by covering their left hands either with a second glove placed over the first, or with a piece of sterile foil (you can sterilize foil squares with steam sterilization as above.) Vaccinated students place the glove or foil "cover" in the proper waste receptacle after having their hands shaken, but before shaking the next person's hand. Thus, the vaccinated individual shakes the next person's hand with a "clean" hand. Complete the experiment as above. What happens to the spread of the epidemic? Vary the number of people receiving the vaccination? How do more (or fewer) vaccinated people effect the outcome?

Liquefaction Activity

What Is Liquefaction?

"Earthquake waves cause water pressures to increase in the sediment and the sand grains to lose contact with each other, leading the sediment to lose strength and behave like a liquid. The soil can lose its ability to support structures, flow down even very gentle slopes, and erupt to the ground surface to form sand boils. Many of these phenomena are accompanied by settlement of the ground surface — usually in uneven patterns that damage buildings, roads and pipelines."
Definition from: http://geomaps.wr.usgs.gov/sfgeo/liquefaction/aboutliq.html

YOU WILL NEED:

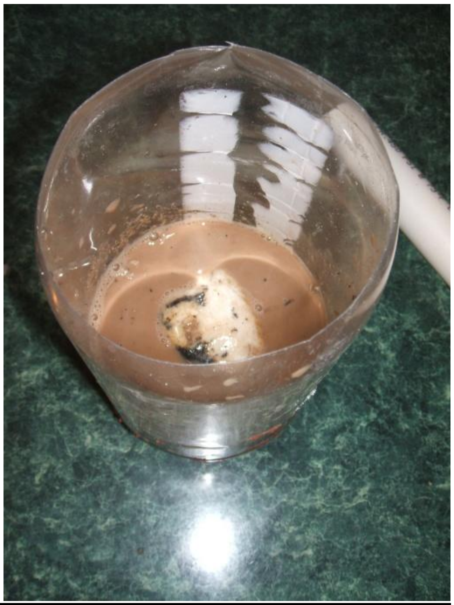
- 1 clear bottle (2 liter soda bottle or other similar clear bottle)
- Sand (enough to fill container about ½ way)
- Approx. 1 cup of water (a little extra may be needed)
- 1 toy house, car, rock or other small, dense object
- Box cutter and/or scissors
- Object to tap container (hammer, mallet, large scissors, etc)

INSTRUCTIONS:

1) Cut top off of bottle so that you can fit your hand inside
2) Fill bottle about half full with sand
3) Pour approximately 1 Cup of water into bottle and let it sink in fully (sand should be saturated but with no water floating on top

4) Set small object (toy house/car/rock) on top of sand. Put a piece of tape on the outside of the bottle marking the top level of the sand

5) Holding the bottle with one hand to prevent knocking it over, rapidly tap side of bottle with a hammer or other object near the bottom of the container *you can also use an electric sander to vibrate the bottle



What happens?

- Water will rise to the top and the object will sink into the sand. This is what can happen during an earthquake in areas with a lot of water in the soil.
- Also notice how the “ground” level has dropped as the air and water has escaped from beneath the sand

FURTHER EXPLORATION

- To repeat the experiment, squeeze the bottle so that the water sinks back in. If soil becomes too compacted; dump into another container and then back into the bottle and press down lightly to make a level surface; more water is usually NOT needed.
- The substrate (different types of layers of earth) beneath cities is different from place to place. Scientists need to understand how different substrates react to ground shaking in order to know where there is risk to infrastructure. Test different types of substrate to see which type, mixes, or layers are more unstable in an earthquake (try clay, sand, silt, gravel)

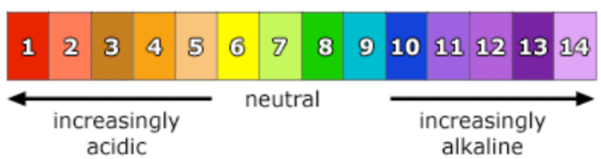
Cabbage Activity

Acid rain, or more accurately acid precipitation, is the term used for describing rainfall with a pH level lower than 5.6. Acid rain is considered to be a man-made natural disaster. This type of pollution is a matter of great debate currently due to the potential of its causing environmental damages all across the world. For the last decade or so acid rain has caused destruction to hundreds of lakes and streams in many parts of the world, including the US, Canada, and Europe. Acid rain forms due to the oxides of sulfite and nitrogen combining with the moisture contained in the atmosphere, resulting in the formation of sulfuric and nitric acids. These acids can be dispersed far away from their places of origin.

Red Cabbage Lab: Acids and Bases

Introduction:

Liquids all around us have either acidic or basic (alkaline) properties. For example, acids taste sour; while, bases taste bitter and feel slippery. However, both strong acids and strong bases can be very dangerous and burn your skin, so it is important to be very careful when using such chemicals. In order to measure how acidic or basic a liquid is, one must use the pH scale as illustrated below:



The strength of the pH scale is determined by the concentration of hydrogen ions (H+) where **a high concentration of** H+ ions indicate a **low** pH and a **high concentration of** H+ ions indicate a **high** pH. The pH scale ranges from 1 to 14 where 1 to 6 is classified as acidic, 7 neutral (neither a base or an acid) and 8 to 14 is classified as basic.

In this lab, you will use the juice from red cabbage as a pH indicator to test common household liquids and determine their pH levels. You will mix cabbage juice with different household liquids and see a color change produced by a pigment called flavin (an anthocyanin) in red cabbage. Through this color change, you will be able to successfully identify the approximate pH of common household liquids using the table below:

Color:	Pink	Dark Red	Violet	Blue	Blue-Green	Green-Yellow
Approx. pH	1-2	3-4	5-7	8	9-10	11-12
Acid/ Base	Acid	Acid	Acid/Neutral	Base	Base	Base

Strength increases at extremes of this scale.

Liquids to Test:	Materials:
• White Vinegar • Apple Juice • Baking Soda • Shampoo (preferably clear) • Conditioner (preferably clear) • Hand Sanitizer	• Pre- Cut Cabbage • Blender • Strainer • Large Container • ~1L Beaker • 6 plastic cups • 6 plastic spoons

Pre-Laboratory Predictions:

Look at each of the liquids being tested. Predict whether each of the substances is acidic, neutral or basic. Circle one. (Think about the properties of acids and bases.)

Hand Sanitizer	Acidic	Neutral	Basic
Lemon Soda	Acidic	Neutral	Basic
Apple Juice	Acidic	Neutral	Basic
White Vinegar	Acidic	Neutral	Basic
Baking Soda	Acidic	Neutral	Basic
Shampoo	Acidic	Neutral	Basic
Conditioner	Acidic	Neutral	Basic

Instructions:

Preparing the Cabbage Juice:

1. Put the red cabbage leaves into the blender with 800mL of water.
2. Close the top and let it blend at high power for 30 seconds.

3. Once it is blended, filter out the leaves inside the mixture with the strainer and pour the mixture into a large container.

*This should provide you with 600-800 ml of cabbage juice.

Mixing the Cabbage Juice:

4. Label each cup with each of the liquids. (Example: vinegar, apple juice, etc.)
5. Pour 100 ml of each individual liquid into its respective cup (except for baking soda).
6. For baking soda, add 3 tablespoons of baking soda into 100 ml water.

Example:

7. Pour 50 ml of cabbage juice into each of the cups. Do this one at a time and record the color change below:

Liquid:	Color Change/ pH	Actual pH
Hand Sanitizer		
Lemon Soda		
Apple Juice		
White Vinegar		
Baking Soda		
Shampoo		
Conditioner		

Now look up the actual pH of each of the substances and see how accurate the cabbage juice indicator was!

How did your reasoning for your predictions change after seeing the approximate pH level?

8. Categorize your results below:

Strong Acids	Weak Acids	Neutral	Weak Bases	Strong Bases

Now add 10 tablespoons more of baking soda into a new cup.

Does the color intensity of the liquid change?
If so, how and why do you think this is?

Concept Questions:

1. Does the addition of water (baking soda +water) alter the pH of weak acids/bases? How does it change the pH of strong acids/bases? Why or why not?
2. How does a difference in 1 pH unit change in terms of H+ concentration? Example: How does a pH of 3 differ from pH of 4? Which one is stronger or weaker? Why?
3. Look at the ingredients for each liquid you tested. Which ingredients contribute to each of the liquid's pH level?

Real Life Applications:

1. Neutralization: Whenever you mix an acid with a base, they neutralize each other. If this is the case, why is Alka- Seltzer used to treat stomach aches? (Note: excess stomach acids cause stomach aches)
2. Acid Rain: What is acid rain and how is it a problem to oceans, rivers, lakes, ponds etc.?

References:

Acids and Bases:
http://www.chem4kids.com/files/react_acidbase.html
Red Cabbage Juice Lab:
http://www.curriki.org/xwiki/bin/view/Coll_MickiHR/AcidsandBases

Additional Web Resources, Activities, and Lesson Plans:

Activity Name: Volcano Classroom Activities and Lesson Plans
Activity Focus: Volcanoes-Natural Disasters
Appropriate Grade Levels: 6-12
Web Site or Where to Access Full Copy: http://geology.com/teacher/volcano.shtml
Description: This site has access to multiple activities to incorporate into MESA time.

Activity Name: Plate Tectonics Classroom Activities and Lesson Plans
Activity Focus: Earthquakes, Plate Tectonics-Natural Disasters
Appropriate Grade Levels: 6-12
Web Site or Where to Access Full Copy: http://geology.com/teacher/plate-tectonics.shtml
Description: This site has access to multiple activities to incorporate into MESA time.

Activity Name: Find the Fire Danger
Activity Focus: Fire Safety-Natural Disasters
Appropriate Grade Levels: 6-8
Web Site or Where to Access Full Copy: http://ag.arizona.edu/firewise/classroom_activity.pdf
Description: To identify fire risk factors for a property located near a wild land urban interface area.

Activity Name: Forest Fire Lesson Plan
Activity Focus: Fire Safety-Natural Disasters
Appropriate Grade Levels: 9-12
Web Site or Where to Access Full Copy: http://www.discoveryeducation.com/teachers/free-lesson-plans/forest-fires.cfm
Description: To identify the benefits and problems associated with fire and the role that fire plays in maintaining a healthy ecosystem.

Activity Name: Emergency Management for Schools
Activity Focus: Natural Disasters
Appropriate Grade Levels: 6-12
Web Site or Where to Access Full Copy:
http://www.ema.gov.au/www/ema/schools.nsf/Page/TeachLesson_Plans
Description: 10 lesson plans related to various types of Natural Disasters. Lesson plans are general and can be modified for grade. The site is provided by the Australian Attorney General's office so some scenarios are directly linked to Australian locations. As a modification, students can investigate local scenarios within New Mexico or the United States.

Activity Name: Overflowing the Banks! A Flood Activity
Activity Focus: Floods-Natural Disasters
Appropriate Grade Levels: 6-12
Web Site or Where to Access Full Copy:
http://www.pbs.org/wgbh/nova/teachers/activities/2307_flood.html
Description: Students will construct a model river system with levees. Site includes PDF handouts and related video.

Activity Name: Hurricane Classroom Activities and Lesson Plans
Activity Focus*:* Hurricanes-Natural Disasters
Appropriate Grade Levels: 6-12
Web Site or Where to Access Full Copy:
http://www.seacoos.org/Community%20and%20Classroom/hurricane-classroom/
Description: This site has access to multiple activities to incorporate into MESA time.

Activity Name: Unit Plan for a Natural Disaster Curriculum
Activity Focus*:* Natural Disasters
Appropriate Grade Levels: 6-12
Web Site or Where to Access Full Copy:
http://www.uwsp.edu/education/pcook/unitplans/docs/NaturalDisasters2.doc
Description: This site has access to multiple activities to incorporate into MESA time.

Activity Name: Wind Speed During Tornadoes Using Fujita Scale
Activity Focus*:* Tornadoes, Wind Speed-Natural Disasters
Appropriate Grade Levels: 6-8
Web Site or Where to Access Full Copy: http://www.discoveryeducation.com/teachers/free-lesson-plans/tornado.cfm
Description: Using the fujita scale students can understand the wind-speed damage incurred during a tornado. Students will also evaluate designs of buildings and think of the process to engineer safe buildings during a disaster.