# BLA List in Numerical Order

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Better Milk for Cats

Suggested Level:
Grades 5 – 7, 8-10

Standard Category:
Technology
Biology

Materials:
- Lactase enzyme, Novo Nordisk Lactozym, 2cm³ (available from the NCBE)
- 2% sodium alginate solution, 8 ml
- 1.5% calcium chloride solution, 100 ml
- Milk, 50 ml (not UHT)
- Semi-quantitative diabetic glucose test strips e.g. Boehringer Mannheim Diabur-Test 5000 or Ames Diastix
- Small piece (about 1 ml) of nylon gauze e.g. net curtain
- 10 ml plastic syringe (without a needle)
- 4mm diameter aquarium airline tubing to fit syringe, about 10cm in length
- Aquarium airline tap or adjustable laboratory tubing clip (Hoffman clip)
- Retort stand, boss and clamp (to support enzyme column)
- Small beakers (e.g. 100 ml) or disposable plastic cups, 2
- Tea strainer

Instructional Strategies:
- Individual or
- Small groups
- Whole class

Strand(s):
Biomaterials

Standard Statement(s):
3.6.7 A, 3.3.7B, 3.6.10A, 3.3.10B

Content Objective(s):
During this activity, students will be able to:
1. Immobilize the lactase in calcium alginate beads.
2. Record all steps, methods and findings in a formal lab report.

Assessment Strategies:
Student generated work.

Procedures:
Cats are unable to digest large amounts of lactose. Milk can be treated with the enzyme lactase to make lactose-reduced milk suitable for cats or humans who are lactose intolerant. Commercially, milk is treated by injecting the enzyme into the carton as the milk is packaged, or by using an immobilized enzyme – an enzyme that has been trapped on an inert material so that it can be used repeatedly. In this activity, students will immobilize the lactase in calcium alginate beads held within a small column, over which the milk is passed. This activity will need one class period to complete.

Practical Details
- All solutions must be made up using distilled or de-ionized water (calcium ions in tap water will cause the sodium alginate to ‘set’).
- Sodium alginate is not readily soluble, and requires both warm water and stirring to dissolve it. Have patience – it will dissolve!
- Immobilize the enzyme by mixing it first with the sodium alginate solution, then adding it a drop at a time from the syringe to the calcium chloride solution. Do not allow the tip of the syringe to come into contact with the calcium chloride solution. The beads, which contain the enzyme immobilized in a matrix of calcium alginate, should be allowed to harden for a few minutes before separating them from the liquid with the tea strainer.
- The accompanying worksheet shows how to set up the immobilized enzyme column using a syringe barrel. It is important to use a small piece of nylon barrel. It is important to use a small piece of nylon gauze inside the barrel, as the beads are just the right size to block the syringe outlet.
- Glucose may be detected in the whey leaving the column after a few minutes using the glucose test strips.
Provide students with appropriate background information and introduce the activity.

Provide students with the following procedural steps for immobilizing the enzyme (you may want to include an accompanying worksheet) and review them, along with any safety precautions.

1) Mix 2 ml of lactase enzyme with 8 ml of 2% sodium alginate solution.
2) Add the alginate/enzyme mixture to 1.5% calcium chloride solution on a drop at a time. Allow the beads to set for a few minutes.
3) Use a tea strainer to separate the beads from the calcium chloride solution.
4) Pack the beads into a column made from a syringe barrel. Ordinary milk (containing lactose sugar) goes into the column. The trapped enzyme splits lactose sugar. Glucose and galactose are formed. Milk leaving the column contains easy-to-digest sugars (glucose and galactose).

Have students perform the immobilization of enzyme lab and record all steps, methods, and findings in a formal lab report. Share and discuss findings and implications.

Safety:
This practical work may be carried out in a food preparation area if clean equipment reserved exclusively for food use is employed. In such circumstances, the liquid leaving the column may be tasted if food reagents have been used. (Novo Nordisk Lactozym is a food-grade enzyme.)
Lactase is a relatively safe enzyme (it is produced naturally by babies to digest their mother’s milk). However, unnecessary contact with the enzyme or inhalation of dust from dried-up enzyme spills should be avoided. In case of spillage or contact with the eyes, rinse by flushing with water.

Further activities:
The immobilized enzyme column may also be used to treat whey, producing sweet whey syrup, which is widely used in confectionary (it is usually described on labels as ‘hydrolyzed whey syrup’ or just ‘whey syrup’).
Lactase (or B-galactosidase) is strongly inhibited by galactose (one of the products of its action on lactose). Hence the flow rate of the substrate over the column is critical to the rate of the enzyme-catalyzed reaction: too fast and there isn’t time for the reaction to occur; too slow a rate and galactose will accumulate and then inhibit the reaction. Students can therefore investigate the effect of flow rate on the conversion of lactose to glucose and galactose.

Source:

Related Web Sites:
www.ncbe.reading.ac.uk/NCBE/PROTOCOLS/praebook.html
Making a better milk for cats

1. Mix 2 cm³ of lactase enzyme with 8 cm³ of 2% sodium alginate solution.

2. Add the alginate/enzyme mixture to 1.5% calcium chloride solution a drop at a time.

3. Use a tea strainer to separate the beads from the calcium chloride solution.

4. Pack the beads into a column made from a syringe barrel.

- Ordinary milk (containing lactose sugar) goes into the column.
- Lactose sugar is split by the trapped enzyme.
- Glucose and galactose are formed.

Milk leaving the column contains easy-to-digest sugars (glucose and galactose).

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Biotechnology Learning Activity Lesson

More Juice From Apples

Content Organizer(s):
Agriculture, Biomaterials

Standard Statement(s):
3.3.7D, 3.8.7B, 3.3.10D, 3.8.10B

Content Objective(s):
At the conclusion of this lesson students will be able to:
1. Record/graph the volume of juice obtained from both lots of apple pulp at five-minute intervals.
2. Analyze the data to compare the output of juice production, and record findings in a formal lab report.

Assessment Strategies:
Student generated graphs and lab reports.

Procedures:
The addition of enzymes in commercial apple juice production increases yield by 20%. In this activity, students will compare the output of juice production with and without enzyme inclusion. The suggested time to complete the activity is one class period.

1. Provide students with appropriate background information and introduce the activity to the class. You may provide students with the following instructions for the activity or provide them with the “More Juice from Apples” handout. Review procedures, answer questions, and assign students to work stations.
   - Chop one medium-sized apple into small pieces. Put half into one beaker, and half into another.
   - Add two mL of diluted pectinase enzyme to one of the beakers, and two ml of water to the other.
   - Stir the beakers’ contents with a clean glass rod.
   - Incubate the beakers in a water bath at 40°C for 15-20 minutes. Have students work on their formal lab reports for this activity during this waiting period.
   - Filter the juice from the apple pieces, using coffee filter papers in funnels placed in measuring cylinders.
   - Record/graph the volume of juice obtained from both lots of apple pulp at five-minute intervals.
2. Monitor students’ procedures and facilitate learning. Have students record and share findings after the completion of the lab. Discuss lab, findings and any implications.
Biotechnology Learning Activity Lesson

➢ Safety

Juice prepared in this way should **NOT** be consumed. The proportion of enzyme used is far greater than that employed in commercial production, where typically, 130 mL of enzyme is added for every ton of apples!

➢ Further Activities

1. Compare the yield of juice from different varieties of apples (or other fruits).
2. Investigate the effects of enzyme dosage and incubation temperature on juice yield.
3. Compare the yield of juice from pulp that has or has not undergone pre-oxidation.
4. What is the effect of adding cellulase to the pulp on the yield of juice? Do pectinase and cellulase in combination further enhance yields?

Source:

Related Web Sites:
www.ncbe.reading.ac.uk/NCBE/PROTOCOLS/pracbook.html
More juice from apples

INSTRUCTIONS:

1. Cut up the apple into small pieces. Put half into one beaker, and half into another. Add 2 cm$^3$ of pectinase enzyme to one beaker, and 2 cm$^3$ of water to the other.

2. Incubate both beakers at 40°C in a water bath for 15 minutes.

3. Filter the juice from the apple pieces.

4. Record how much juice has been produced at 5 minute intervals. Plot the results on a graph.
Biotechnology Learning Activity Lesson

Owl Pellets

Content Organizer(s):
Medical Technology

Suggested Level:
Grades 5 - 7

Standard Category:
Biological Sciences
Inquiry & Design
Unifying Themes
Ecosystems & Their Interactions
Humans & the Environment

Materials:
- Owl pellets
- Dissecting tools (toothpicks work fine)
- Poster board
- Glue
- Small animal skeleton diagrams and skull guide
- Optional: hand lens, or magnifying glasses, gloves

Standard Statement(s):
3.3.7 A, 3.2.7 A, 3.1.7 A, 4.6.7 A, 4.7.7 A, 4.7.7 B

Content Objective(s):
By examining owl pellets, reconstructing prey skeletons, and identifying prey, students will be able to:
1. Construct, and then illustrate a picture of, a simple food chain that represents the eating habits of another bird of prey and its food sources.
2. Describe, through poetry, the interrelationships between owls, small birds, rodents, and the environment in which they live.

Assessment Strategies:
Student generated:
1. Picture or poster of a simple food chain.
2. Poem that describes the interrelationships.
4. Poster of reconstructed skeleton of selected prey.

Procedures:
Owl pellets have been used for scientific study of small mammals and their distribution. With owls doing the collecting, the scientist must only locate the owl roost to obtain the skulls and bones of the small prey living in the area. From these parts, the species can be identified. This has helped map the areas occupied by certain small creatures that might otherwise have escaped detection.

The major purpose of this activity is for students to learn how to construct a simple food chain and recognize interdependence in ecological systems by examining owl pellets, reconstructing prey skeletons, and identifying prey. One class period is suggested to complete the activity.

1. Provide students with appropriate background information and introduction to the activity.
2. Locate some owl pellets under trees or in abandoned buildings where owls may roost. Local wildlife organizations may be able to help you identify possible roosting sites. Bird watchers and people who rehabilitate injured birds of prey may be of particular help. Collected pellets should be dried in a traditional oven at 325 degrees F for forty minutes or 20 seconds on high in a microwave oven. Pellets can also be purchased from scientific supply distributors. Identify the species of owl that cast the pellets if this can be done without disturbing the animal.
3. Divide the students into small groups of two or four. **Review safe lab procedures, including the need to wash hands before and after doing the activity and the importance of not eating or drinking during the activity.** Give each student group an owl pellet.

4. Have students separate the bones from the fur and feathers. This can also be done in a shallow pan of water. Where possible, identify the skulls and jaws of the prey species. Use a hand lens or magnifying glass to look at the teeth. Consider how the teeth are arranged. Would they work best at tearing flesh, grinding seed, or eating plants? Using the teeth as a guide, determine what kinds of food the prey species most likely ate.

5. Determine if there are bones from more than one animal in the pellet. If there are, determine how many different animals and species are represented in one pellet.

6. Lay out the bones to form as many complete skeletons as possible. Skeletons may be glued on to poster board for display and labeling.

7. Make a food chain that includes the owl, its prey and what the prey eats. Have students draw a picture of a simple food chain that represents the eating habits of another bird of prey and its food sources. Have each group report their food chain. Have them write a poem that describes the interrelationships between owls, small birds, rodents, and the environments in which they live.

**Source:**

**Related Web Sites:**
http://bsuvc.bsu.edu/home/smransom/owls.html
http://www.pelletlab.com/
http://www.pelletsinc.com/index.html
http://www.acornnaturalists.com/contents.html
Content Organizer(s):  
Medical Technology

Standard Statement(s)  
3.3.7 A, 3.3.7 B, 3.7.7A, 3.7.7B

Content Objective(s):  
To understand that organisms are made up of tiny things called cells, at the conclusion of this lesson students will be able to:  
1. Examine and compare different organisms through the microscope.  
2. Identify and draw examples of three dimensional cells observed.

Assessment Strategies:  
Student generated:  
1. Drawings and identification of cells as seen through the microscope.  
2. Descriptions of cells as the basic structural and functional unit of living things.  
3. Students make a three dimensional model of selected cells using common materials: Jello, jelly beans, macaroni. spaghetti, etc.

Procedures:  
Modern biotechnology is based upon genetics. Every cell in the human body contains (or once contained) DNA, the substance that makes us unique. In this activity, students will understand that organisms are made up of tiny things called cells as they examine various samples under the microscope. One hour is needed to complete the activity.  

Safety procedures: Before beginning the activity, review or pre-teach lab skills in slide/stain preparation and microscope use.  
1. Introduce the activity by asking the class to think about a cat or dog. Can they name all the parts that make up the animal? Using a flip chart or chalkboard, record their answers. Your list may look like this:  
   ears   face  
   fur    legs  
   eyes   tail  
2. Set up stations by placing microscopes, slides, slide covers, Iodine stain, toothpicks, tweezers, colored pencils, and items to examine at each area. Provide a copy of the Activity Sheet for each person.  
3. Divide the class into groups of two or four (depending upon the number of microscopes you have). Each team should go to a station. Provide students with microscopes and the Activity sheet. Have them observe and draw each item with colored pencils. To view human cells, tell participants to gently scrape the insides of their mouths with toothpicks and wipe the toothpicks on the slide. They may decide to examine other things too. They’ll need to use clean toothpicks to obtain samples.
4. Follow these procedures:
   a. Flower Petals: choose a colored flower petal. Rip the petal at an angle. Place on a slide, add a drop of water and a slide cover. Focus on a few cells. Draw the cells on student page one.
   b. Green Fresh Leaves: Prepare in same manner as flower petal. Draw these cells on student page one.
   c. Tomato Skin: Peel of a small piece of tomato skin and scrape off the pulp. Mount on a slide with a drop of water and slide cover. Focus on a few cells and draw the cells on student activity page one.
   d. Tomato Pulp: From the interior of a slice of tomato, scrape some pulp onto a slide. Add a slide cover, focus on a few cells, draw cells on activity page one.
   e. Onion: Peel the onion section apart, break a section to view the thin transparent layer. Mount a flat piece of this transparent layer in a drop of water, add a slide cover. Focus on a few cells and draw them on activity page two. Next place a drop of iodine on the edge of the slide cover and use the edge of a paper towel placed on the opposite edge to pull the stain across the onion cells. This should stain the cells. Now re-draw some cells on student activity page two.
   f. Potato: Scrape some potato (not skin) onto a slide and add a drop of water and slide cover. Draw a few cells on student activity page two. Next stain the cells with iodine as you did with the onion cells. Draw the stained cells on student page two.
   g. Meat: Tear a section of the meat apart, lengthwise with the grain, and mount on a slide. Straighten out the tissue as much as possible. Add a drop of water and a slide cover. View a few cells that should look like cylinders and make a drawing on student page two. Stain the tissue with methylene blue using the same technique as on the onion slide. Sketch a few cells on student page two.
   h. Cheek cells: with the flat end of a toothpick, gently scrape the lining of your cheek near your molars. Smear the toothpick on the slide. DO NOT ADD A DROP OF WATER> Examine under the microscope. If cells are found, Sketch them in student activity page two. Add a drop of methylene blue directly on top of the smear and add a slide cover. The cells should be easier to find. Sketch some cells on student page two.
   i. Pear: Scrape some pear pulp onto a slide, add a drop of water and slide cover. Examine a few cells and sketch on student activity page two. Stain this slide with methylene blue using the same technique as with the onion slide. You should observe two kinds of cells: the stone cells which cause the gritty texture and the pulp cells. Sketch these cells on student page two.
   j. Hair: Human hair is not composed of cells, but it does grow out of a group of living cells. Cut a two-centimeter length of the end of a hair from your head, mount it on a drop of water, add a slide cover. Observe under a microscope and sketch on student page two. Next choose three classmates that have different color hair and texture than you have. Observe their slide and make sketches on student page two.

5. Explain that each part is made up of tiny, tiny living things. Ask them if they can name these tiny things. (Cells!) Explain that cells are the building blocks that make up all living things. Cells make-up animals from tiny living things to romping and stomping pets.
6. Ask if they can guess how many cells adult humans have. (Billions!) Can they even imagine a number this big? They can try. If they place 100 billion pennies side by side, they would stretch from Philadelphia to San Francisco and back 380 times! That’s a lot of sightseeing!
7. Explain cell theory to your class. All living matter is made up of one or more cells. Each person in the room is made of cells, and the construction instructions for those cells came from other living things.
8. Give groups some time to make observations and illustrations. Move among the teams to help with slide preparation and other needs. It’s a good idea to have another adult helper on hand.
9. After teams have finished, ask:
   • Do all the cells have the same shape? (No!) Describe their shapes.
   • Are all cells the same size? (No!) Which item had the largest cells?
   • Can living things be made of just one cell? (Yes!)
• Are cells living or nonliving? (Living, but they also die. Living things have living cells. When animals or plants die, their cells die too.)
• Are cells easy to see? (No!)

10. To check for students’ understanding of the concept, ask:
• What are all living things made of? (Cells.)
• Are most cells big or little? (Little!)
  ➢ **NOTE:** The teacher may want to introduce single celled organisms at this point.
• Which has more cells, a human or an amoeba? (A human. An amoeba is a one-celled animal that looks like a blob of clear jelly with a dark speck inside. It is considered the lowest and most primitive form of animal life.)

**Source:**
This lab is an adaptation from multiple sources dealing in cell microscopy.

**Related Web Sites:**
http://www.aimsedu.org/
*Cheek to Cheek*, 1995 AIMS Education Foundation
*Cell your Fruits and Vegetables*, 1993 AIMS Education Foundation
*Onion Rings*, 1995 AIMS Education Foundation
Look at these things with your microscope. Draw what the cells look like next to the items you are examining.

Onion

Potato

Hair Follicle

Cheek Cells
**Content Organizer(s):**

Regulation Safety

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**Standard Statement(s)**

3.2.4A, 3.2.7A, 3.2.10A, 3.2.12A, 3.2.4C, 3.2.7C, 3.2.10C, 3.2.12C,
3.3.4B, 3.3.7B , 3.6.4A, 3.6.7A
4.3.7A, 4.3.10A, 4.3.4B, 4.3.7B, 4.3.10B

**Content Objective(s):**

After the completion of this activity, students will be able to:

1. Demonstrate proper hand-washing techniques.
2. Explain when and why it is important to wash hands with soap and water.
3. Conduct a controlled experiment demonstrating the spread of germs.
4. Record and analyze observations and data.
5. Predict, observe, and summarize the experimental results on data sheets.

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**Assessment Strategies:**

Student generated responses and work (see Evaluation Options).

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**Procedures:**

Through a controlled experiment, students learn one way bacteria can be spread and the importance of hand-washing for personal hygiene and food safety. The estimated teaching time to complete the activity is: one session, 1 hour (for younger students, session one is divided into three parts: part one, 10 minutes, part two, 30 minutes, and part three, 20 minutes); sessions two to four, 20-30 minutes each (sessions need to be at least a week apart); session five, 20-30 minutes.

- **Getting Started**
  1. Purchase three large and similar potatoes.
  2. Gather the necessary supplies listed in the Materials section.
  3. Make transparencies of all the attached sheets to use as collective record sheets with younger students and to record examples for older students. Photocopy the **Potato Experiment Prediction**, **Potato Experiment Data**, and **Potato Experiment Summary** sheets for each pair or small group of older students.
  4. The day of the experiment peel three similar potatoes. Wash all three potatoes for at least 20 seconds with soap and water after peeling them. Your hands and the peeler should be washed thoroughly before peeling the potatoes! Put one potato in each of the new, large, self-locking plastic bags to be used later. Label the bags potato 1, 2, and 3. Two to three weeks may be necessary to see revolting results among the potatoes.
SAFETY WARNING: Bags should not be opened after the potato has been handled and sealed inside because of these possibilities: infectious microbes growing on the potatoes; irritation of the nose and throat by mold spores; and foul smell.

Session One
(For younger students, part one)
1. Tell students that potatoes are being used in our experiment to discover how germs or bacteria can be spread. At this point, do not discuss the design of the experiment, since it may affect how students behave in the hand washing experience during Step 3. Explain that over the next couple of weeks they will be observing the potatoes to gather information and see the results.
2. Potato 1 is the unhandled potato in this experiment. Leave it in the bag and keep it sealed. Potato 2 is handled with dirty hands. Pass this potato around the room for all students to handle. (The dirtier the students’ hands, the better.) Seal potato 2 back in its plastic bag. Be sure the bag has the same amount of air as potato 1. Potato 3 is handled later by students with properly washed hands and will then be sealed in a bag. If you do not proceed immediately with Step 3, make sure all students wash their hands after handling potato 2.

(For younger students, part two)
3. Conduct the hand washing activity with students. The ideal situation is a central sink your whole class can gather around. A sink in the classroom, the school nurse’s office, cafeteria, Family and Consumer Science room, or art room can serve this function.

Have students wash their hands, one student at a time. Stand by the students with a watch or stopwatch and say, “Let’s see how long it takes you to wash your hands.” Give all students slips of paper with their hand washing times on them. Optional: Divide the class into lab groups. Have each group select one student representative. Only the representatives wash their hands and have their times recorded.
4. Discuss the hand washing experience by asking:
   - Why do you wash your hands?
   - How did you learn how to wash your hands?
   - When do you wash your hands at school? At home?
   - When do you think it is important to wash your hands?
5. Have students look at their hand washing times. Write the hand washing times on the board. Ask:
   - Which time is the longest? The shortest? (Older students can average the hand washing times.)
   - Which time do you think is the best? (Don’t give any feedback at this point. Students may think the shortest time is best.)
6. Have older students calculate and graph the median, mode, and mean (or average) of the hand washing times.

(For younger students, part three)
7. Ask:
   - What do you think a germ is?
   - Where do you think they live? (Yes. Help students understand that our hands are one of the most common places for germs.)
   - Can germs live on you? (Yes, they are microscopic.)
   - How big are they? Can we see them? (No, they are microscopic.)
   - Do you think washing your hands does anything to germs?
   - Why do you think it is important to use soap and water when washing our hands?
8. Explain to students that there are germs on almost everything in our world. Germs are so small you can see them only with a microscope. Germs do not move, but they can “hitchhike” on our hands. When we handle
our food and eat with dirty hands, germs can enter our bodies through our mouth. Germs can make us sick, but we can stop them by washing our hands with soap and water. Washing with soap and water is one of the most important steps to staying healthy.

9. Demonstrate the effect of using soap when washing hands by blowing up the balloon. The balloon represents a germ. Release the air from your balloon by popping it with a pin. In a dramatic voice, tell the students that this represents soap’s effect on germs. Soap acts like a “germ buster.” It breaks open the outer coats of the bacteria, causing it to die. When we use soap with water, we wash the germs away so they can’t make us sick.

10. Ask:
   - When is it most important to wash hands?
   - To do an effective job, how long should we wash our hands?

Tell them that for soap to work on germs they should wash their hands for 20 seconds. Discuss the actual length of their hand washing times (from Step 3).

11. Ask students to suggest important rules to follow in proper hand washing technique. Record the rules in a visible place. Hopefully, students will suggest rules including:
   - Using soap
   - Rubbing hands for 20 seconds
   - Rinsing with water

   Note: There does not appear to be agreement on water temperature. Some say it should be as hot as the person can stand. Others say use a comfortable temperature so you will properly wash your hands.

12. Highlight the rules as you or a student model the proper hand washing technique.
   - Turning the water on to get hands wet (if using bar or powder soap) and shutting it off (remind them not to waste water). Water is not necessary when using liquid soap.
   - Using soap (as a bar or liquid)
   - Vigorously rubbing your hands together, front and back
   - Counting to 20 slowly (representing 20 seconds) while rubbing hands
   - Rinsing hands
   - Drying hands using a clean towel. Paper towel, or air blower

Students can demonstrate the rules by going through all the steps as a class.

13. Have a group of students or the whole class properly wash their hands so potato 3 can be handled. (See Extension 1 for a Hand Washing Song.) It is very important that potato 3 be handled only by clean hands. After the potato is handled, seal it in its bag with the same amount of air as bags 1 and 2. Place all three bags together in a visible place. Ask:
   - What is the same about the three potatoes and bags? Different?
   - What has been done to each of them?

Group the similarities and differences. With older students, introduce the concepts of control and experimental variables. Have them identify the control and experimental variables in this experiment.

➤ Session Two

1. Use the transparency Potato Experiment Prediction. For older students, distribute copies to groups to record their predictions.

2. Discuss the directions with students. Have them consider what was done to each potato in completing their prediction drawings. Talk with students about the importance of looking carefully at the potatoes. Urge them to record minute details. In a visible place make a long list of words that could be used to describe the potatoes.

3. Have groups finish the last two questions on the sheet. With younger students, complete the transparency together.

4. Pass the potato bags around. Make sure they are not opened! Groups need this prediction sheet to complete the summary sheet.

Optional: Play a germ buster game outside or in the gymnasium. This game can be played as part of or between sessions. You will need chalk or masking tape, 4 or 5 Nerf balls, and colored string or yarn arm bands or paper headbands for all but one student. Outline a giant hand on the ground or floor. All but one
student are the germs. They wear the arm or headbands and can move anywhere inside the hand boundaries. One student is the germ buster and is given one Nerf ball (represents soap bubble). The object of the game is for the germ buster to hit the germs with the soap bubble.

Begin with one germ buster. The germ buster air dribbles the soap bubble (passes Nerf ball between hands; the nerf ball cannot touch the ground) while chasing the germs. The germs try to avoid the soap bubble and must stay inside the hand boundaries. When a germ gets hit with the soap bubble, he/she takes off the arm or headband and becomes a germ buster. Once there are two germ busters, they air dribble the soap bubble to each other. A germ buster may not run if he/she has possession of the soap bubble. This provides the opportunity for teamwork and strategies. Additional soap bubbles may be added for more excitement. The last germ caught becomes the germ buster for the next game.

³
Session Three (a week later)
1. Use the transparency Potato Experiment Data. Distribute copies to groups of older students to record their first set of observations.
2. On the Day line, have students record the number of days passed since setting up the experiment. Discuss the directions with students. (They don’t have any other data to compare yet. That will occur in subsequent weeks.) After passing the three bags around, have groups finish their observations. Stress the importance of observing carefully and taking notes on every possible detail. Explain that one skill practiced by scientists is making accurate and detailed observations in their data gathering. For younger students, complete the transparency with them. Groups need this data sheet for future reference.

³
Session Four (a week later)
Using the second column on the Potato Experiment Data sheet, have groups make another set of observations. Pass the bags around. Remind students of the importance of careful observation and description. Label the number of days. This time students can compare their first set of data with this data for additional comments. Complete the transparency with younger students. (Potato 2 may be starting to show bacterial growth. A multitude of colors is possible. Potato 1 and 3 should be similar in appearance.) Groups need this data sheet to complete the summary sheet.

³
Session Five (another week later)
1. (If potato 2 is not showing dramatic bacterial growth, wait a few more days.) Have groups make their last set of observations using the third column on the data sheet and the bags of potatoes. Students now have two other sets of data to compare with this one for additional comments. Complete the transparency with younger students.
2. Using the Prediction and the Data sheets, have groups complete the Potato Experiment Summary sheet. Discuss the directions with students. Allow groups time to discuss their findings and make conclusions. You may need to assist students with the interpretation of their data. Complete the transparency with younger students. Discuss questions on the sheet. Summarize by asking:
   • What was the initial difference you could observe about the potatoes?
   • What were the differences between potatoes 1, 2, and 3? Similarities?
   • What did you observe over time?
   • Based on your data, what do you conclude about the potatoes?
   • What recommendations would you make about hand washing based on your findings?
   • What are important rules to follow when washing your hands? (Use water, use soap, and wash for 20 seconds.)
   • How can what you learned in this experiment help you decide when it is important to wash your hands?
Dispose of the potatoes in their plastic bags.

³
Evaluation Options
1. Have students respond to a series of statements with thumbs up for true, thumbs down for false.
   ✓ If our hands look clean, we don’t need to wash them. (False.)
   ✓ It doesn’t matter how long I wash my hands. (False.)
   ✓ I need to wash my hands with soap and water for 20 seconds to get rid of germs. (True.)
   ✓ If I’m the only one eating my food, I don’t need to wash my hands before eating. (False.)
2. Have students write about or make a drawing demonstrating the rules for washing hands. Have older students design information signs about hand washing and how it prevents the spread of disease, signs that can be placed in restrooms or other appropriate places.

3. Have students practice washing their hands properly at the sink, demonstrating the rules. Have them count aloud to 20. Remind students not to waste water. Have them describe why it is important to follow these rules.

4. Have students describe a variable they could control in an experiment about germs. Have them conduct the experiment.

➢ Extensions and Variations

1. Have students sing the following song while washing their hands. It reinforces the lesson concepts and is more fun than counting to 20. It takes approximately 20 seconds to sing.

   **Hand Washing Song**
   
   Song tune: “Frere Jacques”
   
   I wash my fingers,  
   I wash my hands,  
   Cause germs can hurt,  
   Germs can hurt!  
   My hands are getting cleaner,  
   Good-bye dirt,  
   My hands are getting cleaner!  
   Good-bye dirt!

2. Conduct the potato experiment again. This time use four potatoes. Potato 1 and 2 are treated exactly as in the first experiment. On potato 3 use regular soap and on potato 4 use antibacterial soap. In the set-up, students are controlling all the variables except the treatment of the potatoes. Students make predictions, gather data through observations, and summarize the experimental results. Did the type of soap make a difference?

   Optional: Antibacterial soap eliminates practically all the microbes on the hands and keeps them wiped out for many hours. Have students design and conduct the experiment using antibacterial soap and every hour for a specific number of hours, the students handle a different clean potato. Potatoes are placed in individual plastic bags and sealed. Students record their observations.

   Optional: Germs need warmth, moisture, and nourishment (food) to grow. Have students design and conduct potato experiments using these variables. For example, how does temperature affect bacterial growth?

3. Investigate the nutrient cycle and benefits of microorganisms such as bacteria. There are numerous kinds of microorganisms responsible for breaking down and decomposing organic waste. The microorganisms decompose waste into simpler elements or compounds that enrich soil and provide nutrients for new plants. What would happen if there were no microorganisms to decompose waste or enrich the soil?

4. Demonstrate cleaning fingernails with a fingernail file and fingernail brush, soap, and water. Discuss with students why it’s important to clean under the fingernails regularly. Discuss how fingernails can be a hiding place for germs.

5. Invite the school nurse, a health-care professional, or a department of health employee to visit the classroom to talk about the diseases that are transmitted by contact and the importance of proper hand washing in the medical profession. Have the speaker demonstrate the time, the technique, and other things done to prevent the spread of germs. Be sure to find out the type of soap used

6. Arrange a finger painting activity for students. Record the time it takes for students to wash all the paint from their hands. Where did the paint seem most difficult to remove? How might this be similar to washing germs off of our hands?

7. Invite the school cook, a department of health employee, or a food-industry employee to visit the classroom to talk about the importance of proper hand washing in the food-service industry. Have students notice that all restaurant and grocery store restrooms have – or should have – signs stating, “All employees must wash their hands before returning to work.” Why?
Biotechnology Learning Activity Lesson

8. Have students check their desks and/or a variety of surfaces within the classroom. Give students a one inch slice of potato. Have them wipe the slice across the surface, place it in a plastic bag, seal the bag, and observe the potato slice for bacterial growth. Or if agar plates are available, have students use a cotton swab tip to check for germs on various surfaces. If microscopes are available, have students take a closer look at the growth.

9. Have students keep records of their hand washing practices throughout the year. Were there times students needed to be reminded about correct hand washing? What affect did correct hand washing have on absences?

10. Have students conduct a survey on the number of students who wash their hands before eating lunch. Display the results in the cafeteria. Compare their results to the American Society for Microbiology research results provided in the Supporting Information.

11. Have older students conduct research on diseases that interest them. Ask students to describe the germ, provide a picture of the germ, and identify it as a bacteria or virus.

Source:
Developmental Activities for Science and Health

Related Web Sites:
http://home.earthlink.net/~zinkd/prevent.htm
http://falcon.cc.ukans.edu/~jbrown/ecoli.html
Potato Experiment Prediction

Names:______________________________________________________________________

Directions: Complete the questions below.
1. What do you think will happen to the three potatoes in three weeks? This is your guess or prediction. **Draw**
   what you think each potato will look over time and **write** why you think that.

**Potato 1:**

![Image of Potato 1]

Why?

**Potato 2:**

![Image of Potato 2]

Why?

**Potato 3:**

![Image of Potato 3]

Why?

2. What are the reasons for your predictions?
3. On what knowledge are you basing your prediction? In other words, what do you already know?

**Potato Experiment Data**

Names: ____________________________________________________________________

Directions: Draw on the potatoes to show what you see happening. Write your observations below each potato. Do the potatoes look as you thought they would? Why or why not? Compare each set of your observations. How are they the same? Different?

**Potato 1:**

Day: ________________  Day: ________________  Day: ________________

Observations:  Observations:  Observations:

**Potato 2:**

Observations:  Observations:  Observations:

**Potato 3:**

Observations:  Observations:  Observations:
Potato Experiment Summary

Names: ______________________________________________________________________

Directions: Compare all the observations you gathered on your potato data sheet to answer the questions.
1. How did each potato change over time? **Draw** what the “before” and “after” potatoes look like and describe them.

**Potato 1:**

**Before**

![Image](before1.png)

**After**

![Image](after1.png)

Describe: __________________________________________________________________

**Potato 2:**

![Image](before2.png)

![Image](after2.png)

Describe: __________________________________________________________________

**Potato 3:**

![Image](before3.png)

![Image](after3.png)

Describe: __________________________________________________________________

2. Go back and read your original guess or prediction about each potato. How did your prediction compare with what your observations showed?

3. What conclusions can you make from this experiment?

4. What have you learned?
Toxics Lesson Plan

Content Organizer(s):
Resource Recovery

Standard Statement(s):
4.8.7C

Content Objective(s):
At the conclusion of this activity, students will be able to:
1. Read labels of household products looking for warnings on use, storage and disposal of the product.
2. Discover that the products we purchase at stores may have a harmful effect on our health and our environment.
3. Make a choice to use these household products or alternative products.

Assessment Strategies:
Student produced materials that will:
1. Describe the location in students’ residences of these household products.
2. Discuss the safe storage and disposal of hazardous products to prevent harm, to children, pets, wildlife and water supply.
3. Discuss the substitute alternative household products for those home products that contain warning labels. Students will make suggestions of alternatives.

Procedures:
Background Information: A toxic material is any substance that is capable of harming a person if ingested, inhaled, or absorbed through any body surface. Toxic substances vary widely in the types of harm they cause, the conditions under which they become harmful, and the amount it takes to cause harm. We do not know exactly how many households in our society use commercial cleaning products, but the number is quite high. In this activity, students survey themselves and their families to find out attitudes and beliefs people hold about toxics. This activity will take three periods.

Part 1:
1. Introduce students to the survey by posing the questions to the class and discussing their responses. Explain that a survey is a set of questions with no right or wrong answers; surveys allow us to find out what different people think about the same questions.
2. Tell the class that they will be taking home the same set of questions that they have just answered in class. Tell them that they should ask each member of their family to record their individual responses on a separate sheet and share their responses verbally with the student. Ask the student to bring the survey back to school the following day.

Part 2:
1. Discuss the survey results with the students in a class discussion. Discussion questions:
   • What does toxic seem to mean to the people we surveyed?
Biotechnology Learning Activity Lesson

- Do most people seem to agree on the question of when it is okay to use toxics? If not, why do you think people have different ideas about this?
- Did members of your family answer the questions the same way as you and as each other?
- What else did you find out?
- Was there anything that surprised you?

2. Send home a copy of Household Hazardous Waste Substitution List with each student. Have them list three substitutions they made for household toxics.
3. Assign floor plan assessment tool for students to complete.

Part 3:

1. Have students share locations of materials stored and their substitutions for toxic products in the home.

Source:

This activity was taken from www.cfe.cornell.edu/wmi/TrashGoesToSchool/Toxics.html

Related Web Sites:

http://www.cfe.cornell.edu/wmi/TrashGoesToSchool/TrashIntro.html
Household Hazardous Product Survey

Name ___________________________ Date ___________________________

1. How many of the following potentially hazardous products are found in your home? Make a check mark in column A for each type of waste, such as paint thinner, that you find. Use column B to ask your parents if these items were in their homes when they were your age.

<table>
<thead>
<tr>
<th>A</th>
<th>Item</th>
<th>B</th>
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<tr>
<td></td>
<td>Nail Polish Remover</td>
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<td></td>
<td>Oven Cleaner</td>
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<td></td>
<td>Kerosene</td>
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<td></td>
<td>Bleach</td>
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<td></td>
<td>Furniture Polish</td>
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<td></td>
<td>Furniture Refinisher</td>
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<td>Paint Stripper</td>
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<td>Paint Thinner</td>
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<td>Drain Cleaner</td>
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<td>Weed Killer</td>
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<td>Degreaser</td>
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<td>Rug Cleaner</td>
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<td></td>
<td>Metal Polish</td>
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<td></td>
<td>Rust Remover</td>
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<td></td>
<td>Car Wax</td>
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<td></td>
<td>Wood Preservative</td>
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<td>Antifreeze</td>
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<td></td>
<td>Motor Oil</td>
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<td></td>
<td>Insect Repellent</td>
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<td></td>
<td>Pest Strips</td>
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<td>Batteries</td>
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<td>Drain Cleaner</td>
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<td></td>
<td>Others</td>
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</table>

2. Were there any items that YOU checked off in Column A that your parents did not include in Column B? What were they and where are they found in your home?

_________________________________________________________________________________ ____________
_________________________________________________________________________________ ____________
_________________________________________________________________________________ ____________

3. List the ways you can reduce the amount of hazardous products in your home.

_________________________________________________________________________________ ____________
_________________________________________________________________________________ ____________
_________________________________________________________________________________ ____________

4. How can you and your family safely dispose of household hazardous waste?

_________________________________________________________________________________ ____________
_________________________________________________________________________________ ____________
_________________________________________________________________________________ ____________

5. In your house, which room contained the most hazardous products? Why?

_________________________________________________________________________________ ____________
_________________________________________________________________________________ ____________

page 3
Possible Substitutions for Household Toxics

**Air Freshener:** Set vinegar out in an open dish.

**Drain Cleaner:** Pour boiling water down the drain, or use a plunger or metal snake.

**Furniture Polish:** 1 teaspoon lemon oil in 1 pint of mineral oil, or rub crushed raw nuts on the wood for an oily polish.

**Houseplant Insecticides:** Wash or spray leaves with soapy water, then rinse.

**Mothballs:** Put clothes in cedar chests, or place cedar chips around clothes.

**Oven Cleaner:** Salt, baking soda, water (end elbow grease!)

**Roach Spray:** Chopped bay leaves and cucumber skins, or boric acid (sold in powdered form), or 1 part borax and 1 part brown sugar set out in dishes (these are not as effective, and the latter two may be hazardous to animals and children).

**Silver Cleaner:** Soak silver in 1 qt. warm water containing 1 teaspoon baking soda, 1 teaspoon salt, and a piece of aluminum foil.

**Toilet-Bowl Cleaner:** ½ cup bleach.

**Window Cleaner:** 2 tablespoons vinegar in 1 quart water.

Source: Edited from *A Guide to the Safe Use and Disposal of Hazardous Household Products*, Metropolitan Area Planning Council, Massachusetts
Content Organizer(s):
Resource Recovery

Standard Statement(s):
3.6.7 A, 3.8.7 A, 3.8.7B, 4.3.4A, 4.3.4B, 4.8.4C

Content Objective(s):
During this activity, students will be able to:
1. Describe how bodies of water become polluted.
2. Demonstrate several ways to clean polluted water.
3. Relate how our actions can adversely affect our environment.

Assessment Strategies:
Complete the assessment included with the Benjamin Harbor handout.

Procedures:
Allow at least 60 minutes for this activity plus 20-30 minutes of set up time.
1. Group students by fours.
2. Fill a large, clear container with 3-4 gallons of water.
2. Hand out the small containers of pollutants to six students and assign the following parts, soil - farmer, cooking oil - mechanic, blue food coloring - factory worker, garlic powder and black pepper – homemaker, styrofoam pieces - picnicker, detergent - Uncle Wally.
3. Explain that you are going to tell a story and when the actors hear their characters named, they will add their pollutant to Benjamin Harbor.
4. After reading the story, have the children gather in cooperative working groups, distribute the student recording sheets for a brief review and emphasize the procedures and rules. Be sure to stress that the only person authorized to manage the collection and distribution of materials is the Materials Manager for each group. In addition, All materials used to clean the lake must stay on the group tray. Nothing may be thrown away.
5. Each group must also keep a tally of the cost associated with the clean-up procedure. Each material used has a cost factor and it is suggested that one person in each group, the financial advisor, keep track of the clean-up cost.

Teacher Notes: This activity combines environmental awareness and creative problem solving. It must be noted here that certain pollutants added to the “harbor” may not be retrievable (e.g. the garlic powder smell). This feature is built in not to frustrate students, but to bring home an important point: Humans do not have all the answers to the environmental problems they create. You may decide to conduct this activity outside so that the students are free to focus more on experimentation and less on good housekeeping.

Science Background: Oil spills are sometimes cleaned up with straw. A variety of filters can be made and will act similarly to how leaves and soil clean water as it percolates down into the ground. Housekeeping: This is a messy activity, but that is actually the point. Pollution is easier and less costly to prevent than to clean up. Hide your trash cans as children may forget to hold on to all used and unused cleaning material. Children need to be held responsible for the entire clean up process. The Maintenance Director from each cooperative group should be in charge of directing the clean up phase of this activity.

Related Web Sites:
This plan is taken from CESTA project with the help of Dr. William Metz and Dr. Ken Schroder. They adapted this activity from Jonah Roll, Franklin Institute, 1989.
Benjamin Harbor

The town of “Who-Cares” lay on the banks of beautiful, clean Benjamin Harbor. The townspeople of Who-Cares never really thought very much about the harbor they, just used it much in the same way as numerous generations had before them.

One, “Never-Ever-To-Be-Forgotten” morning the townspeople of “Who-Cares” woke up to a sight that shook them beyond belief. The night before this “Never-To-Be-Forgotten” morning it had rained very hard and a large amount of top soil washed into Benjamin Harbor from Farmer Cowplop’s west pasture (Farmer dumps in the top soil). But this was not the only mishap that occurred during the night.

Across town, a mechanic at Clyde’s Garage tipped over a tank of used motor oil and it ran into a vacant lot behind the building (Mechanic pours in the oil). But that’s not all... a homemaker rinsed the dishes after the annual Firemen’s Weasel Roast putting hugeantic amounts of black pepper and garlic powder into the waste water system (Homemaker pours in the garlic powder and black pepper). To make matters worse, a few thousand picnickers did not clean up after themselves and left trash all around the harbor (Picnicker dumps in trash). Uncle Wally, of Uncle Wally’s Diaper Service, used much more detergent than called for in his new washing machines and the excess was discharged into YOU-KNOW-WHERE (Uncle Wally pours in the detergent). Finally, an employee at the local widget factory accidentally poured a flask of “P-9 with Happenstance” down the drain. (Factory Worker pours in blue food coloring).

And so...you can plainly see the dilemma that met the townspeople of “Who-Cares” on that fateful morning. That’s why you’ve been called in. Your job is to clean up the harbor.
Benjamin Harbor

Directions: Your team will be given 40 minutes to clean up a sample of polluted Benjamin Harbor. You will need to keep a record of all the materials you use and the results of each test.

Put a tally mark in the box each time you use a cup of polluted Benjamin Harbor for a test.

<table>
<thead>
<tr>
<th>Materials Used and Sketch of set up</th>
<th>Results of Test</th>
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Please describe your best cleaning method and why you “think” this worked well.

Please explain how you would feel about drinking the water your team cleaned.

Compare the amount of polluted water you tried to clean to the amount water you were able to clean.

Considering the amount of clean up materials used can you suggest a better way of dealing with this problem?
The Town Council of Newport, Rhode Island met last night in an effort to find a permanent solution to the many pollution problems presently affecting the harbor of Newport and quality of the local beaches. The most recent incident occurred last night following a heavy rainstorm, the fifth such disaster this year. There were piles of trash and soapsuds floating in the harbor, the clean blue water had turned an oily pink and was very odorous. The normally clean white beaches were covered with a coating of muddy topsoil. Fishing, clam and oyster beds are threatened, as is the tourist industry, which is the basis for Newport’s summer economy. The cost for cleaning has increased each time the town has had such a problem. The Council has sought State and Federal aid but has been flatly denied by government lawmakers because pollution laws were broken. This leaves Newport in very bad spot. The town cannot afford to continue paying for clean-up efforts and if the Council raises taxes to cover respective costs it will force many long time residents to move. To make matters worse the tourist industry will probably completely vanish if the harbor and the beaches are not fit to use.

**Assignment**

Based upon your experience in previous clean-up efforts write a letter to the Newport, Rhode Island Town Council advising them as to how they might permanently solve their pollution problems.

Make sure that your writing:
- Gives enough information about how to control each pollutant that ended up in Benjamin Harbor;
- Tells the Town Council why it is so expensive to continue cleaning up the pollution and what they could do to save money;
- Uses interesting words and complete sentences;
- Have correct spelling, grammar, and punctuation.
- Connects to something else you have experienced or read about in your world (self, world, text).
A Better Solution to Potential Pollution

Directions: Write a letter to the Benjamin Harbor Town Council telling them:
♦ What happened?
♦ What your team tried to do.
♦ The result of your efforts including the quality and quantity of the sample and the amount of clean up material used
♦ What do you propose that would be a better and more permanent solution
Benjamin Harbor
Materials Price List

One unit of the following materials:
  Sand........................................... $4.00 @
  Saw Dust .................................... $2.00 @
  Kitty Litter (if available)............. $5.00 @
  Vinegar (if available)................. $15.00 @

Plastic-ware prices:
  Small cups.................................. $1.00 @
  Large containers ......................... $2.25 @
  Spoons ..................................... $1.75 @
  Funnels .................................... $3.25 @

Cotton Balls............................... $1.00 @
Paper Towels............................... $1.00 @
Filters ...................................... $4.50 @
Nuclear Reactor Incident

Content Organizer(s):
Regulation and Safety

Standard Statement(s):
3.6.12 A, 3.2.12 C, 3.2.12 D
4.3.12A, 4.3.12B, 4.3.12C

Content Objective(s):
At the conclusion of this activity, students will be able to:
1. Experience the issues involved in environmental planning.
2. Learn the effects of a nuclear accident and be able to draw conclusions and scenarios from a disaster at a nuclear power plant.
   - Track the path of radioactive dust from the Chernobyl nuclear reactor incident.
   - List and discuss effects upon the political, economic, health, and environmental areas.
   - Simulate disaster possibilities at the reactor nearest their home.

Assessment Strategies:
Teacher observations and student generated work/responses.

Procedures:
This activity will take approximately four 45-minute periods.

Period One:
1. Introduce the activity and define terms.
2. Discuss the Chernobyl incident.
3. Have students list and define terms.
4. Have students discuss the Chernobyl incident and generate questions about the accident and its effects.
5. Discuss the major types of nuclear reactors.

Period Two:
1. Have students research the Chernobyl incident and map out the area of nuclear contamination.
2. Have students list the effects on the politics, health, economics, and environmental areas.

Period Three:
1. Have students simulate a similar disaster at a nearby reactor and map a similar radioactive dust pattern.
2. Have students draw conclusions and scenarios from this disaster.
3. Have the students prepare solutions to eliminate the potential for the disaster, or to deal with the disaster in a more efficient manner.

Period Four:
1. Discuss reactor safety.
2. Establish that the high emotional content of an issue like nuclear power affects perception.
3. Have students discuss the extensive media coverage given to Chernobyl and compare this to other major disasters.


Related Web Sites:
http://www.infoukes.com/history/chernobyl/
http://www.nea.fr/html/rp/chernobyl/
http://www.uilondon.org/chernidx.htm

Suggested Level:
Grades 11-12

Standard Category:
Technology Education Inquiry & Design

Materials:
- Research materials about Chernobyl
- Activity Sheet (included)

Instructional Strategies:
- Whole class
- Small groups
Overview

Have you ever thought about the risks associated with nuclear power and compared those risks to other events? Have you ever looked at both sides of the issue concerning nuclear power? This issue of nuclear power is a very volatile one. It is not easy to sort out all the facts. You must analyze the issues carefully.

Your Problem:

Track the path of the radioactive dust from the Chernobyl nuclear reactor incident. List the effects upon the political, economic, health and environmental areas. Simulate a similar disaster at the reactor nearest to your home. Draw conclusions and scenarios from this disaster.

- Research the Chernobyl disaster
- Track the radioactive dust path
- List and discuss the effects of the radiation upon the political, economic, health, and environmental areas.
- Simulate a similar disaster at the nuclear reactor nearest to your home
- Map a similar radioactive dust path
- Draw conclusions and scenarios
- Discuss your conclusions in class
Title: Nuclear Reactor Incident

Matrix Reference Code: S,B,GL

Primary Objective: Experience the issues involved in environmental planning.

Length of Unit (Days): 4

Description of Activity: This activity demonstrates to the learner the importance of bio-related technology on a global basis. Students will learn the effects of a nuclear accident and be able to draw conclusions and scenarios from that disaster at a nuclear power plant.

Developed by: Savage, E. (1990)
Technology Systems Handbook
Bowling Green, Ohio
The Model Technology Systems Handbook

Adapted by: Timothy J. Weber, Consultant
Ohio Model Technology Systems Project

INPUT

ISSUES INVOLVED IN NUCLEAR POWER PLANTS

PROCESS

RESEARCH THE
CHERNOBYL NUCLEAR
REACTOR INCIDENT;
SIMULATE A SIMILAR
DISASTER AT THE REAC.
NEAREST YOUR HOME

OUTPUT

LIST EFFECTS UPON
THE POLITICAL,
ECONOMIC, HEALTH,
AND ENVIRONMENTAL
AREAS
Overview:

Have you ever thought about the risks associated with nuclear power and compared those risks to other events? Have you ever looked at both sides of the issue concerning nuclear power? This issue of nuclear power is a very volatile one. It is not easy to sort out all the facts. You must analyze the issues carefully.

YOUR PROBLEM FOR THIS ACTIVITY IS TO:

Track the path of the radioactive dust from the Chernobyl nuclear reactor incident. List the effects upon the political, economic, health, and environmental areas. Simulate a similar disaster at the reactor nearest your home. Draw conclusions and scenarios from this disaster.

Procedures-

1. Research the Chernobyl reactor disaster.
2. Track the radioactive dust path.
3. List and discuss the effects of the radiation upon the political, economic, health, and environmental areas.
4. Simulate a similar disaster at the reactor nearest your home. Map a similar radioactive dust path.
5. Draw conclusions and scenarios.
6. Discuss these in class.
Biotechnology Learning Activity Lesson

Energy-Environment Relationships

Content Organizer(s):
Regulation Safety

Standard Statement(s):
3.6.12 A, 3.8.12 B

Content Objective(s):
At the conclusion of this activity, students will be able to:

1. Explore how the action of individuals and organizations can affect our environment.
   - Defend a position about an aspect of the energy / environment problem.
   - Make judgments on the arguments presented in the role-playing.
   - List examples of decisions that they may have to make in relation to the energy/environment crises.

Assessment Strategies:
1. Student’s defense of a position in the role-playing activity and take an active part in the activity.
2. Students will write a paragraph explaining the dilemma involved with making decisions about energy sources and use of energy in relationship to their effects on the environment.

Procedures:
This activity will require three 45-minute periods.

Period One:
1. Introduce the activity.
2. Pass out role sheets and have students choose which role they wish to play.
   - Choose a role with which you feel comfortable.
3. Have students begin researching that role.
   - Formulate arguments in favor of your position.

Period Two:
1. Set the role players in a circle or semi-circle. The teacher is in the middle as the moderator.
2. Open the discussion by delineating the topic to be discussed:
   - Should we build a nuclear plant in the area?
   - Should natural gas and oil prices be controlled?
   - Where should federal government money go for energy research?
   - What should new car pollution standards be?
   - Can the local fossil fuel plant continue to pollute?
Biotechnology Learning Activity Lesson

- What mining techniques should be permissible?

Period THREE:
1. Continue the role-play discussion for half the period.
2. Have students write a paragraph to be evaluated by the teacher.

Source:
Developed by Technology Infusion Project (1984), Senior High School Teaching Materials, The Commonwealth Institute for the Improvement of Science and Mathematics Education, 333 Market Street, Harrisburg, PA 17126

Adapted by Timothy Weber, Ohio Model Technology Systems Project.

Related Web Sites:
http://starfire.ne.uiuc.edu/~ne201/1996/browde/
http://www.nea.fr/html/rp/chernobyl/
http://www.nrc.gov/
http://www.uilondon.org/chernidx.htm

Many more sites – Search under “nuclear reactors”
GENERAL OBJECTIVE:

As a result of this activity, students will understand that there are many aspects that need to be taken into consideration when considering various energy sources and that they will be making value decisions concerning energy and environment in everyday living.

PERFORMANCE OBJECTIVE:

Students will be able to:

1. Defend a position about an aspect of the energy-environment problem.

2. Make judgments on the arguments presented on the role-play.

3. List examples of decisions that they may have to make in relation to the energy/environment crisis.

LEARNING ACTIVITY:

1. This activity will involve role-play, with students taking the positions of various members of the community concerned about various aspects of the energy-environment problem. Given below are some suggestions for roles and a description of the role-player's position on the issue. You may use these and/or whatever others you wish.

a. Moderator - recognizes each speaker in turn. (if you wish you may play this part yourself.)

b. Electric company representative - wants the cheapest fuel developed (nuclear and coal). Will have to pass the cost of pollution control on to customer.

c. Environmentalists #1 - concerned about strip mining and thermal pollution.

d. Environmentalists #2 - concerned about air pollution and its effects.

e. Coal company representative - wants to mine as cheaply and as easily as possible (strip mining).

f. Uranium company representative - pro-nuclear, pro-breeder.

g. Consumer #1 - speaks as a utility-bill payer for low cost energy.

h. Consumer #2 - wants the most convenient sources of energy for home use.

i. Legislator - wants a sensible solution equitable both to industry and his constituents.

j. Energy company representative - wants to raise oil and natural gas prices.

k. Local mayor - "Don't build it here; build it over there."

l. Auto manufacturer - wants to build cars with as few expensive pollution controls as possible.
Biotechnology Learning Activity Lesson

m. Heart Association representative - wants as little air pollution as possible.

n. Scientist - wants money for research on new power sources, favors nuclear breeders.

Assign these roles a day or two before-hand and ask the participants to consider how they would feel being whomever they will portray. Encourage research - the students should be able to present coherent arguments in favor of their positions.

For the actual role-play, set the participants in a circle or semicircle with the moderator in the middle. The rest of the class can be alternates or spectators. Make up large (8" x 16") signs with the roles printed on them and have the students display them for easy identification.

The moderator opens the discussion by delineating the topic to be discussed

Some suggestions:
- Should we build a nuclear plant in the area?
- Should natural gas and oil prices be controlled?
- Where should federal government money go for energy research? - What should new car-pollution standards be?
- Can the local fossil fuel plant continue to pollute?
- What mining techniques should be permissible?

Notice that some roles are not appropriate to some questions; these players can be removed at your discretion.

It is the moderator's responsibility to inject comments occasionally to keep discussion on the right track. He should call on those wishing to give their views in turn. Emphasize that all of these issues are cost-benefit problems. How much are we willing to pay for what benefits in decreased pollution? You may wish to appoint one spectator as secretary to keep a record of views held and decisions made.

2. Have students make a list of statements that show some decisions that students might become involved with in the energy/environment crisis.

Examples:

a. I am mechanically inclined, so when I get my new car I can take off the antipollution devices so that I can get better gas mileage.

b. I do not want a new electric generating plant near me, so I am willing to cut back on my energy consumption and to try and convince others to do likewise.

c. Industrial companies should not have to install anti-pollution devices because that means I have to pay more for their products.
EVALUATION:

The student will be able to write a paragraph explaining the dilemma involved with making decisions about energy sources and use of energy in relation to their effects on the environment.

REFERENCES:

Energy In Our Society, Energy Education Advisory Council (sponsored by Philadelphia Electric Company)


Biotechnology Learning Activity Lesson BLA#: 84

pGLO Transformation

Content Organizer(s):
Medical Technology, Biomaterials, Genetic Engineering

Standard Statement(s):

Content Objective(s):
After completing the activity, students will be able to:
1. Learn, apply, and master an understanding of the scientific inquiry process.
2. Define transformation and its role in genetic engineering and biotechnology.
3. Transform a bacterium using sterile technique.
4. Analyze and interpret experimental results using comparisons with controls.
5. Calculate transformation efficiency.
6. Apply knowledge gained to design an experiment using biological transformation.

Assessment Strategies:
Student generated responses and products.

Procedures:

Note: This activity should precede BLA 2.

This unique transformation activity allows students to easily explore mechanisms of gene regulation and genetic selection through the unique construction of pGLO. pGLO plasmid carries a gene encoded for Green Fluorescent Protein (GFP). The entire process (transformation of organism through expression of new genetic material) is observable with an inexpensive hand-held UV lamp. This activity needs two days to complete.

Note: This activity precedes BLA #2, “Secrets of the Rainforest.”
1. Follow the Manual curriculum and Graphic Quick Guide included in the kit.

Extension:
The pGLO system also allows an additional experiment involving purification of the recombinant fluorescent protein in Bio-Rad Kit #2.

Source:
Bio-Rad Corporation
Bio-Rad Laboratories
Life Science Research Group
2000 Alfred Nobel Drive
Hercules, CA 94547
1.800.424.6723

Related Web Sites:
http://www.bio-rad.com

Suggested Level:
Grades 10-12

Standard Category:
Biological Sciences
Technology Education
Technological Devices
Inquiry & Design
Science, Technology & Human Endeavors

Materials:
Bacterial Transformation
pGLO kit (materials in kit are for 8 complete student workstations):
- Transformation Buffer, sterile
- 40 Petri dishes
- Inoculation loops
- Plasmid (pGLO), lyophilized
- E. Coli strain, lyophilized
- LB Broth, sterile
- Ampcillin, lyophilized
- Arabinose, lyophilized
- 60 Microtubes –2.0 mL Sterile color coded
- 8 Floating microtube racks
- 40 Plastic pipets
- LB-Agar (Lennox) Powder Packet
- Purchase kit from Bio-Rad catalog #166-0003EDU

Required Accessories not included in kit:
- UV lamp
- Microwave oven
- 1 –liter flask
- Distilled water, 500 mL
- 37°C incubator oven (optional)

Instructional Strategies:
- Groups
- Whole class
Biotechnology Learning Activity Lesson

Rehydrate bacteria and streak starter plates

Incubate overnight at 37 °C

Pick single colonies. Inoculate transformation & control tubes

incubate both tubes on ice for 15 minutes

Heat shock at 42 °C for 50 seconds

Place on ice for 2 minutes

Add nutrient broth & incubate for 10 minutes for the gene expression

Spread bacterial suspensions onto plates

DAY 1

Incubate overnight at 37 °C

White colonies
Fluorescent green colonies with UV Lamp
No growth
Bacterial lawn

Analyze and interpret results

DAY 2

Extension: purify & analyze GFP using Bio-Rad Kit #2
Buckle that Seatbelt!

Content Organizer(s)
Regulation Safety

Standard Statement(s):
3.6.7.C, 3.8.4 B, 3.8.7B, 3.7.7A, 3.7.7B

Content Objective(s):
After completing this activity:
1. Students will be able to see how technology has improved their quality of life.
2. Students will recognize there are various steps to the technological process.

Assessment Strategies:
Student will:
1. Demonstrate the safe and unsafe use of the model car’s seatbelt.
2. Devise at least one successful way to keep the occupant (an egg) in the vehicle, unharmed.
3. Using K'nex, construct a dragster with a system to protect the occupant from a head on crash.
4. Demonstrate and compare each system’s performance.
5. Relate the activity to real life events on our highways.
6. Show a problem solving flow chart in designing the successful seatbelt.

Procedures:
1. Present students with problems of people who are driving without using their seatbelt.
2. Show the ramp and explain testing procedures.
3. Have students construct an “accident”. Have them observe the results of the car and the egg. Students might measure the time the car takes to collide with the ramp. Students might measure the distance that the marble flies. Encourage students to be careful with their measurements.
4. Discuss inertia and friction and how it is observed in this “accident”.
5. After the activity, discuss the materials that worked best or worked poorest.

Source: William Wonders
Mark Temons

Related Web Sites:
http://www.nhtsa.dot.gov/

Materials:
- Wooden ramp
- Eggs
- K’nex dragster
- Books
- Unlimited use of materials: wood, metal, plastics, fasteners and adhesives.
- Rubber bands
- Ribbon
- Axles
- Hard boiled egg
- Pitsco wheels

Instructional Strategies:
- Small Group
How Can You Size Up the Situation?

Content Organizer(s):
Medical Technology, Biomaterials, Genetic Engineering

Standard Statement(s):
3.7.12A, 3.2.12C, 3.2.12D, 3.8.12A, 3.8.12B

Content Objective(s):
After completing this activity, students will be able to:
1. Learn, apply and demonstrate a mastery of the scientific inquiry process.
2. Understand the process of protein purification and its role in biotechnology.
3. Analyze and interpret results.
4. Use knowledge gained to design a creative experiment using protein chromatography.

Assessment Strategies:
Student generated responses and products.

Procedures:
Size exclusion chromatography (SEC) is a powerful technique for separating solubilized molecules by their size. Size exclusion chromatography is an important technique used in biotechnology to separate a desired protein from larger or smaller contaminating proteins. In this activity, students explore the basic principles of size exclusion chromatography. One class period is needed to complete the activity.

1. Follow the Manual curriculum and Graphic Quick Guide included in kit.

Source:
Bio-Rad Corporation

Related Web Sites:
Rehydrate sample mixture
(Hemoglobin and Vitamin B12)

Load mixture onto sizing column

Molecules separate according to size. Colored protein and vitamin allow easy visualization

Collect fractions and separate molecules on the basis of size

DAY 1
How Can DNA Pattern Help Solve Human Problems

Content Organizer(s):
Medical Technology, Regulation Safety, Genetic Engineering

Standard Statement(s):
3.2.10B, 3.2.12B, 3.3.10B

Content Objective(s):
After completing this activity, students will be able to:
1. Learn, apply and demonstrate a mastery of the scientific inquiry process.
2. Become familiar with agarose gel electrophoresis techniques.
3. Become familiar with the applications of restriction enzymes in forensic biotechnology.
4. Estimate and compare DNA fragment sizes on agarose gels.

Assessment Strategies:
Student generated responses and products.

Procedures:
This experiment introduces the basic concepts of DNA fingerprinting (DNA Profiling), a method used in various medical and forensic procedures, as well as in paternity determinations. This activity allows students to simulate the technique, with lab results providing DNA patterns in a gel that reveal the differences and similarities in an individual’s genetic make up. Three class periods are needed to complete the activity.

Suggested student background:
Students should be familiar with:
- Using Micropipettes.
- Graph analysis.
- General lab skills and safety.
- Biology’s central framework (DNA>RNA>PROTEIN>TRAIT).

1. Follow the Teacher’s Guide, student manual and Graphic Quick Guide included in kit. Cat. # 166-0003EDU
   166-0008EDU

Source:
Bio-Rad Corporation, Life Science Research Group
2000 Alfred Nobel Drive
Hercules, CA 94597
1.800.424.6723

Related Web Sites:
http://csdb.nider.nih.gov/csdb/chanchai_site/educ180/nih/overview.html
http://www.bio-rad.com
http://www.bergen.org/AAST/Projects/Gel/fingerprint1.htm

Suggested Level:
Grades 10-12

Standard Category:
Technology Education
Technological Devices
Inquiry and Design
Science Technology & Human Endeavors

Materials:
DNA Fingerprinting Kit
(materials provided are for 8 complete student workstations):
- DNA size standard
- Crime scene DNA
- Suspect 1 DNA
- Suspect 2 DNA
- Suspect 3 DNA
- Suspect 4 DNA
- Restriction Enzyme Buffer
- Bam H1/Hind III Enzyme Mix
- Sample Loading Dye
- DNA Staining Solution, Bio-Safe
- Microtubes, 1.5 ml, color coded
- 8 Foam test tube racks
- 10 Gel staining trays

Required equipment not included in kit:
- Micropipette (1-10 ul or 2-20 ul)
- Pipet tips –1 box of 96
- DNA Electrophoresis chamber
- Power supply, PowerPac 300
- 10XTBE electrophoresis buffer
- Agarose powder
- Microwave oven
- 37°C water bath (optional)
- Microcentrifuge (optional)

Instructional Strategies:
- Groups
- Whole class
Obtain samples of DNA from crime scene and 4 suspects, and DNA size standard

Digest 5 DNA samples with restriction enzyme mix

DAY 1
Incubate at 37 °C for 50 minutes or overnight at room temperature

Load samples into agarose gel

DAY 2
Electrophorese 120 V / 30 minutes

Monitor migration of tracking dyes

Stain gel with Bio-Safe DNA staining solution or ethidium bromide

DAY 3
Match crime scene DNA to suspect's DNA

Extensions: molecular puzzles included in kit manual
Find the Peanut

Content Organizer(s):
Genetic Engineering, Agriculture

Standard Statement(s):
3.1.4 A, 3.1.4 B, 3.1.4 D

Content Objective(s):
At the conclusion of the lesson the student will:
1. Demonstrate how to make careful observations.

Assessment Strategies:
Use a pre-test and post-test with class. Give them an object to describe or draw at the beginning of the lesson. Give them the same object to describe or draw after the lesson. Count the number of details the student described before and after. The end of lesson descriptions should be more numerous. The detail and accuracy of the drawings should be improved.

Procedures:
There are numerous ways to help students learn careful observations of living things.
- Watch plants (Fast Plants and Potatoes work well in classes).
- Watch animals grow and interact. Mealworms, fish, isopods and earthworms are useful.
- Distribute a peanut to each student and have them study it. Collect the peanuts and see if each student can find their own again. This can be done with other living things as well. The descriptions and drawings in support of this lesson develop curiosity and observational power.

Extensions:
- Prepare a food: How has it changed during the preparation? Students can watch their parent in the kitchen or the teacher can demonstrate with boiled eggs (albumen agglutinates due to denaturation), cream turns to butter when beaten.
- Create and maintain a food cycle in the classroom: e.g., frog and mealworms, fish and fruit flies.

Source:

Related Web Sites:
http://www.pde.psu.edu/connections/MATH/253.htm