Week 1: October 4, 2008- Nature of Science, observation and inference

See also Activity 37 in PLT: "Reduce, Reuse, Recycle" (attached)

Learning Objectives:

1. Students will be able to determine the kinds of garbage people throw away and will reflect on their own disposal habits.
2. Students will be able to state an overarching problem with managing Bloomington's trash and will begin to seek solutions to that problem.

Standards:

5.1.5 Explain that technology extends the ability of people to make positive and/or negative changes in the world.

5.1.6 Explain how the solution to one problem, such as the use of pesticides in agriculture or the use of dumps for waste disposal, may create other problems.

5.1.7 Give examples of materials not present in nature, such as cloth, plastic, and concrete, that have become available because of science and technology.

5.2.4 Keep a notebook to record observations and be able to distinguish inferences from actual observations.

5.4.7 Explain that living things, such as plants and animals, differ in their characteristics, and that sometimes these differences can give members of these groups (plants and animals) an advantage in surviving and reproducing.

7.4.10 Describe how technologies having to do with food production, sanitation, and disease prevention have dramatically changed how people live and work and have resulted in changes in factors that affect the growth of human population.

7.4.14 Explain that the environment may contain dangerous levels of substances that are harmful to human beings. Understand, therefore, that the good health of individuals requires monitoring the soil, air, and water as well as taking steps to keep them safe.

8.4.8 Describe how environmental conditions affect the survival of individual organisms and how entire species may prosper in spite of the poor survivability or bad fortune of individuals.

Materials:

- Chart paper

- Markers
- Copies of Human Bingo cards
- Notebook for each student
- A/V equipment to show Wall-E
- Garbage bags (small plastic grocery bags)
- Rubber gloves

Description of the lesson:

Part A: Introduction

Part B: Observation and Inference regarding Bloomington waste management

Introduction (10-15 min)

1. Human Bingo

Observation (25-30 min)

1. *Engage:* Begin with a K-W-L chart on our waste disposal habits.
2. Once the K and the W have been completed, we will show students various slides of landfill pictures and clips from the movie "Wall-E". Meanwhile, students will take notes on the items they see in the landfill pictures.
3. We will create a chart that divides these items into categories: paper products, aluminum/steel, glass, plastic, organic waste (food and yard waste), and other.

Inference (20 min)

1. *Explore:* Students will infer what is in their garbage. Notes will be taken in their notebooks and on the board.
2. Students will break up into groups and share their inferences with their small group. They will be asked what actions might reduce the amount of waste going into landfills.
3. Once each group has come up with a list of solutions, they will be asked to share their solutions with the class.

Explain:

1. Ask students what they think is negative about a landfill.
2. Describe various reasons (leachate contaminates water, smell attracts flies and vermin, burning trash creates air pollution, space and maintenance is expensive, hazardous waste not properly disposed of).

Closure: Go outside and explore the garbage around us: what kinds are things are being thrown on the ground? Is there a lot of trash? Why or why not? Are there other places in the US/World that have more garbage on the ground? Why or why not?

Pick up garbage to promote a cleaner Bloomington.

Name:_____

HUMAN BINGO!

My parents are both from Indiana	I have a pet other than a cat or dog	I am the youngest child in my family	Halloween is my favorite holiday
I have traveled outside of the United States	Science is my favorite subject in school	I am taller than one of my older siblings	I was born in Bloomington
I have been to an IU basketball game	I think worms are disgusting	I like the Indianapolis Colts	I have participated in Saturday Science QUEST before
I want to go to Indiana University, Bloomington for college	I am wearing something green	I like broccoli	I have played tennis

PAPER	ALUMINUM/STEEL	GLASS	PLASTIC	ORGANIC	OTHER

Week 2: October 11th- Evidence to form explanations & facilitate scientific discussion

Learning Objectives:

1. Students will be able to compare the mass of household trash produced at different homes.
2. Students will be able to assess the amount of trash that can be recycled, reused, or composted.
3. Students will consider actions that generate lunch trash. Students will examine ways which generate less lunch trash.
4. Students will be able to determine whether packaging can be recycled or not.
5. Students will be able to learn and use the terms bio and non- biodegradable.
6. Students will be able to collect, analyze, and discuss scientific data.

Standards:

5.1.1	Recognize and describe that results of similar scientific investigations may turn out differently because of inconsistencies in methods, materials, and observations*.
5.2.1	Multiply and divide whole numbers* mentally, on paper, and with a calculator.
5.2.4	Keep a notebook to record observations and be able to distinguish inferences* from actual observations.
6.1.2	Give examples of different ways scientists investigate natural phenomena and identify processes all scientists use, such as collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses* and explanations, in order to make sense of the evidence.
6.2.5	Organize information in simple tables and graphs and identify relationships they reveal. Use tables and graphs as examples of evidence for explanations when writing essays or writing about lab work, fieldwork, etc.
7.4.14	Explain that the environment may contain dangerous levels of substances that are harmful to human beings. Understand, therefore, that the good health of individuals requires monitoring the soil, air, and water as well as taking steps to keep them safe.
8.2.7	Participate in group discussions on scientific topics by restating or summarizing accurately what others have said, asking for clarification or elaboration, and expressing alternative positions.
8.2.8	Use tables, charts, and graphs in making arguments and claims in, for example, oral and written presentations about lab or fieldwork.

Materials:

- Scales for each group
- Plastic gloves

- Small balance (scale)
- Trash bags
- Sample trash collections
- Containers for sorted trash
- Student data sheets
- Calculators
- Sample Lunches
- Pie chart of national averages

Part A- Description of Lesson:

1. Students will have collected and brought in a log of one week's worth of household trash. Discussion and recording of data on board will give students a sense of what they and their peers have thrown away for the week.
2. Instructors will provide several sample garbage bags with a week's worth of trash.
3. In groups, students will weigh filled trash bags on scales. Discuss proper measurement techniques. They must subtract their own weight from the weight of the trash bags and begin filling in data table.
4. One member from each group should record their data on board so that others can have access to it for their worksheets.
5. Students should sort trash into different garbage bags for the following categories:

    - paper
    - metal
    - glass
    - plastic
    - solid food
    - other

6. Weigh each student holding their assigned bag. Subtract the student's weight from the combined weight total. Record in grams/kilograms/pounds (depending on scale units) on the Student Activity Sheet.
7. Using the classroom data set, total the weights of trash for each category.
8. Create a pie chart to show the amounts of each type of trash that was collected for your data.
9. Compare classroom data to national averages

Concluding Questions:

1. Were the amounts of waste collected in each category what you expected? Explain.

2. How might the volume of trash be reduced at these homes? Be specific.

3. How does your trash data compare to other areas?

Student Activity Sheet

Remember to subtract your own weight from that of the trash bag before recording data!

Category	Bag #1	2	3	4	5	Total
Total Mass of Bag						
Mass of Paper						
Mass of Metal						
Mass of Glass						
Mass of Plastic						
Mass of Solid Food						
Mass of Other						

Part B- Description of Lesson

Discuss the meanings of the terms biodegradable and non-biodegradable. Given the following list, try and classify them according to the ratings listed.

Kind of Package	Example Grocery Store Item	Reuse	Reduce	Recycle	Land fill	Bio-degradable ?
No packaging or natural package	Melons, pineapples, fruits					
Returnable glass bottles	Milk bottles, soda and beer bottles with deposit returns					
Shiny paper	Bags of candy, cookies, chips, and					

	other snacks					
Uncoated cardboard	Cereal boxes, detergent boxes, dessert mix boxes					
Newspaper	Printed paper					
Aluminum cans	Beverage containers					
Plastic bottles with twist-off tops	Soft drinks					
Plastic bags	From grocery store					
Batteries	Batteries					
Steel cans	Canned fruits and veggies					
Plastic containers	Plastic bags, heavy plastic containers					
Coated paper	Paper milk and juice cartons					
Aluminum-foil-based containers	Foil-lined boxes and bags					
Collapsible metal tubes	Toothpaste, hand cream					
Aerosol cans	Toiletries, deodorants, hairsprays, insecticides					

Part C- Description of Lesson:

LUNCH A
Lunch box containing a thermos of drink, a piece of fruit such as an apple, pear or plum, a sandwich container, chips and/or carrots and celery sticks in a reusable plastic container, napkin.

LUNCH B
Paper bag containing juice carton, sandwich wrapped in plastic wrap, bag of chips, Twinkie or fruit pie, banana, carrots or celery sticks wrapped in plastic wrap, and a pudding cup, napkin and spoon.

Procedure:

1. Discuss and estimate the amount of trash that will be generated by each lunch.
2. Weigh the non-recyclable/ reusable waste from each lunch.
3. Record your results on the board.

Concluding Questions:

1. Which lunch produced less trash?
2. Why did one lunch produce more trash than the other?
3. Why would students not bring the "less trash-producing" lunches to school?
4. How might you alter your lunch so that it produces less trash?

Extensions:

1. Design a Lunch box and compose the perfectly packaged school lunch.
2. Share with class.

***For next week, give students parent permission forms to take home a compost bin!!*

Week 3: October 18, 2008- Relationship between hands-on and follow-up activities

See also Activity 24 in PLT: "Nature's Recyclers" (attached)

Lesson Objectives:

1. Students will be able to describe how worms breakdown organic material.
2. Students will be able to draw the anatomy of a worm.
3. Students will be able to describe how worms contribute to the lifecycle of organic matter (for example, a banana).

Standards:

4.1.9 Explain how some products and materials are easier to recycle than others.

4.4.2 Investigate, observe, and describe that insects and various other organisms depend on dead plant and animal material for food.

4.4.6 Explain how in all environments, organisms are growing, dying, and decaying, and new organisms are being produced by the old ones.

6.4.3 Describe some of the great variety of body plans and internal structures animals and plants have that contribute to their being able to make or find food and reproduce.

7.4.2 Describe that all organisms, including the human species*, are part of and depend on two main interconnected global food webs*, the ocean food web and the land food web.

7.4.8 Describe how organisms that eat plants break down the plant structures to produce the materials and energy that they need to survive, and in turn, how they are consumed by other organisms.

8.4.4 Describe how matter is transferred from one organism to another repeatedly and between organisms and their physical environment.

Materials:

- Small Rubbermaid bins (not clear) with lids
- Newspapers
- Organic waste
- Worms!
- Spray bottles (for water)
- Knife to make holes in bins
- Worksheets of the anatomy of the red wiggler
- Student notebooks

Description of the lesson:

1. *Engage:* Now that we have seen how much organic waste we dispose of, what can we do about it? There are many ways to manage organic waste: garbage disposals (but that poses a burden on our water treatment plants), farm animals (not all of us are able to do this), compost (requires maintenance and space), and vermicomposting.
2. *Explore:* Provide students with a functional vermicompost bin. Give them 10 minutes to explore the bin, and have them write down three comments and three questions they have about the bins.
3. Review students comments and questions.
4. *Explain:* Provide a short PowerPoint presentation on vermicomposting, describing how it works, the anatomy of red worms, and how to care for a vermicompost bin.
5. WORKSHOP: Students will make their own vermicompost bin. Permission from parents will be requested the week before (Oct. 11) and a poll will be taken to see who is interested in keeping a bin at home. An example compost bin will be brought in to show the students the result.
6. Closure: How long do you think it takes the red wigglers to break down: 1) a banana peel, 2) a coffee filter, 3) wet newspaper, 4) dry newspaper, 5) an eggshell
7. Journal writing: Trace the lifecycle (from cradle-to grave) of a banana.

Week 4: October 25th-Formative Assessment

Learning Objectives:

1. In this activity, students determine the composition of a soil sample by performing a texture test. They will feel the texture of the soil when it is damp and use their data to classify the soil as sand, clay, or silt.
2. In this activity, students will measure and record the compaction of soil to determine how much space is available for air and water
3. In this activity, students will measure and record how long it takes water to soak into the soil, and then use these data to infer the degree of compaction of the soil.

Standards:

5.2.4 Keep a notebook to record observations and be able to distinguish inferences from actual observations.

6.2.5 Organize information in simple tables and graphs and identify relationships they reveal. Use tables and graphs as examples of evidence for explanations when writing essays or writing about lab work, fieldwork, etc.

5.2.7 Read and follow step-by-step instructions when learning new procedures.

6.3.15 Explain that although weathered rock is the basic component of soil, the composition texture of soil and its fertility and resistance to erosion are greatly influenced by plant roots and debris, bacteria, fungi, worms, insects, and other organisms.

6.2.5 Organize information in simple tables and graphs and identify relationships they reveal. Use tables and graphs as examples of evidence for explanations when writing essays or writing about lab work, fieldwork, etc.

5.5.1 Make precise and varied measurements and specify the appropriate units.

Materials:

- Soil Proerties Overview worksheet
- Soil Properties worksheet
- Field journal
- Texture-by-Feel Analysis of Soil worksheet
- Spray bottle
- Hand wipes or paper towels
- Samples of clay, silt, and sand
- Permanent marker or masking tape
- Two pencils

- Empty soup can (or other similarly sized can) with ends removed
- Metric ruler
- Container of water
- Watch with second hand or stopwatch
- Cups

Description of Lesson:

Part A: Discuss journal entries about composting. Ask students to read their entry aloud.

Part B: Conduct lab stations to discover soil properties. Website contains additional information. http://www.fieldmuseum.org/undergroundadventure/index.shtml Before conducting tests, discuss proper measurement techniques!

Texture Test (30-45 min):

1. In groups, students should take a handful of soil from their soil sample and spray it with water until it is damp, but not soaking wet.
2. Rub the soil between fingers and observe and feel its texture.
    - How does the soil feel? Is it sticky, slippery, or gritty?
    - Do the particles look and feel small, large, or somewhere in between?
    - Does the soil feel most like sand, silt, or clay?
3. Use the Texture-by-Feel Analysis of Soil worksheet to figure out what type of soil it is.
4. Return the soil to the container and use the wipes or damp paper towels to clean hands.
5. Record data on Soil Properties worksheet.

Questions for formative assessment:

What do your data tell you about the composition of your soil? Is the soil from your sample mostly sand, silt, or clay? How do you know? Based on the data you collected, do you think your hypothesis was correct or incorrect? Why?

Students should be able to identify the predominant soil type in their sample (sand, silt, or clay) based on the way the soil feels. If the sample feels gritty and contains large visible particles, it is high in sand. If the sample feels smooth and slippery and not sticky between your fingers, it has a high percentage of silt. If the sample feels sticky and can be rolled into a worm shape without breaking apart, the sample has a high percentage of clay. A soil with a combination of all three particle types is called loam. Most samples will likely contain some percentage of all three soil types and therefore will be a loam.

Organic matter or humus is made up of decomposed plants and animals that enrich the soil with nutrients. There are many chemical tests that can help you identify the amount of humus in a soil sample, but looking at the soil color will give you a rough estimate. Generally, the darker black the soil, the more humus. Also look for twigs and leaves within the soil that have not finished decomposing.

How might the soil texture affect the types and numbers of creatures living in the soil? What data could you collect to help answer this question?

Soil that is primarily composed of sand, silt or clay can make a poor home for organisms. Loam, a mixture of the different soil particles, is more conducive to underground life because sand helps open up the soil, silt holds the moisture, and clay releases minerals.

Soil Compaction Test (15-20 min):

1. Push the pointy end of a pencil into the soil as far as you can, using normal force. It is important here that students not use excessive force, such as hammering or stomping the pencil into the soil.
2. Use the other pencil to make a mark on the pencil at the soil level.
3. Pull the pencil out of the soil. Using a ruler, measure the distance from the mark made to the pencil point. This will tell you how far you were able to push the pencil into the soil.
4. Use an eraser to remove the mark you made on the pencil, and then repeat this test several times in different places.
5. Record data on Soil Properties worksheet.

Questions for formative assessment:

What do your data tell you about the compaction of your soil? You can read about soil compaction and what it means at the Soil Properties Overview page.

Students should understand that lightly compacted soil will allow the pencil to be pushed deeper into the soil. It will be more difficult to push the pencil into highly compacted soil.

Were the results from any of your trials very different from your other results? What might cause that to happen?

Answers will vary. Some things that could cause unexpected results for one trial include running into a rock or using more or less force than on other trials.

How might the weather or season affect the data? What were some other variables that could affect the data? How?

If the ground is frozen or nearly frozen, that might make it more difficult to push the pencil into less compacted soil. Likewise, it might be easier to push the pencil into more compacted soil if the ground is extremely saturated.

Now that you have measured the soil compaction at your site, would you expect to find many soil critters there or just a few? What kinds of critters would you expect to see?

This answer will vary based on the site. In general, you would expect to find greater numbers and varieties of creatures in soil that is less compacted. This is because soil that is less compacted has more room for the air and water that organisms need to survive.

Based on the soil compaction, do you think this might be a good place to start a class garden? Why or why not?

Again, this answer will vary. In general, soil that is less compacted is more hospitable for plants, especially garden plants, although various plants are adapted for growth in highly compacted soil.

Percolation Test (45-60 min):

1. Push the can 3 cm into the soil, until it reaches the line encircling the can.
2. Pour water into the can until it reaches the top. Be sure to fill the can quickly. Don't let the water overflow the can.
3. Immediately use a stopwatch to measure how long it takes for the water to soak completely into the soil. If you do not have a stopwatch, you can use the second hand of a watch.
   Because timing is important here, it is a good idea for students to work in groups of two or three. One student can pour the water, while another watches and begins timing as soon as the water has been poured.
4. Repeat this test several times in different spots.
5. Record data on Soil Properties worksheet.

Questions for formative assessment:

Did the water soak into the soil quickly or slowly? What does this tell you about the soil compaction at your site? You can read about soil compaction and what it means at the Soil Properties Overview page.

Students should understand that water will flow faster through lightly compacted soil and more slowly through highly compacted soil.

How did your data compare with those of other students at other areas of the site?

Results will vary according the overall composition of the soil at your field site. If some sections contain more clay than others, for example, students in that area would have very different results from students whose contain more sandy soil.

How do your results compare to the Compaction Test results? Would you expect the results of both tests to be the same or different?

Both tests measure soil compaction and should therefore yield similar results.

How might the weather or season affect the data?

If the ground is frozen or nearly frozen, that might make it more difficult for water to flow through the soil and to push the can into the soil. If the ground is extremely saturated, water might not soak into the soil as quickly as it normally would.

Looking at the bigger picture, how might composting help yield nutritious soil?

Teacher should record tough or difficult questions on board throughout activity and address these at the end of the station work. Ask the students if there are questions to investigate further

As a class, address the questions:

1. What makes a soil good for growing plants?
2. How does the composted soil help with growing plants?

Part C: Instructor will show PowerPoint slides on composting: http://aggie-horticulture.tamu.edu/sustainable/slidesets/kidscompost/kid20.html (move to week 3)

Part D: Students, in groups of 2 will work on Computer Interactive Lesson: http://school.discoveryeducation.com/schooladventures/soil/soil_safari.html

Category	Trial #1	#2	#3	#4	#5	Total
Total Mass of Bag						
Mass of Paper						
Mass of Metal						
Mass of Glass						
Mass of Plastic						
Mass of Solid Food						
Mass of Other						

Kind of Package	Example Grocery Store Item	Reuse	Re-duce	Re-cycle	Land-fill	Bio-de-grada ble?
No packaging or natural package	Melons, pineapples, fruits					
Returnable glass bottles	Milk bottles, soda and beer bottles with deposit returns					
Shiny paper	Bags of candy, cookies, chips, and other snacks					
Uncoated cardboard	Cereal boxes, detergent boxes, dessert mix boxes					
Newspaper	Printed paper					
Aluminum cans	Beverage containers					
Plastic bottles with twist-off tops	Soft drinks					
Plastic bags	From grocery store					
Batteries	Batteries					
Steel cans	Canned fruits and veggies					
Plastic containers	Plastic bags, heavy plastic containers					
Coated paper	Paper milk and juice cartons					
Aluminum-foil-based containers	Foil-lined boxes and bags					
Collapsible metal tubes	Toothpaste, hand cream					
Aerosol cans	Toiletries, deodorants, hairsprays, insecticides					

Week 5: November 1, 2008- Integration of science to other disciplines

Learning Objectives:

1. Students will be able to develop a service learning project to educate their chosen audience about good waste management practices.
2. Students will utilize their writing skills, art, music, speech to create a powerful message.

Standards:

8.1.8 Explain that humans help shape the future by generating knowledge, developing new technologies, and communicating ideas to others.

8.2.8 Use tables, charts, and graphs in making arguments and claims in, for example, oral and written presentations about lab or fieldwork.

Materials:

Materials will depend on what the students choose for their service learning project. The following materials will be made available to them:

- Video camera
- Poster board
- Markers
- Paints
- Computers for Publisher and PowerPoint

Description of the Lesson:

1. Students will create a project to educate the public about Bloomington's waste management practices and possible alternatives.
2. Students will be divided into groups of 4-6 to create promotional material.
3. The integration of writing skills, art, music, and speech will be encouraged throughout the planning process.
4. Saturday Science teachers will rove throughout the groups to support group work.

Week 6- November 8, 2008

1. Presentation of group projects.
2. Presentation of certificates, t-shirts, etc.
3. Whole group activity in SOE Auditorium