DIGGING UNDERNEATH SOIL

GRADE THREE

Module Prepared by Laurie Goode and Krystal Rodney
To fulfill requirements for
The College of William and Mary
CRIN E06
Fall 2008
Dr. Matkins

Table of Contents

Overview

Theme: What is soil and why is it important to life?

Virginia Standards of Learning

3.1 The student will plan and conduct investigations in which
- a) predictions and observations are made;
- c) questions are developed to formulate hypotheses;
- g) data are gathered, charted, and graphed (line plot, picture graph and bar graph);
- j) inferences are made and conclusions are drawn; and
- k) natural events are sequenced chronologically.

3.7 The student will investigate and understand the major components of soil, its origin, and importance to plants and animals including humans. Key concepts include
- a) soil provides the support and nutrients necessary for plant growth;
- b) topsoil is a natural product of subsoil and bedrock;
- c) rock, clay, silt, sand, and humus are components of soils; and
- d) soil is a natural resource and should be conserved.

National Science Education Standards

Content Standard A:
As a result of their activities in grades K-4, all students should develop
- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Content Standard D:
As a result of their activities in grades K-4, all students should develop an understanding of
- Properties of earth materials
- Objects in the sky
- Changes in earth and sky

Content Standard F:
As a result of their activities in grades K-4, all students should develop understanding of
- Personal health
- Characteristics and changes in population
- Types of resources
- Changes in environments
- Science and technology in local challenges

Teaching Standard B:
Teachers of science guide and facilitate learning. In doing this, teachers
- Focus and support inquiries while interacting with students.
- Orchestrate discourse among students about scientific ideas.

- Challenge students to accept and share responsibility for their own learning.
- Recognize and respond to student diversity and encourage all students to participate fully in science learning.
- Encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science.

Teaching Standard C:
Teachers of science engage in ongoing assessment of their teaching and of student learning. In doing this, teachers

- Use multiple methods and systematically gather data about student understanding and ability.
- Analyze assessment data to guide teaching.
- Guide students in self-assessment.
- Use student data, observations of teaching, and interactions with colleagues to reflect on and improve teaching practice.
- Use student data, observations of teaching, and interactions with colleagues to report student achievement and opportunities to learn to students, teachers, parents, policy makers, and the general public.

Teaching Standard D:
Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science. In doing this, teachers

- Structure the time available so that students are able to engage in extended investigations.
- Create a setting for student work that is flexible and supportive of science inquiry.
- Ensure a safe working environment.
- Make the available science tools, materials, media, and technological resources accessible to students.
- Identify and use resources outside the school.
- Engage students in designing the learning environment.

Teaching Standard E:
Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning. In doing this, teachers

- Display and demand respect for the diverse ideas, skills, and experiences of all students.
- Enable students to have a significant voice in decisions about the content and context of their work and require students to take responsibility for the learning of all members of the community.
- Nurture collaboration among students.
- Structure and facilitate ongoing formal and informal discussion based on a shared understanding of rules of scientific discourse.
- Model and emphasize the skills, attitudes, and values of scientific inquiry.

Description of Students

This module will be taught in a third grade class of 20 students at Norge Elementary School in Williamsburg, Virginia. The students range in age from 8 to 9. Demographically, there are six minority students in the class. Most of the students are on grade level in reading, though there are four students who are below grade-level and four students who are above-grade level. Most of the students have a natural curiosity for learning. They enjoy doing hands-on science activities and experiments, and are highly engaged in these activities. All students have pre-requisites skills and knowledge to understand the module. They have learned about measurement (length and capacity) in math and previously have been exposed to soil, rocks, and plants.

Connectivity

Day-to-day: Connectivity within the module can be seen through the concept map. Similar pictures in the concept map denote connections among the lesson plans. All lessons will connect to the last section of the module, "What have we learned about soil?" All that is explored in the module will be included in Days 9 and 10. In the first three days of the module, students will explore the layers and components of soil, and how soil is made. These lessons from Days 1-3 will connect to the lesson plans in Days 5-8. These lesson plans focus on the best soil for plant growth (experiment/analysis of results), soil's importance to people, and soil conservation. An example of the day-to-day connectivity is seen within the first two days. On Day 1, students observe the many components of topsoil, which is extended into Day 2 when subsoil and bedrock are added on to topsoil as layers of soil. Also, connectivity is apparent when learning the creation process of soil (beginning of unit) in order to better understand the importance of soil conservation (end of module).

Connection to Students: The students will have some background knowledge of soil because they have been exposed to it before. This module will extend students' knowledge on the topic. One of the most important days in this module is Day 7, when students will learn about why soil is important to them. Without soil, students would not have food to eat or oxygen to breathe. Students will be able to apply knowledge acquired on Day 6 to conserve soil. In this module, students will also learn about how to create a good experiment, which they can use to create experiments on subjects that interest them.

Nature of Science

Days 4, 5, and 8 focus mostly on the nature of science. In lesson 4, nature of science is addressed most explicitly. Students learn about how to create an experiment to test the best soil for plant growth. They do not do this based on "The Scientific Method," but instead are allowed to create their own experiment as a class. On Days 5 and 8, students will carry out their experiment and analyze the results. Through these lessons, they will analyze evidence that they gather using the sense of sight. These activities allow students to learn about the nature of science. These lessons use guided inquiry. Students are given questions, and will design their investigations with minimal teacher help. These lessons would qualify as level two in the continuum of scientific inquiry.

Inquiry Approaches

100% of the learning cycle lessons included in this module use inquiry-based approaches. Students discover natural phenomena about soil through this module, such as how soil is made, to what materials soil is made from, to how different types of soil affect plant growth rather than being transmitted the information through lecture. Many times students work in groups to facilitate this act of constructing knowledge before an explanation is offered by a discussion among the class or the teacher. The lessons are taught in a student-centered classroom, and students are encouraged to ask questions and find answers to these questions rather than being told what to ask and what the answers are.

Hands-on Lessons

In conjunction with all of the lesson plans using inquiry-based methods, 100% of the learning cycle lessons also use hands-on approaches in which students get to first-handedly create, observe, and discover answers about characteristics of soil. Starting on Day 1, students make soil and continue this hands-on experience in day 2 when digging in an "archeological site." Students also participate in creating an experiment to implement on Day 5 and creating a mini-experiment to find ways to conserve soil.

Authentic Materials

Five of the eight learning cycle lessons use authentic science materials. On Day 1, students examine sand, clay, and other sources that make up soil through the digital microscope and use these objects to create their own soil. On Day 2, students explore the layers of soil with materials that show the change in color of soil layers and a shovel cannot dig through bedrock. They also hypothesize how igneous rocks from volcanoes affect soil after looking at igneous rocks. On Day 3, sandstone is used to explore erosion. Days 5 and 8 use authentic materials to create an experiment with different types of soil to find the best soil for soybean growth.

Technology and Safety

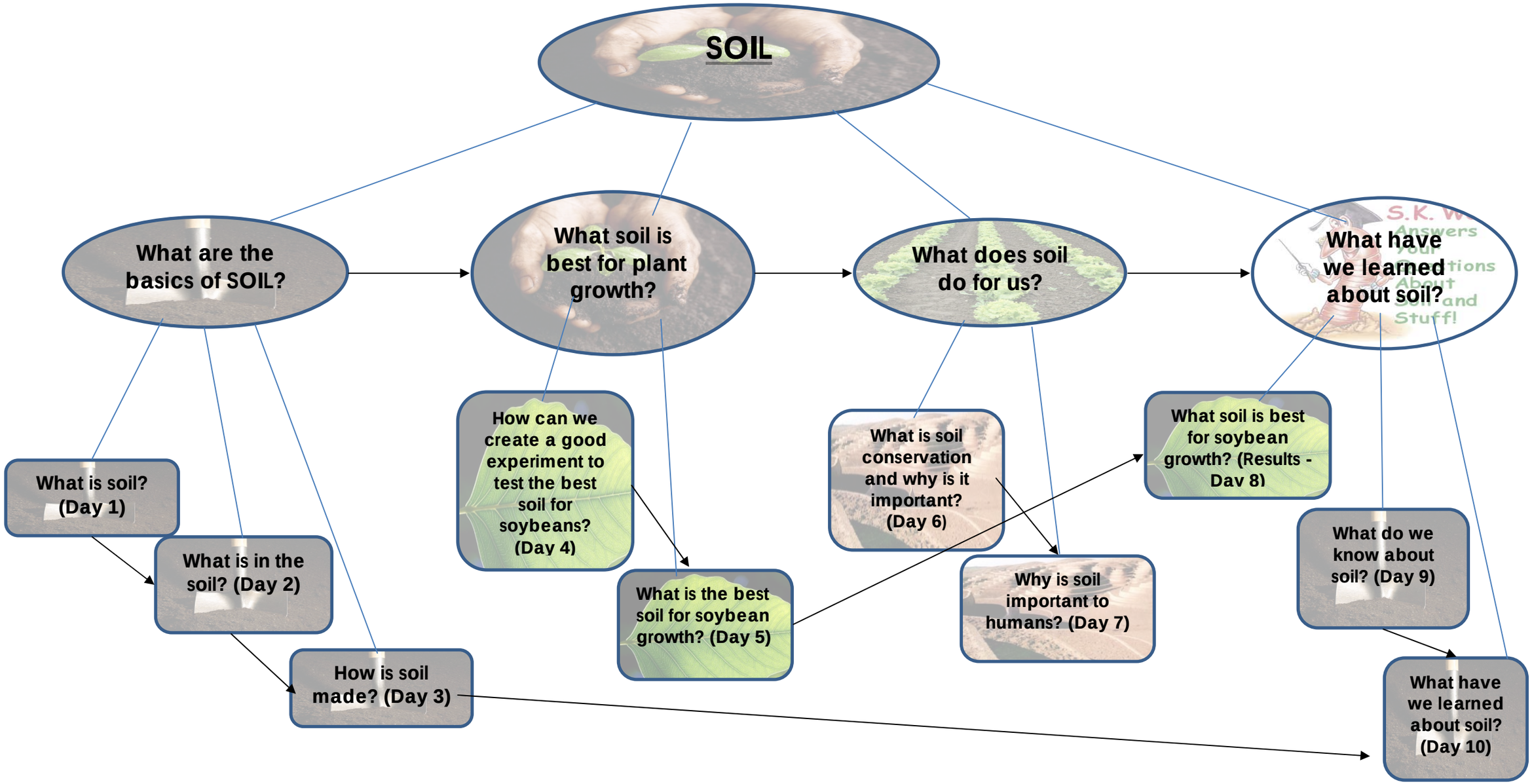
The module includes technology on Day 1, Day 2, and Day 3. On the first day, students use digital microscopes to closely observe components of the soil. After students independently use the microscope, the teacher uses the microscope and the projector in the explanation about the components of soil. A document camera is used on Day 2 to help students record notes in their science notebooks and can be used to demonstrate the construction of the flipbook on Day 3 if needed. Computer technology is also included when students are learning about the layers of soil; a thirty second video clip about volcanoes from the BrainPOP website is shown to get students thinking about what is below bedrock and if/how this affects soil.

The greatest safety concern comes on the first day of the module when students use hammers to make soil. Students should be reminded the purpose of the hammer, and that it is not to be used as a toy. It is recommended to have adult volunteers to supervise student use of hammers. If this is not possible, teachers can call groups over one at a time to use a hammer. Another safety concern is with the use of shovels during the archeological dig (depending on the type of shovels used). One way to reduce this safety risk is to use plastic shovels rather than sharp metal shovels. Goggles should be worn to protect students' eyes on day 3 to prevent sand from being blown into eyes.

Rationale

This module was created to give students the opportunity to explore characteristics of soil and the importance of soil to everyday life. It is a topic that is familiar to students since it is commonly seen and recognized, but this module extends students' knowledge beyond their current knowledge of soil. The unit has been created to cover the appropriate state standards, but special care was taken to not limit the activity ideas to the standards. It is important for students to understand how soil impacts their daily life and why it is important to conserve soil as well as that there are multiple types of soil. In addition to meeting the state requirements, it is important to teach this hands-on, inquiry based module to demonstrate that learning is a process. There is a connection to many other subjects in this module, including math, language arts, and history.

Concept Map


SOIL
What are the basics of SOIL?
What soil is best for plant growth?
What does soil do for us?
What have we learned about soil?
What is soil? (Day 1)
What is in the soil? (Day 2)
How is soil made? (Day 3)
How can we create a good experiment to test the best soil for soybeans? (Day 4)
What is the best soil for soybean growth? (Day 5)
What is soil conservation and why is it important? (Day 6)
Why is soil important to humans? (Day 7)
What soil is best for soybean growth? (Results - Day 8)
What do we know about soil? (Day 9)
What have we learned about soil? (Day 10)

Schedule

*Student participation is assessed informally daily.

Day 1	Day 2
Daily Question: What is soil? *Students will learn* that rock, clay, silt, sand, and humus are components of soil. *Activity:* Students will look into a large jar filled with golf balls, marbles, pony beads, packing peanuts, Rice Krispies, and water which represent the components of soil. Tell students the jar is soil and ask for ideas of what each component represents. Give students materials to "make soil in a bag." The options of materials for students are rocks, leaves, gummy worms, sand, clay, and dirt, water. With goggles in place and supervision on the hammer, have students hammer the components of soil in a closed bag. After "soil" is broken down, compare different students' soil (color, texture, etc.) using digital microscopes. Explain to students the components of soil. *Assessment:* Students will write descriptions of their "soil" in their science journals and at least one other description of a classmate's soil.	*Daily Question:* What is in the soil? *Students will learn* that there are three main layers of soil (bedrock, subsoil, and topsoil). *Activity*: Students will draw what they think they would find under the grass. Students will then dig in a setup archeological site. Students will record artifacts found and what type of soil the artifact was found in. Afterwards, with teacher explanation, the students will learn the terms bedrock, subsoil, and topsoil and create a flipbook that shows the layers of soil. Students will extend the lesson by looking at igneous rocks from volcanoes. *Assessment:* Students will label the layers of soil on a worksheet to be pasted in their interactive science notebook. Students will create a flipbook to remember the layers of the soil.
Day 3	**Day 4**
Daily Question: How is soil made? *Students will learn* that soil is created from erosion over a long period of time. *Activity:* Students will see the effect of a fan (wind) on confetti. Distribute the students' bags of soil from Day 1. Ask students to summarize how they made the soil. Tell students that this is "manmade soil" and we want to know how "nature" makes soil. Students will make sand "mountains" with dry sand and then use straws to blow the sand and see what happens. Then students will use damp sand to make a mountain and use a watering can to observe what happens when it "sprinkles" and "downpours." Students will be introduced to the following terms: erosion and runoff. Students will then observe the effects of freezing a rock. *Assessment*: Students will draw a picture of the creation of soil (from mountain to soil) in their science notebook.	*Daily Question:* What is a good experiment? *Students will create* a procedure for a class experiment on the best type of soil for growing plants. *Activity:* The teacher will help students to create a procedure for an experiment to be done in class. The teacher will also lead students in making sure that the experiment is uniform. *Assessment:* The class will create a procedure for an experiment to execute the next day.

Day 5	Day 6
Daily Question: What soil is best for plant growth? *Student will conduct* an experiment on the best soil for plant growth. *Activity:* Students will conduct the experiment that the class created on the previous day. Students will then discuss if and how they could make their experiment better. *Assessment:* Students will write out their hypotheses, giving reasons why they feel that their hypotheses are correct.	*Daily Question:* What is soil conservation and why is it important? *Students will learn* that soil is a limited natural resource and needs to be conserved. *Activity:* The teacher will engage the students by cutting an apple into fourths. Show students that ¼ represents lands and only the top layer of the apple (apple peeling) is topsoil. Students will then create a short experiment with given materials to test what might prevent erosion. Students will present their results. As a class, discuss the most beneficial methods of preventing erosion and why it is important to prevent erosion. *Assessment:* Students will present their experiment findings in a logical manner that is informative to their classmates.
Day 7	**Day 8**
Daily Question: How is soil important to people? *Student will learn* the importance of soil to humans. *Activity:* Students will construct food chains including humans. Through constructing these chains, they will see that many foods that are important to humans are grown in the soil. They will also see that meats that we eat need plants to survive. After doing this, the teacher will discuss with students other reasons that soil is important to humans. *Assessment:* In their science journals, students will write what they feel is the most important thing that soil does for humans.	*Daily Question:* What soil is best for plant growth? (Revisited) *Student will analyze* the data from their experiment, and *discuss* whether their results support or do not support their hypotheses. *Activity*: Students will count how many seeds germinated in their cups, and decide whether the results support/do not support their hypotheses. The teacher will also introduce different plants that use different types of soil that are not like potting soil (dune grass, cacti, etc.). *Assessment*: Students will write if their hypotheses were supported by their data, and cite the evidence that shows this.
Day 9	**Day 10**
Daily Question: What do we know about soil? *Student will participate* in an interactive review on topics of soil. *Activity:* "Quiz, Quiz, Train, Train" Students will each receive an index card with a relative question about soil and the answer. Students walk around with their hands in the air until they reach another student with a raised hand. Students are not allowed to walk past students with raised hands. Students share questions and have their partner answer the question (with hints if needed). Once both questions are answered, students switch cards and continue the process with raised hands looking for a new partner. After the activity, the teacher asks if there were any "hard" questions or questions about any of the questions. *Assessment:* Students participating in an on-task manner.	*Daily Question:* What have we learned about soil? *Student will demonstrate* what they have learned about soil. *Activity:* Students will take a science test. *Assessment:* Unit test

Selected Lessons in Detail
Days 2-5

Topic: Layers of Soil
Date: Day 2
NSES: Content Standards A, D, F; Teaching Standards B, C, D, E
Grade level: 3rd
SOL: 3.1 The student will plan and conduct investigations in which
Subject: Life Science-Soil

a) predictions and observations are made;
c) questions are developed to formulate hypotheses;
j) inferences are made and conclusions are drawn; and
k) natural events are sequenced chronologically.

3.7 The student will investigate and understand major components of soil, its origin, and importance to plants and animals including humans. Key concepts include

b) topsoil is a natural product of subsoil and bedrock.

Daily Question: What is in the soil?

Procedures for Learning Experience	Guiding Questions	Materials Needed	**E**valuation (Assessment)	Approximate Time Needed
Engagement: Students will draw a picture of what they think is under the grass outside. Ask them to be as detailed as possible. If desired, students can write a paragraph describing the picture.	- What do you think is underneath the grass outside? - Do you think this changes the further below the grass you go? If so, how so? - Do you think that everything in the picture affects the soil?	Computer paper	Informal: observe student participation	10 minutes
Exploration: *Archeological Dig* (groups of four) Since students can not feasibly dig to the subsoil and bedrock layer of soil outside, students will explore the layers of the soil in a simulated archeological dig set up outside in four opaque large tupperware containers. Since the students will be studying Japanese culture, they will be searching for Japanese artifacts. Students will document and record their findings on the given	- What do you notice about the soil? - Where are you finding the artifacts? - Why do you think the soil changes the further you dig?	- 5 large tupperware containers - slate - pebbles - potting soil - historical artifacts relating to history unit	Informal: Observe student participation Formal: collect handout to ensure students recorded the artifacts	15 minutes

handout (see handout 1 – attached to this lesson) which will then be glued into their science notebook. The teacher will first model the importance of the documentation and recording step of the process to the whole group with a simulated dig before the students begin.		- shovels for each student - gloves - newspaper - smocks		
Explanation: The teacher will show students a "homemade" cross-section of the layers of soil before showing an overhead with the layers of the soil: bedrock, subsoil, and topsoil (see handout 2). After gluing the notes taken from the overhead into their science interactive notebooks, students will create a "layers of the soil" flipbook (see handout 3).	- Where did you find the most artifacts? What color was this soil? - Did anyone find anything at the bottom of the containers? - Why do you think the layers at the bottom were harder?	- cross section of soil in glass jar - overhead or document camera - interactive notebooks - flipbook handout	Formal: labeling of notes and creation of flipbook	15 minutes
Extension: *Beyond bedrock* Does bedrock extend to the middle of the earth? What is beyond bedrock? Show a clip of volcano exploding from the BrainPOP video on volcanoes. Ask students to hypothesize what is coming out of the mountain top in their science notebooks. Pass out igneous rocks for students to explore and observe.	- What colors do you see inside that mountain? - What do you think is coming out of the volcano? - How do rocks from the volcanoes end up with soil?	- computer with internet access connected to projector - science notebooks	Informal: observe student attentiveness and participation in completing his/her hypothesis	5 minutes

Notes: Differentiation is built into the lesson with the grouping of students during the exploratory archeological dig. Also, for the learning disabled students, the teacher will give a filled in page of notes to glue in the science interactive notebook. Safety should be considered for this lesson. Explain to students to keep hands off of their face when digging in the dirt and to keep shovels pointed down at all times and must remain in the dirt. For easy cleanup, put down newspaper under the containers and if students are sitting on the ground while digging, have students sit/kneel on newspaper as well. Students should wear smocks and gloves during the dig.

Sources:

Adapted from Laura Smalling.

Adapted from The Globe Program. (2006) *Elementary Globe: Getting to Know Dirt*. University Corporation for Atmospheric Research. Retrieved November 17, 2008, from http://www.globe.gov/fsl/elementaryglobe/docs/EGLOBE_SoilActivity1.pdf.

BrainPOP. (1999-2008). ***BrainPOP.*** Retrieved November 17, 2008, from http://www.brainpop.com.

Rubric – Day 2

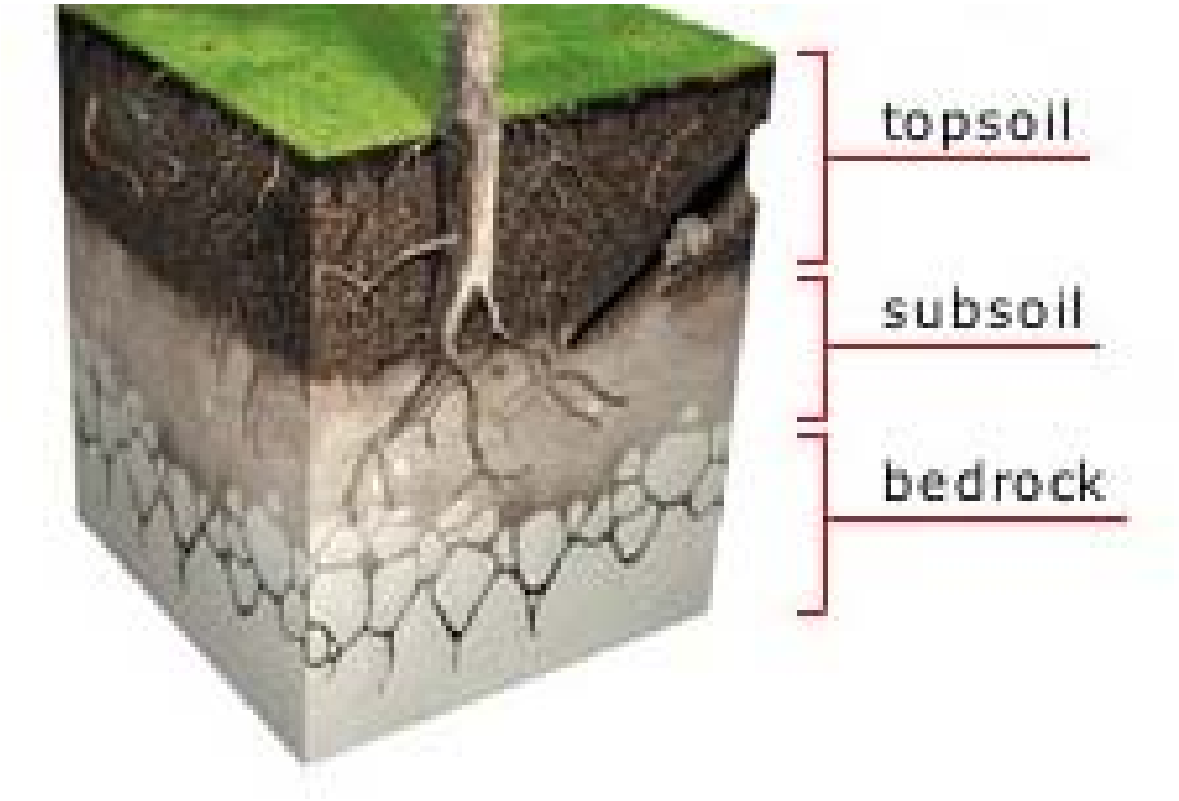
CATEGORY	Awarded Scientist 3 points	Proficient Scientist 2 points	Budding Scientist 0-1 points
Student Participation	Student was appropriately on the task at hand, following directions, and found a balance between listening to others' ideas and providing own ideas.	Student was on task most of the time, followed most directions, but either dominated group talk or did not offer enough ideas.	Student was not on current task or could not stay on task, did not follow directions, and did not offer any original ideas and/or did not listen to other's contributions.
Archeological Dig Handouts	Student has completely recorded at least four artifacts found in the dig: drawn a picture, described where it was found, offered hypothesis for what it may have been or what it may have been used for.	Student has completely recorded two artifacts OR inaccurately recorded three or more artifacts.	Student has inaccurately recorded two or fewer artifacts.
Science Notebook	Student has legibly recorded all notes written on the board. Earn √+ for day on page.	Student has written all notes on the board but some words are illegible or missing. Earn √ for day on page.	Student is missing key information in the notes and the notes are incomplete to study. Earn √− for day on page and must be recopied
Soil Flipbook	Student has correctly labeled all parts and has written at least three characteristics of each layer on the back of the flip.	Student has correctly labeled all parts but has only written one or two characteristics of each layer.	Student has mislabeled the layers of soil and/or is missing characteristics of the layers.

Handout 1
Archaeological Dig Handout

NAME: _____

DIRECTIONS: Record one artifact found in each box on the left through a drawing. For each artifact, describe what you think the artifact may be in the right hand box. There are more boxes on the back if needed.

Handout 2
Layers of the Soil



Adapted from: http://visual.merriam-webster.com/plants-gardening/plants/plant/soil-profile.php.

Topsoil-_____

_____

_____

Subsoil-_____

_____

_____

Bedrock-_____

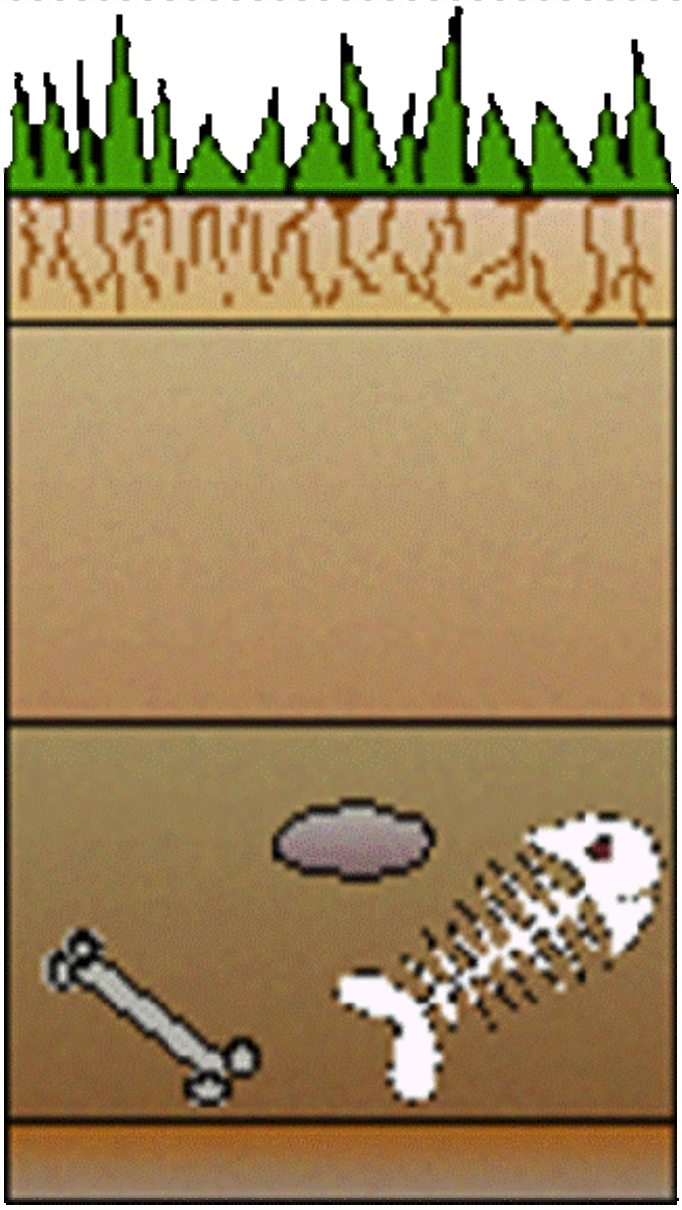
_____

_____

Handout 3
Layers of the Soil Flipbook

Directions**:**

1. Cut along the dotted lines.
2. Place the plain white cut out over top of the soil diagram and staple on black rectangles.
3. Label the three blanks with the correct layer of soil and on the back give a description of that soil layer.



Topic: Erosion: the Making of Soil
NSES: Content Standards A, D, F; Teaching Standards B, C, D, E
SOL: 3.1 The student will plan and conduct investigations in which
a) predictions and observations are made;
c) questions are developed to formulate hypotheses;
j) inferences are made and conclusions are drawn; and
k) natural events are sequenced chronologically.
3.7 The student will investigate and understand major components of soil, its origin, and importance to plants and animals including humans. Key concepts include
d) soil is a natural resource and should be conserved.
Daily Question: How is soil made?

Date: Day 3
Grade level: 3rd
Subject: Life Science-Soil

Procedures for Learning Experience	Guiding Questions	Materials Needed	**E**valuation (Assessment)	Approximate Time Needed
Engagement: Students holding confetti walk up to a fan one by one. Students release confetti in front of the fan. Brainstorm answers to the guiding questions as a whole class.	- What did the confetti do when you let go? -Why do you think the confetti moved? - What does the fan represent in nature? - What are things in nature that the confetti may represent?	- fan - confetti	Informal: observe student participation	5 minutes
Exploration: *Boulders to Bits* (groups of 4) 1) Students are given sandstone and sand. 2) Students blow onto a mountain of dry sand with a straw. 3) Students build a "packed down" mountain with damp sand high enough that only the top 1 cm of the popsicle stick is visible. 4) With water and straws, students try to get the sand to move. Students can rebuild the mountain as many times as they would like. 5) Give students leaves and have them add this to	- What happens to the sandstone when rubbed? When blown on? - What happens to the sand? - Can you make holes in the sand? - What does the sand do? Where does it go? -What happens if you "sprinkle" water?	Sand; sandstone; 13x9 baking pan; thick textbook; water; watering can; leaves; straw; color coded popsicle sticks marked in 1 cm intervals; ruler	Informal: observe student participation. Ensure that each student is performing his/her specific task in the group.	20 minutes

the sand mountain, anywhere they want. Repeat step 3.	- What happens if there is a hard "downpour?" - What can the ruler help you do? - Do the leaves make any difference in what happens to the sand?			
Explanation: Students will discuss what they recorded from their observations in the exploration. Teacher will define the following key terms: erosion, weathering, freezing, and runoff and explain how erosion breaks down large rocks to form tiny soil particles. Students will draw a picture of the formation of soil (mountain to soil) or write a description how soil is formed in their science notebooks.	- What did we start with? - What was leftover? - How did things change? - What was in the bottom of the pan after a rain or wind storm?	Science journals	Drawing and/or description of how soil is formed.	15 minutes
Extension: *Freezing a rock* The teacher will distribute two rocks to each group of 4 (same as exploration groups). One rock will have been frozen overnight after being soaked in water. The students will look at the rocks and discuss their observations.	- What do you see when looking at the rocks? - How might this relate to soil and erosion? - Why do you think there are cracks in the frozen rock? - What might happen if the rock is frozen, thawed, frozen, and thawed over and over?	5 unfrozen rocks 5 frozen rocks	Informal: observe student participation	5 minutes

Notes: Differentiation is built into the lesson through the groups of students. Teachers should be prepared to clean up the confetti (handheld vacuum). Since using hammers/mallets, students should wear goggles and be given safety instructions and a tutorial about how to use the hammer/mallet. If possible, bring in adult volunteers to supervise each group's use of the tool.

Sources:

Bosak, S. (2000). *Science Is…*(2nd Ed.). Ontario: Scholastic Canada Ltd.
Original ideas by Laurie Goode and Krystal Rodney.

Rubric – Day 3

CATEGORY	Awarded Scientist 3 points	Proficient Scientist 2 points	Budding Scientist 0-1 points
Student Participation	Student was appropriately on the task at hand, following directions, and found a balance between listening to others' ideas and providing own ideas.	Student was on task most of the time, followed most directions, but either dominated group talk or did not offer enough ideas.	Student was not on current task or could not stay on task, did not follow directions, and did not offer any original ideas and/or did not listen to other's contributions.
Science Journals: Drawing/Writing	Student accurately shows how soil is created from larger materials through a drawing, written description, or both. Earns √+ on page for the day.	Student attempts to show how soil is created from larger materials through a drawing and/or written description, but key concepts are missing. Earns √ on page for the day.	Student has not attempted to show how soil is created from larger materials through a drawing or written description OR attempt shows no understanding of concept. Earns √- on page for the day and must be redone.

Topic: Types of Soil/Good Experiments **Date**: Day 4
NSES: Content Standard A, D; Teaching Standards B,C,D,E. **Grade level**: 3rd
SOL: 3.1 The student will plan and conduct investigations in which **Subject**: Life Science

a) predictions and observations are made;
c) questions are developed to formulate hypotheses;
g) data are gathered, charted, and graphed (line plot, picture graph and bar graph);
j) inferences are made and conclusions are drawn; and
k) natural events are sequenced chronologically.

3.7 The student will investigate and understand the major components of soil, its origin, and importance to plants and animals including humans. Key concepts include

a) soil provides the support and nutrients necessary for plant growth.

Daily Question: How can we create a good experiment to test types of soil?

Procedures for Learning Experience	Guiding Questions	Materials Needed	**E**valuation (Assessment)	Approximate Time Needed
Engagement: Teacher will read a short passage to the students (see handout 4). The passage will be about a person who is trying to conduct an experiment. The passage will explain the person's experimental procedure. This procedure will have some flaws (e.g. – the person manipulated the wrong/multiple variable(s), the person did not keep everything uniform, etc.). Students should write down what they think is wrong with the experiment. The teacher should ask students if they can think about what is wrong with the experiment.	- What might be wrong with this experiment? - What was good about this experiment?	Passage	Informal - Listen to student responses.	10 minutes
Exploration: The teacher will tell the students that they will be testing the best type of soil to grow soybeans. Students will be asked to create a list of materials that should be included in their experiment. Students can gather ideas from the items at the front of the room, but should be told that they are not limited to these items. Before starting to write out their experiments, students	- What are we testing? - What will change as a result of our experiment? - What do you think we will need?	Paper and pencil, soil, cups, water, soybeans, plastic bins, etc.	Informal - Teacher will go around to each group to listen to the ideas that are generated. Teacher may want to write down some good and not-so-good points to	20 minutes

should write what should be changed in the experiment (independent variable) and what other thing they think will change (dependent variable). Students should then look at their list of materials, and make their best attempt to come up with a procedure for an experiment that the class can do to test the best soil to grow soybeans. Students will do this in groups of 2 or 3.			discuss during the explanation.	
Explanation: The teacher will start by explaining what the independent and dependent variables are, and what they would be in the class' experiment. The teacher will then talk about other components of a well-structured experiment, by using some ideas generated during the engagement. To help students visualize these components, the teacher may use an experimental design diagram.	- What is an independent variable? Dependent variable? - How can we make sure that we are testing what we want to test?	Copy of the experimental design diagram (attached)	Informal - Listen to student responses	10 minutes
Extension: Students and teachers will create a step-by-step procedure for the class experiment. This procedure should be specific, and use information from the explanation. After doing this, the students and teacher should compile a list of materials as a whole group. The teacher should ensure that the students include sunlight and air as materials needed.	- How can we make sure that everything is uniform?	Experimental design diagram	Informal - Listen to student responses	20 minutes

Notes: Differentiation is managed through use of groups. The procedure created in the extension will be used for the next day's lesson.

Sources:

Matkins, J.J. (2007). *Elementary Science Education Course Pack*. Pg. 17.

Original ideas from Krystal Rodney and Laurie Goode.

Handout 4

Passage:

Ayanna wanted to know if fertilizer really helped plants grow bigger. She decided to test out her hypothesis that fertilizer does not help plants grow bigger. She created an 8-week experiment to test her hypothesis. She decided to use all of the plants in her dad's backyard. This summer, her dad planted lettuce, sunflowers, and tomatoes. She bought Miracle-gro and put the same amount on each plant every week. After doing her experiment for 2 weeks, she ran out of Miracle-gro. Her dad went to the store, and bought her a big bag of Scott's fertilizer. At the end of 8 weeks, she found that all the plants were bigger than they were at the beginning of summer. She said that her results showed that fertilizer makes plants grow bigger.

Rubric – Day 4

CATEGORY	Awarded Scientist 3 points	Proficient Scientist 2 points	Budding Scientist 0-1 points
Group Participation	Student works well with others. Student gave suggestions for materials needed and steps for the procedure.	Student worked well with others. Provided suggestions for materials needed or steps for the procedure.	Students did not work well with others (not paying attention to the group, etc.). Did not provide suggestions for the materials or procedure.
Experimental flaws	Student read the passage in full, and wrote down at least one thing that they thought was wrong with the passage.	Student read the passage in full, and wrote down one thing he/she thought was wrong with the passage.	Student did not read the passage in full and did not provide an answer.
Class Participation	Student attempts to participate in creation of materials list/ procedure (give suggestions) without being called on by teacher (raises their hand of their own will).	Student attempts to participate when called on by teacher.	Student does not attempt to participate even when called on by teacher.

Topic: Soil
Date: Day 5
NSES: Content Standard A, D; Teaching Standards B,C,D,E.
Grade level: 3rd
SOL: 3.1 The student will plan and conduct investigations in which:
Subject: Life Science – Types of Soil

a) predictions and observations are made;
c) questions are developed to formulate hypotheses;
g) data are gathered, charted, and graphed (line plot, picture graph and bar graph);
j) inferences are made and conclusions are drawn; and
k) natural events are sequenced chronologically.

3.7 The student will investigate and understand the major components of soil, its origin, and importance to plants and animals including humans. Key concepts include:
a) soil provides the support and nutrients necessary for plant growth.

Daily Question: What type of soil is best for soybean growth?

Procedures for Learning Experience	Guiding Questions	Materials Needed	**E**valuation (Assessment)	Approximate Time Needed
Engagement: Students made a step-by-step procedure for their experiment the previous day. Students and teacher should review this procedure and/or finish it (if they did not have enough time the previous day)	- Are there any changes that should be made?	Copies of the procedure.	Informal – listening to student responses.	10 minutes
Exploration: Students will be given 3 types of soil. The class will be broken into 6 groups. Each person in the group will get one plastic cup. Each student will punch 4 holes in the bottom of the cup. They will fill their cups with their growing material and plant their seeds according to the directions that they came up with the previous day. After doing this, they will place their cups on the window sill, placing them inside plastic bins (to catch any draining water). (If your window sill does not get enough light/warmth during the day, you might consider getting a plant light). Students should water their seeds using a pre-determined amount of water	- How do you predict that your seed will grow in your growing material? - Are there other materials that you would like to try? - How much water drained from your cups?	Determined from Day 4's lesson. Measuring cups.	Informal – observation of students' actions.	25 minutes

(decided in the previous day's lesson). Students must measure how much water drained out of their cups when they watered their cups. (Students will have discussed this in the previous day's lesson). Students should record any immediate observations they noticed while they were performing the experiment.				
Explanation: Have the students clean up, and sit back at their desks. The teacher should explain that good soil has all of the materials that were used in the experiment. The teacher should talk about the percentages of each material in good soil.	- Are there any observations that you would like to share?		Informal – listening to student responses.	10 minutes
Extension: Students will work in their previous groups. Students will be given a sample of the soil that they worked with during the experiment. Students will mix soil with water in a cup, then place a teaspoon of alum into the cup, and stir. All organic material will float to the top of the cup. Students should share observations with the class.	- How much organic material was in your soil sample? - What do you think this means for your soybeans?	Soil, alum, water, cups/containers, spoons.	Informal – listening to student responses	15 minutes

Notes: The teacher should perform a similar experiment about a week prior to doing this lesson, to analyze along with students' results in class on Day 8. The experiment's procedure should be typed before the class to give to each student.

Rubric – Day 5

CATEGORY	Awarded Scientist 3 points	Proficient Scientist 2 points	Budding Scientist 0-1 points
Hypothesis	Student developed and wrote down a hypothesis.	Student developed but did not write down a hypothesis.	Student did not develop or write down a hypothesis.
Materials	Student used all materials appropriately.	Students used some materials appropriately.	Students did not use any materials appropriately (played with materials, etc.)
Following Procedure	Student followed procedure as outlined. Student measured how much water drained from their cup, and wrote down the measurement using the proper units.	Student followed procedure closely, but not exactly. Student measured amount of water that drained from the cup, but did not write down the measurement in the proper units.	Student did not follow procedure. Student either did not measure drainage or did not write down the measurement at all.
Participation	Student planted one seed. Student wrote down immediate observations, and attempted to share them with the class (by raising their hand).	Student planted one seed. Student wrote down immediate observations, and attempted to share them with the class (when directly asked by teacher - did not raise their hand)	Student did not plant seed and/or did not attempt to share observations with the class when asked directly by teacher.

Stories of Use

Overall the teaching of this module went smoothly. Student participation was high and on task and test results documented that the material was understood by the majority of students.

In the introduction to the module, students were intrigued with the jar of assorted beads and were shocked to find out that it represented soil. When discussing what soil meant to students, most responded with ideas such as "brown," "outside in the ground," and "where things grow." Not one student seemed to realize the many components of soil. Students loved using the hammer to make their own soil and were very cautious to document all the materials used in their "homemade soil." Students went beyond the requirement of writing a description of one other classmate's soil, and were very interested in comparing many soils with the digital microscope.

The next day, students had many different ideas of what was underneath the soil which was proven in their illustrations ranging from solid black ("black hole") to bright reds and oranges. Students were excited to dig in their archeological sites, but only a few groups remembered to document their findings even after the mini-lesson on the importance of this step. These students who failed to document had to rely on other group's documentation and their memories to draw conclusions about the different layers of soil, topsoil, subsoil, and bedrock. After listening to student discussion after the clip on volcanoes, I head some students wishing they could "draw another picture showing that there was lava and stuff under the soil."

The third day was very interesting as students got a bit rambunctious after watching confetti fly across the room. It was difficult reeling back the students in order to make certain students were discovering effects of erosion. Some students were trying to blow through the straw to make "wind" in their partner's face, but this was quickly stopped. From the discussion, students were able to draw a great deal of information from the exploration and were even able to come up with definitions to key terms.

On day 4, we learned about creating a good experiment. The students read the passage, and I was surprised at how many flaws they were able to pick out in Ayanna's experiment. The one thing that was difficult for them was realizing that using different types of fertilizer was an issue. However, it led us directly into a discussion about keeping everything in our experiment constant, except the independent variable. Of course, I had planned to discuss this later in the

lesson, but I think that it really helped the students think about their step-by-step procedures. The students learned a lot from the passage and the ensuing discussion. They came up with really great procedures and materials lists. One group's procedure was so good, that I asked them to share it with the class. We decided to adopt the procedure to use for the class. All we needed to do was make things more specific, like outline how much soil we were going to use, and where to get it from. The only other thing that the students had issues with was identifying the independent variable. I was able to clear it up by helping telling them that independent variable that we change, and the dependent variable is something that was constant at the beginning of the experiment, that has now changed.

On day 5, we performed the experiment. It went very smoothly, and it seemed that everyone had sound hypotheses. From what I observed, students were performing the experiment as we outlined. Everyone measured the amount of water that drained from his/her cups, and followed all other procedures almost exactly. I was able to catch students before they made minor mistakes. Before lunch, we talked about how the experiment went, and I commended them for doing the experiment as planned. They responded by telling me that they did not want to mess up the results and make them worthless. It was very good that they realized that if they messed up, it would invalidate the entire experiment. I was really glad that they grasped that concept.

Day 6 and 7 went hand in hand. It was very interesting, because I think that the students thought they knew all of the reasons that soil was important. They said that soil was important because we get our food from it. It was interesting to see how surprised the students were to think about how erosion would affect their lives. I almost think that they were scared, considering how much they have heard about the big hurricanes and all of the damage that they have done.

On Day 8, they analyzed the results of Day 5. I simulated the experiment at the beginning of the unit. I explained to the students that we could not draw a conclusion on our experiment based on the results we find today, we could possibly create stronger hypotheses from looking at the results. They determined that the soil from school was the best for soybean growth. They decided this from the amount of organic material that they saw from the alum experiment in Day 5 and from the height of the plants on Day 8.

Bibliography

Adapted from Agriculture in the Classroom. *Apple Earth*. Retrieved November 17, 2008, from http://www.agintheclass.com/teachers/lessons/elementary%20web%20lessons%20v.1.pdf

Bosak, S. (2000). *Science Is…*(2nd Ed.). Ontario: Scholastic Canada Ltd.

BrainPOP. (1999-2008). ***BrainPOP.*** Retrieved November 17, 2008, from http://www.brainpop.com.

Commonwealth of Virginia. (2003). *Science Standards of Learning Curriculum Framework*. Retrieved November 17, 2008, from http://www.penk12.va.us/VDOE/Instruction/Science/sciCF.html

Cormaic Web Design. (1997-2008). *Pavement Layers: Sub-grades*. Retrieved November 29, 2008, from http://www.pavingexpert.com/subgrade.htm.

Adapted from work constructed by The Globe Program. (2006) *Elementary Globe: Getting to Know Dirt*. University Corporation for Atmospheric Research. Retrieved November 17, 2008, from http://www.globe.gov/fsl/elementaryglobe/docs/EGLOBE_SoilActivity1.pdf.

Adapted archeological dig ideas from Laura Smalling.

Matkins, J.J. (2007). *Elementary Science Education Course Pack*. The College of William and Mary.

QA International. (2008). *Merriam-Webster Visual Dictionary Online.* Retrieved November 29, 2008, from http://visual.merriam-webster.com/plants-gardening/plants/plant/soil-profile.php.

Adapted from Robinson, C. (2008). *K-12 Teaching Resources and Activities: Physical model of soil.* Retrieved on November 16, 2008 from http://www.wtamu.edu/~crobinson/DrDirt/soil_air.html

Source Materials