Soil Unit for 8TH Grade Science

TEACHING NOTES

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Unit Introduction

What Makes Up Soil

Soil is not one thing but rather a blend of many constantly changing components. Just as different parts of the country have different soil types, you will be able to see variations in soil makeup in a small area. Three to six different types of soil may be found on the average property. These differences are due to the variation in the amounts of three different solid materials: sand, silt, and clay.

Sand is composed of silicates and is porous. Nutrients leech out easily and sand has little ability to hold moisture. Sand by itself has no value as a productive soil, but its porous qualities are important for allowing air and water to penetrate through the soil to reach plant roots.

Silt is made up of smaller particles. Silt helps hold moisture and nutrients in the soil so they will be available to plants.

Clay is made up of finely ground materials that cling together. Clay is a wonderful material to make bricks out of, but too much in soil can cause problems. Although it is rich in nutrients, too much clay in soil will cause it to become impenetrable to moisture and air.

Humus is another important component in soil. Humus is the decayed matter from vegetables and animals. These materials were broken down by microorganisms, which live in the soil. Humus is what plants eat.

All these things are mixed together by earthworms to make soil. Scientists estimate that there are 1.5 million earthworms per acre of soil. In one year, an acre of worms can move 20 tons of soil. As they tunnel through the ground the worms help break up the earth, allowing air and water in to the soil.

This document includes a comprehensive unit on soil, appropriate for students in grades 7 or 8. This unit emphasizes hands-on activities, and teaches science processes reflective of the National Science Standards.

Inclusive of this unit, students will be manipulating soil in various ways, such as taking a soil sample, discovering the composition of soil, and performing a soil sample. Other topics addressed in hands-on activities involve measuring permeability, determining pH, and examining erosion's effects on soil.

As an introduction to this soil unit, students should do some investigating to develop some background knowledge on soil before proceeding with their own experiments. A great tutorial can be found at the following web site:

http://www.nhq.nrcs.usda.gov/CCS/squirm/skworm.html

National Standards Addressed:

Content Standard A: Science as Inquiry

Abilities necessary to do scientific inquiry

Understandings about scientific inquiry

Content Standard B: Physical Science

Properties and changes of properties in matter

Content Standard C: Life Science

Populations and ecosystems

Content Standard D: Earth and Space Science

Structure of the earth system

Content Standard F: Science in Personal and Social Perspectives

Personal health

Populations, resources, and environments

Natural hazards

Risks and benefits

Science and technology in society

Content Standard G: History and Nature of Science

Science as a human endeavor

Nature of science

Lesson Plans

This unit includes eleven lesson plans, each requiring various amounts of time to complete. If all lessons are utilized, this unit could encompass at least one month of science instruction. The lesson topics are as follows:

1. Taking a Soil Sample
2. Soil Composition
3. Soil Composition
4. Soil Profile
5. Types of Soil
6. Permeability
7. Permeability
8. Permeability
9. Determining pH
10. Determining Acids and bases
11. Erosion

Guided Inquiry Lesson Plan #1: How to Take a Soil Sample

Length of Lesson: One class period (45 minutes)

Scientific Processes Addressed: Observing, Classifying

Science Concepts Addressed: Soil Sample

National Standards Addressed: A, G

Objectives: Students will:

1. Learn about taking proper soil samples.
2. Obtain a proper soil sample at home.

Materials:

Information on taking soil sample
Large plastic cups
Steel trowel or shovel
Plastic zip-lock bags
Gloves

Introductory Activity: Based on what the students learned from the web quest on soil, they will receive instruction on obtaining their own soil samples. The class will be broken up into groups of four students and they will work together for the remainder of the unit.

Description of Activities and Discussion Questions: To obtain a representative sample you must gather soil from at least five locations in a defined area. Collect the sample when the soil is moist, but not wet, if possible. You are going to need at least 3-4 cups of soil for your laboratory experiments, so make sure you gather enough material to test.

Using a steel trowel dig down to 6 inches in each of the locations, slice off a piece of the sample, removing sod and debris. Scrape it into a clean plastic zip lock bag. Touching the sample with your hands can change the pH, so wear gloves if you can and try to avoid directly handling the soil. Replace the plug in the dirt before moving on.

Thoroughly mix the samples together in the bag. Break up the lumps and remove plant parts, roots, and rocks. Seal the bag and bring into class.

Expected Conclusions: Students will gain the necessary knowledge of at least three different types of soil (sand, silt, clay and/or loam) to explore further into the subject of soil composition and formation and the different tests that can be done on soil.

Assessment: Homework assignment: Students, working in groups, are required to each bring in a soil sample. Students receive credit for accomplishing that task. By not bringing in a sample, they are letting their whole group down.

Extensions:

Language Arts – Students can write an essay, predicting why differences in soil are important.

Math – Students first create a list of common characteristics of the different soils. Then, they can make a histogram, graphing the number of soil samples with each characteristic.

Guided Inquiry Lesson Plan #2: Soil Composition

Length of Lesson: One class period

Scientific Processes Addressed: Observing, Communicating

Science Concepts Addressed: Soil Composition

National Standards Addressed: A, B, G

Objectives: Students will:

1. Explain how the composition of the soil affects its fertility.
2. Determine whether the soil's composition has an effect on how well plants grow.
3. Explain the visual differences of the different soil samples brought into class through use of the different senses.

Materials: Each Group (3 or 4 students)

1 2-liter bottle	2 supports
1 tray	Some combination of soil, sand, and clay
6 bean seeds (or corn)	grass seeds
1 rooted plant	scissors
masking tape	journal

Introductory Activity: Have students take out their soil samples and place them in the center of the group. Observe the visual differences between the soils and write a paragraph describing their observations.

Main Activities: There will be a minimum of four classifications of soil:

1. 1/2 clay, 1/2 silt
2. all silt
3. all sand
4. 1/3 sand, 1/3 clay, 1/3 silt

You can make as many different mixtures as there are groups in your class. Each group then plants three areas of the container with three different seeds/plants. The same amount of water and sunlight is provided for all containers. Each group should label their container and describe the soil

composition. Students will then place the bottle on the supports in a tray to catch the drainage.

Students are asked to individually journal on how the plants and seeds are growing in each of the containers throughout the allotted time frame (2-3 weeks).

Suggestions (Teachers): The supports used in this lesson consist of two boards about four inches by five inches, one with a deep dip and the other with a shallow dip to fit the neck of the 2-liter bottle. It works best if you can get some plants rooted before this activity so students can see not only how the soil affects the seeds, but also how it affects an "already established" plant.

Expected Conclusions: Students should conclude that there are visual differences as well as texture differences between the soils.

Assessment: Journals will be collected at the end of the unit and will be graded on depth of thought and depiction of findings.

Extensions: Students could be asked to find out which part of the state has the same soil composition as their set-up. Then they can do a report on the types of crops or vegetation that grows there, and compare that with their results. You should set this activity up before you discuss it in class, so you have some results to compare to as you look at each soil type.

Guided Inquiry Lesson Plan #3: The Jar and Water Test

Length of Lesson: One class period

Scientific Processes Addressed: Predicting, Observing, Measuring, Calculating, and Communicating

Science Concepts Addressed: Soil Composition

National Standards Addressed: A, B, D

Objectives: Students will be able to:
1. Observe the layering effect that the soil is forming as is settles.
2. Measure the depths of each layer of soil.
3. Calculate the percentage that each layer accounts for in the total soil sample.

Materials:

1 quart jar with straight sides and a lid.
2 cups of soil
1 tsp (5 mls) of water softener (Calgon)
Tap water
Ruler

Introductory Activity: Have the students get in their groups and discuss how they think the soil will settle. Then have each group share their ideas with the class. Write each different idea on the board for all to see.

Description of Activities: The Jar and Water test is one good way to determine the texture of soil.

1. Take your soil sample, break up the clods and remove the deris.
2. Put 2 cups of the soil in a jar and add 1 tsp (5 mls) of water softener. This will help break up the particles.
3. Fill up the jar with tap water, put the lid on tightly and shake the jar until all the soil particles are suspended in the water.
4. After one minute, measure the depth of the sediment on the bottom. This is the sand layer.
5. In two hours, measure the layer of sediment that will be lying on top of the sand. This is the silt layer.

6. After 24 hours, measure the third layer on the top. This will be the clay layer. Most of the organic matter will float on the surface of the water.
7. Now you are to figure out the percentages of sand, silt and clay in your soil sample. Divide the depth of each layer you measured by the total depth of the soil in the jar. Multiply each number by 100 to get a percentage.
   For example, The layer of sand is ¾ inch and the total sample is 3 inches. The sand accounts for .25, or 25% of the total soil sample.

Expected Conclusions: Students will be able to explain the following:
Soil comes in many different types. Types of soil are differentiated by the content and amount (percentages) of each element in the varying types of soil. (ie: soil can be made up of sand, silt, clay and other elements.)

Assessment: Will be based on student interaction in cooperative groups, and on their ability to observe, measure and calculate the percentages of each soil layer.

Extensions:
Language Arts – In their journals, have the students describe what they observed after the soil settled after 2 hours and after 24 hours.
Social Studies - The Mississippi River sends tons of silt and soil washed from farmers' fields into the Gulf of Mexico each year. Use your resources to confirm this statement, and find out any other information you can about this.
Computer Skills - You may use the Internet to help you with the above search.

Guided Inquiry Lesson Plan #4: Soil Profiles

Length of Lesson: One class period

Scientific Processes addressed: Observing

Science Concept Addressed: Soil Profiles.

National Standards Addressed: A,

Objective: Students will be exposed to the methods soil scientists use to gather data about past soil conditions.

Materials:

Clear plastic or glass container. (Food jars or clear plastic fruit containers are also acceptable.)
Samples of sand, soil, and clay.
Gravel.

Introductory Activity: Scientists use soil profiles to determine past climates and environments of deposition. Soil profiles can tell us if there was a river present in earlier times, the amount of plant growth determined by organic matter content, or whether wind and dust was the main soil builder.

Main Activities:

1. Obtain a clear plastic container. Place 1-2 cm of gravel in the bottom of the container.
2. Place about 3-4 cm of soil on top of the gravel.
3. Place 1-2 cm of sand on top of the black soil
4. Finally place 5 cm of clay on top of the sand.
5. Have students draw out the soil sample on a piece of paper. Use colored pencils to color the drawn samples. Make sure the samples are drawn to scale. Have the students use a ruler to make an accurate depiction.
6. Explain to the students that they are soil scientists that have been hired to help figure out past environmental conditions.
7. Give the students the questions as a data sheet to fill out and to explain past environmental conditions.

Expected Conclusions: Students will gain an appreciation of different soil conditions and how they effect plant and vegetation growth.

Assessment: Data sheet will be collected and graded.

DATA SHEET FOR LESSON #4

SOIL PROFILES

1. Based on your soil profile, what is the depth of the first layer in the profile?

What environmental conditions could have led to the deposition of this layer?

2. What is the depth of the second layer?

Do you think that the environmental conditions at the time that this layer was deposited would have been productive to plant growth? Why?

3. The third layer is sand. What environmental conditions could have been responsible for the deposition of the sand?

4. What does this last layer in this soil profile tell you about the environmental conditions?

5. Label the soil samples A B C and D starting from the bottom.

6. Which soil profile demonstrates a drought condition?

7. Which soil profile demonstrates deposition by a river or stream?

8. Which profile demonstrates high amounts of plant growth?

9. Which soil sample demonstrates a very slow stream or lake?

10. Based upon the soil profiles that you have observed, prepare a 1 page report to the USGS that explains past environmental conditions.

Guided Inquiry Lesson Plan #5: Jack Hanson Mystery Task (Types of Soil)

Length of Lesson: Two-three class periods

Scientific Processes Addressed: Observing, Classifying, Communicating, Inferring

Science Concepts Addressed: Types of Soil

National Standards Addressed: A

Objectives:

1. Given different soil samples, the students will be able to observe and record their different characteristics and make logical guess of where each soil is taken from. (Either a field, construction site, lake, woods, or a driveway.)
2. The students will use their observations and information about the soil samples, and the picture of Jack Hanson's boot to make an inference as to where Joe Frisbee's body is located.

Materials Needed:

**Teacher Materials Needed*:
Joe Frisbee's drawn body outline on butcher paper
Joe Frisbee's estate drawn on butcher paper
Jack Hansons' boot and worksheet
Overhead projector
Overhead transparencies
**Student Materials Needed*:
Detective Notesheets (Notebooks)
5 soil samples for each group
Soil A taken from lake
Soil B taken from driveway
Soil C taken from woods
Soil D taken from field
Soil E taken from construction site

Introductory Activity: This lesson should be introduced after the students have had the opportunity to observe sand, clay, and loam, and have done a soil profile. This lesson is a follow-up lesson from the soil profile lesson in which the students observed and recorded the three different types of soil. The students will use this

previous knowledge to make logical guesses about where each soil sample was taken from.

Explain to the children that there is a problem and the students have to be detectives to help solve the problem. Tell them that there has been a murder! Joe Frisbee, a rich millionaire inventor of the frisbee has been killed and it is the students' job to collect data. Show them the drawing of the estate and explain to them that the police found Jack Hanson's shoe in the estate with several soil samples on it. Somehow the samples have been wiped clean from the shoe. The police took soil samples from around the estate but forgot to label them.

Activities & Typical Discussion Questions: It is the student's job to actively observe the five different types of soil and decide which soil goes to what part of the estate. The students work together in their groups, discussing possible solutions and stating their evidence for their findings. In this phase, the students will record their findings on the worksheet labeled detective notes.

1. Concept Introduction:
Using the overhead projector, the transparencies and the estate map, the teacher records the students ideas about each soil.
Possible questions the teacher could ask:
1. Who has a guess about where soil A is taken from? Where do you think?
2. What characteristics have you found about soil A that makes you guess that is where it is taken from?
3. Could the soil have been taken from somewhere else? Does anyone have any other possible ideas?
4. What do we notice that is similar about Soil C and D? (both are dark soil) What are different about the two soils? (one has leaves, twigs, acorns etc. other doesn't) What can this tell us?
5. Soil E is rather different than any other soil. Who can tell me what type of soil this is? Hint: We looked at this soil in class.

If the students disagree with an answer the teacher tells them, they have to find information to prove their findings. If a student gives an answer without appropriate evidence, the teacher tells the student that it will be thrown out of court and the idea will not be able to help solve the case.

2. Concept Application Phase:

Once the students have identified the soil types, the teacher poses a new problem for the students to solve. They look at the picture of the boot and decide which soil sample goes with which layer on Jack Hanson's boot. The teacher gives a description of each layer of soil because the drawing is hard to read.
She asks them for example:
1.The first layer on the boot has medium size rocks and parts of plastic in it. What possible soil sample could this be? Why do you think so?
2.The next layer has big chunks of a light brown material so where could this sample be from and why?
The teacher does this for each layer.

Then they look at the footprints the teacher has drawn onto the map and discuss possible solutions to where Joe Frisbee's body is buried. The students can take turns coming up to the enlarged picture of the estate and discussing possible solutions in their groups. After the discussion, each group should agree on one possible solution. This means that there will be a great deal of problem solving and debating skills used.

Expected Conclusions: The class will most likely run out of time but the key to the whole activity is to keep the students thinking and guessing. Do not give them the answer at the end of the class but wait until the next class period. The kids will be talking about the murder in the halls, on the playground, and may even bring the idea home with them.

Assessment: Teacher observations- Are students participating in the discussion? Are they making logical guesses based on information found?

Detective Notes sheet- Are the students' responses logical and is sufficient evidence given for their findings? Did the students discover the correct soil samples?

Extensions:
Language Arts - The students could record their findings and ideas about the murder in narration form.
Math - The estate could be given accurate measurements in which the students would have to manipulate to solve various math problems.

Guided Inquiry Lesson Plan # 6: Soil Permeability

Length of Lesson: One-two class periods

Scientific Processes Addressed: Observing, Measuring, Identifying, Controlling for variables, Interpreting Data and Experimenting

Science Concepts Addressed: Soil Permeability (Introductory Lesson 1 of 3)

National Standards Addressed: *A, B, D, G*

Objective: The students will understand that water moves through different types of soil at different rates by recording the amount of water permeating through soil in 3 minutes.

Materials:

Ring stand
Funnel
Cotton balls,
Large beaker
(2) 100 ml graduated cylinders
4 different types of soil
Water
Pencil

Introductory Activity: Ask the students what they have already learned about soils. Remind the students that different soils each have different characteristics. Explain that they will learn another way that soils differ: permeability. Explain that the speed in which water moves through soil is called permeability. Emphasize the word, permeability writing it on the board. Ask students how permeability could be measured.

Activities & Typical Discussion Questions: Model the following steps for students, thinking aloud and explaining each step. Fill in an example data table for students on an overhead. After the testing of soil #1 is modeled, students work in their groups, testing soils 2-4.

1. Set up apparatus so that ring stand is supporting funnel (a clamp or ring may be used to hold funnel in place). There should be ample room beneath the funnel for the large beaker to fit.
2. Place a cotton ball in the small end of the funnel.
3. Using a graduated cylinder, measure 100 ml of soil #1 and place it in the funnel, on top of the cotton ball.
4. Place the beaker underneath the funnel.
5. Using the other graduated cylinder, measure 50 ml of water and dump it into the funnel. Let the water percolate through the soil and collect in the beaker for 3 minutes only!
6. Measure the amount of water in the beaker and place this number in data table #1.
7. Clean apparatus, placing the used soil in the designated area. Then, repeat steps 2-6 for soil samples 2-4. Record all data in data table #1.

Be sure to complete the following questions:

1. Define porosity and permeability.
2. In which of the soil samples did the water percolate the quickest? Why did this happen?
3. In which of the soil samples did the water percolate the slowest? Why did this happen?
4. Using the dissecting scope, observe the 4 soil types on low power. Sketch what the soil particles look like in the space provided.

Expected Conclusions: The most dense soil will be the least permeable.

Assessment: Did the students complete the table? Is the student's data reasonable and accurate? Did the students participate in the discussion? Did groups carry out the experiment and work together?

Water Amount Added to Soil	Water Amount in Beaker	Percentage of Water in Soil
Sample #1		
Sample #2		
Sample #3		
Sample #4		

Extensions:

Language Arts - Students respond verbally or in writing to the following prompt: Why is it important to know the permeability of soil near a well?

Math - Student calculations of permeability inclusive of simply the measurement of the water for each trial and then the calculation of the percentages for the third column of the chart.

Computer Skills – Students could search for information on permeability on the internet and share their findings with the class.

Guided Inquiry Lesson Plan # 7: Soil Permeability

Length of Lesson: One class period

Scientific Processes Addressed: Classifying, Measuring, Predicting, Identifying and controlling variables, Interpreting data, Constructing models.

Science Concepts Addressed: Soil Permeability (Lesson 2 of 3)

National Standards Addressed: A, B, C, D, G

Objective: Students will investigate the permeability of clay, sand, and organic soil by measuring the time it takes for water to flow through each.

Materials:

Ring stand
Circular clamp
Clear PVC or other type of tubing at least 20 cm long
Filter paper or fine screen
600 ml beaker
250 ml beaker
Plastic funnel to fit around bottom of PVC tubing
Stop watch
Samples of sand, clay, and organic potting soil or garden soil

Data Sheet:

Soil Type	Length of Time for Permeation

Introductory Activity: Review the previous lesson, which introduced permeability. Talk with students about what permeability is and what method they used to investigate it. Ask students if they can think of different ways to test a soil's permeability.

Description of Activities & Typical Discussion Questions: Model the experiment for the students, using soil #1. Have students predict which soil will the water flow through the quickest? The slowest?

1. Place the PVC tubing into the circular ring clamp and connect to the ring stand high enough to allow a 600 ml beaker to be placed beneath the tube.
2. Place filter paper or screen into the plastic funnel and attach the wide part of the funnel to the tube with tape. Be sure to tape all the way around the funnel so at to create a watertight barrier.
3. Place 100 ml of sand into the tube.
4. Add 250 ml of water into the tube. Have a lab partner time how long it takes for water to flow through the sand until all dripping has stopped.
5. Students repeat steps 3 and 4 with the clay and organic soil.
6. Have students create a data table displaying data.

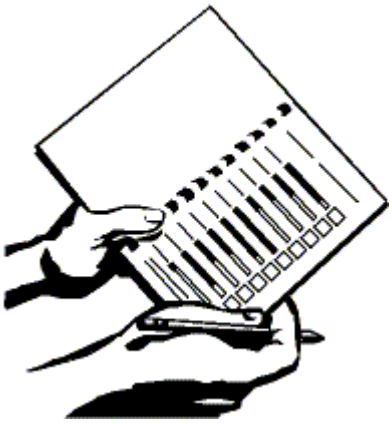
After all groups have tested all soil, discuss the following questions.
1. Which soil sample demonstrated the most permeability?
2. If you were to plant a garden which soil type would you use and why?
3. How does soil particle size affect the permeability?

Expected Conclusions: The sand will be most water permeable and the clay the least.

Assessment: Did students successfully carry out the experiments? Did students arrive at expected conclusions? Were responsibilities shared among the group members?

Extensions:
Language Arts - Have the students write a brief journal entry which contains their thoughts on what they have learned about soil and what they think is the most interesting and relevant fact/piece of information for them.
Math - Have students graph material vs. time in a bar graph, using the data that they collected during this activity.
Social Studies - Have the students call a local farmer and talk to him about soil permeability, and what qualities he looks for in his ideal soil.

Computer Skills - Have the students go onto the Internet and see what new information they can find on soil permeability. They may find some new and interesting activities of their own!



Guided Inquiry Lesson Plan # 8: Soil Permeability

Length of Lesson: One class period

Scientific Processes Addressed: Interpreting data, Classifying, Communicating, Measuring, Predicting, Observing.

Science Concepts Addressed: Soil Permeability (Summary Lesson)

National Standards Addressed: A,B,G

Objective: The students will test the water permeability of each of four types of soil.

Materials:

3 tin cans with the bottoms cut out
Fine screening
Gravel
Sand
Clay
Black dirt
Duct tape or some other type of clamp
6 – 250 ml beakers
Magnifying glass
Plain white paper

Data Table:

Soil Type	Soil Texture and color	Predicted Permeability	Amount of Water after 1 Minute	Amount of Water after 5 Minutes

Introductory Activity: Elicit from students what they have already learned about permeability and types of soil. Explain to the students that they will summarize

what they have learned in today's experiment, using their prior knowledge to test their predictions.

Activities & Typical Discussion Questions: Each group of students should collect 3 pieces of plain white paper and samples of three different types of soil. Place each type of soil on a piece of paper and look at the texture and color of the soil. Record this information in a data table.

After observing the three soil types each student should make a prediction of which the water will run through the fastest to the slowest.

Prepare each of the three cans by duct taping the fine screening to one of the open ends of the can.

Into each of the three cans place about 2 inches of the three different types of soil.

Holding one of the cans with soil over a 250 ml beaker pour 200 ml of water into the soil and collect how much water will run through it in 1 minute. Then after 5 minutes see how much water has moved through the soil.

Repeat with the other 2 types of soil.

3. How did your predictions compare with the results?
4. Which of these soils would be the best to use as drainage material?
5. How does the texture of the soil compare to its water permeability?
6. Do you think your results would change if you packed the soil into the can?

Expected Conclusions: Clay will have the longest permeability time and gravel the shortest.

Assessment: Did the groups arrive at the expected conclusions?

Extensions: In groups of two, students can explore the U.S. Map of Soil Permeability: http://www.epa.gov/iwi/1999sept/iv20_usmap.html

Guided Inquiry Lesson Plan # 9: Acids and Bases

Length of Lesson: Two - three class periods

Scientific Processes Addressed: Observing, Classifying, Communicating, Measuring, Predicting

Science Concepts Addressed: pH

National Standards Addressed: A,B,D,F

Objectives: Students will be able to:

1. Define pH.
2. Draw and label a pH scale.
3. Tell what the pH of different items is.
4. Explain why pH is important to humans and how it effects the environment and our lives.

Materials:

Beakers
Litmus paper
Paper towels
Paper and pencils
Substances to test: lemons, apples, vinegar, shampoo, bananas, water, eggs, Ocean water, milk of magnesia, soap, ammonia,
Any materials that help develop background knowledge about pH such as a textbook, color bar.

Introductory Activity: Introduce and explain what pH is. Draw and label a pH scale.

Example:

pH scale

```
|--|--|---|---|---|---|---|--|---|--|--|---|---|---|
0  1  2   3   4   5   6   7  8  9  10  11 12  13  14
                       ^
    Acid  (H3O+)       Neutral      Alkaline
                          (Base, OH-)
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Establish the pH level for acid, neutral, or alkaline.

Main Activities: Explain to the students what litmus paper is, does, and how to use it. Give the students several pieces of litmus paper that will test pH 1-12 and litmus paper that will test pH 6-8. Test the substances with the litmus paper and compare against a color bar to determine the pH number.

Record the pH level for each substance being tested. Discuss possible reasons for differences in pH level. Test other substances within the room which can include saliva, sweat, juice, soda, etc.

Expected Conclusions: The students should start to develop an understanding of the real life application of the scientific concept of pH. The students should feel comfortable with testing the pH of objects.

Assessment: The students will share their individual lists of tested objects and their pH levels and compare their results with others.

Possible Extensions:

Math-graph the pH levels of several substances tested.
English-A short essay on how pH is used in our everyday lives.
Computer Skills – On the web site www.miamisci.org/ph/ students can further explore testing the pH of various substances.

Guided Inquiry Lesson Plan #10: Acid and Base Cleansers

Length of Lesson: One class period

Scientific Processes Addressed: Observing, Classifying, Communicating, Measuring, Predicting

Science Concepts Addressed: Acids and Bases

National Standards Addressed: A,B,D,F

Objectives: Students will:

1. Experiment with various liquids with different pH levels.
2. Hypothesize which liquid will clean the pennies the best based on the previous lesson about acids and bases.
3. Record all observations.
4. Determine the liquid that cleans the pennies the best and discus why they believe this to be so.

Materials:

Beakers
Lemon juice
Baking soda and water
Vinegar
Lava soap and water
100 dirty pennies.

Introductory Activity: Review previous lesson about acids and bases. Review the differences between them.

Main Activity: Have students hypothesize individually which liquid will clean the dirty pennies best. List these hypotheses and reasons for them. Pass out the liquids in the beakers and the dirty pennies. Have the students place a penny in each liquid. Students should record all observations. Students should report their observations and conclusions as to which liquid cleaned the pennies best with the class.

Expected Conclusions: The students should practice their hypothesizing, observation and recording skills and develop a deeper understanding of the differences between acids and bases.

Assessment: Performance assessment will be used as they will be discovering information throughout their activities.

Possible Extensions:

Math - The students can time and chart the time it took for the pennies to become clean.

Guided Inquiry Lesson Plan #11: Soil Erosion

Length of Lesson: One class period

Scientific Processes Addressed: Measurement, Observation, Hypothesis, and Calculation.

Science Concepts Addressed: the concept of water erosion on soil surfaces and the beneficial effects of conservation practices.

National Standards Addressed: A,B,C,D,F,G

Objectives: Students will learn:

1. That crop residue left on the soil surface slows erosion compared to erosion on bare soil.
2. How to use conservation terraces to slow the speed of water running off
3. the soil's surface.
4. How farming on a contour can slow water runoff speed because each row works as a miniature terrace
5. How combinations of these conservation practices can significantly reduce the amount of topsoil lost each year.

Materials:

1. One 5 quart pail of topsoil and one of sand for each group. Preferably the topsoil is a loam, silt loam, clay loam, or silty clay loam texture. In other words, a soil with a "nice" feel that one might want in ones garden as compared to something that is "heavy" with clay and hard to work or something that is very sandy.

2. Shallow containers. These are boxes, food service trays, pop flats, etc. to put the soil or sand into for the exercise. Generally the containers are about 1 foot wide by 1.5 feet long to several inches thick. The containers may be larger if desired. One may construct wooden boxes that can be reused.

3. A bag or box of grass clippings. This material is put on the soil surface to demonstrate the effect of crop residue.

4. A source of "rain", such as a sprinkler can or a hose with a fine mist setting. Water needs to be applied to the finished "soil surface" in a manner that is akin to a light-to-moderate rain and is that not so heavy or so forceful as to immediately wash the soil away.

5. A place such as outdoors to do the exercise. Since this exercise calls for the mixture of students, soil, and water; it is messy.

6. Grass seed or sod may be needed if a growing crop demonstration is to be used.

Introductory Activity: Have the students hypothesize about the damaging effects they think a farmer would have if his fields were to endure massive water erosion, (i.e. soil erosion?) What if he had just planted his crops? How do you think that the farmer could prevent this from happening?

Activities: Have the students break into their groups. The exercise itself can begin in a number of ways. The instructor may want to prepare several examples of soil surfaces and then demonstrate how each reacts to rain or the instructor may want to briefly explain the various conservation practices and allow the students to make their own displays. Brief descriptions of several examples may be used. After each is set up, one end is propped up to simulate a hillside.

1. Bare soil-no conservation: Take a container and place a sufficient amount of soil on it to cover the surface to a depth of 1 to several inches (depending on the depth of the container), smooth the surface so it looks like a bare field and lightly pack the soil. When water is applied to this example, it should show the most runoff and the greatest amount of erosion. Note the more the soil is packed the easier it is for the water to run off, conversely, the looser the soil surface is the more water enters it and the more "rain" necessary to begin erosion.

2. Bare sand-no conservation: Take a container and set this example up like #1. When water is applied it rapidly soaks or infiltrates into the sand and very little runs off or causes erosion. This example is used mostly to show how rapidly water infiltrates into the coarse (sand) soils as compared to the loam, soils, etc. It might be explained that while the water infiltrates rapidly, the sand can actually hold very little. It also shows why water

erosion is not considered as much a problem on very sandy soils as on loamy, silty and clay soils. It also demonstrates what happens when an impervious layer (the bottom of the tray) stops water movement and the soil becomes saturated (stability is lost and the sand slips as in a landslide).

3. Bare soil-terraces: Set up the example as in #1. Make sure there is enough soil so one can make a series of terraces, which should be parallel to the slope. When water is applied the series of terraces should slow or stop the water flow. This slows erosion and allows water infiltration particularly in the terrace "channel". As additional water is applied the terraces will overflow and erosion will be intensified.

4. Bare soil-contour farming: Set up the example as in #1. Using your fingers or some utensil make a series of ridges parallel to the slope such as would be formed from row cropping. When water is applied the rows act like small terraces, but overflow much sooner. Mostly likely when the water overflows, small erosion rills will be formed going down the slope and may do additional cutting.

5. Soil+crop residue-no other conservation practices: Set up example as in #1. Sprinkle grass clippings onto the soil surface. One may set up an additional number of examples to demonstrate what varying amounts of crop residue can do to slow erosion. For this example, sprinkle enough grass clippings to completely cover the soil surface. When water is applied the crop residue breaks the force of the water droplets. Thus the droplets don't break apart the soil particles which is a condition enabling the soil to erode. Also the crop residue slows the water flow into the soil, allowing more to infiltrate.

6. Soil+crop residue-terraces: Set up as in example #3. Sprinkle grass clippings onto the soil surface as in example #5. When water is applied one should observe less erosion than in either #3 or #5.

7. Soil+crop residue-contour farming: Set up as in example #4. Sprinkle grass clippings onto soil surface. Apply water as in the other examples. There should be less erosion than in #4.

8. Soil with a crop: Planning ahead is necessary for this one as a crop of grass must be planted and growing to show how growing crops reduce erosion potential. A plot of sod could be substituted.

9. Rows running up and down the hill: Any of the above demonstrations can be done, but with the rows or terraces running up and down the hill. This should show increased erosion potential. (See the original)

Modifications:
- Varying the slope of the trays will also have a effect on the erosion potential.
- Intensity of the rainfall can also effect the potential of the soil for erosion.
- If the water is shut off before the soil is washed away, students can examine the cross section of the demonstration. Packing by raindrops may be visible on the bare soil versus less packing when protected by residue.

Expected Conclusions: Student will find various results depending upon the mixture of soil, conservation technique, and crop residue used for each sample.

Assessment: Will be based on student interaction in cooperative groups, and on their ability to meet the four objectives for the lesson. Students should make their own displays and be able to give brief descriptions of the examples that they used to prove that the soil conservation techniques they selected were in fact successful.

Extensions: Instructor could arrange for the class to go on a field trip to a local farm to actually see the effects that they have been studying on a real farm and ask questions of the farmer.
Language Arts - Ask the students to hypothesize on what effects of beach erosion has on shore communities each year. What do they do to try to minimize these effects? For instance, plant dune grass.
Social Studies - Instructor could arrange for the class to go on a field trip to a local farm to actual see the effects that they have been studying on a real farm and ask questions of the farmer.
Computer Skills - Have the students find a picture of a Mangrove on the Internet. Tip: look in Florida.

Related Books

Consider the Earth, Environment Activities for Intermediate Students
By Julie Gates
1989, Teacher Ideas Press

Dirt, The Ecstatic Skin of the Earth
By William Bryant Logan
1996, The Berkley Publishing Group

Dirt, Wonderful Dirt
By Peter Murray and Penny Dann
1995, Child's World Inc.

Elements and the Nature and Property of Soils
By Nyle C. Brady and Ray R. Weil
1999, Prentice Hall

The Living Earth
by Eleonore Schmid
1994, North South Books

Mud, Sand, and Water
By Dorothy Hill
1977

The Nature and Properties of Soils
by Nyle C. Brady, Ray C. Weil,
and Raymond Weil
1998, Prentice Hall

Our Endangered Planet: Soil
by Suzanne Winckler and Mary M. Rodgers
1993, Lerner Publications Company

Planet Earth Activity Book and Teacher's Guide for Grades 4-6
1984, Milliken Publishing Co.

Rocks and Soil (Science Projects)
by Robert Snedden and Chris Fairclough
1998, Raintree/Steck Vaughn

Rocks and Soil (A Thematic Unit/Workbook)
by Janet A. Hale, Cheryl Buhler, and Sue Fullam
1992, Teacher Created Materials

The Science of Soil (Living Science)
by Jonathan Bockneck
1999, Gareth Stevens

Soil Properties
by Cheng Liu and Jack B. Evett
1996, Prentice Hall

Soil Science Education: Philsophy and Perspectives
By Terry J. Logan and Walter J. Farmer
1994, Soil Science Society of America

Soil Science Simplified
by Helmut Kohnke and D.P. Franzmeier
1995, Waveland Press

Soil (See for Yourself)
by Karen Bryant-Mole and Barrie Watts
1996, Raintree/Steck Vaughn

Super Science Book of Rocks and Soils
By Robert Snedden and Frances Lloyd
1994, Raintree Steck-Vaughn

Teaching Science with Soil
by Albert Schatz
1972, Rodale Press

Soil Websites

Soil Glossary: http://soilslab.cfr.washington.edu/S-7/soilglossary.html

Soil Sites Just for Kids:

**** http://www.nhq.nrcs.usda.gov/CCS/squirm/skworm.html

**** http://www.cjnetworks.com/~sccdistrict/soilpro.htm

http://www.soest.hawaii.edu/spacegrant/class_acts/Porosity2.html

http://www.nj.com/yucky/worm/

Soil in General:

http://ltpwww.gsfc.nasa.gov/globe/index.htm

http://www.ag.uiuc.edu/~robsond/solutions/horticulture/soils.html

http://www.soils.org/

http://www.aehs.com/

http://www.publish.csiro.au/journals/ajsr/index.html

http://www.isric.nl/

http://www.usda.gov/news/usdakids/index.html

http://www.ifas.ufl.ed/~soilweb/soilsite.htm

http://rain.org/~sals/Petrik.html

Acid Mine Drainage Sites:

http://www.wvu.edu/~research/techbriefs/acidminetechbrief.html

http://www.dep.state.pa.us/dep/deputate/minres/districts/AMDPostmortenm.html

http://www.abc.net.au/m/science/earth/stories/s1789.htm

Soil Erosion Sites:

http://www.glc.org/basin/glbp.html

http://muextension.missouri.edu/xplor/agguides/agengin/g01562.htm

http://www.sensit.com/erorefs.htm

http://www.africanews.org/pana/environment/19981102/feat2.html

http://www.sedlab.olemiss.edu/uep.html

Soil Permeability:

http://spectre.ag.uiuc.edu/archives/experts/tillage/0284.html

http://www.ag.uiuc.edu/archives/experts/tillage/0071.html

http://climchange.cr.usgs.gov/rio_puerco/puerco2/infiltration.html

pH/Acids and Bases:

http://www.ofcn.org/cyber.serv/academy/ace/sci/ceosci/cecsc181.html

www.miamisci.org/ph

www.ericir.syr.edu/Virtual/Lesson/Plans

http://encarta.msn.com

http://www.science.ubc.ca/~chem/tutorials/pH/content.html

http://www.phregents.com/

pH Sites For Kids:

www.ec.gc.ca/acidrain/kids.html

www.miamisci.org/ph

Related Videos

On American Soil (1983) VHS. $49.00 shipping/handling (call for teacher discount prices) Bullfrog Films, P.O. Box 149 Oley, PA 19457. 800-543-3764. http://www.bullfrogfilms or by email: bullfrog@igc.org.

Rocks and Soil (1997 Bill Nye Science Guy Episode), VHS. Write or call for price information: Disney Educational Productions, 1200 Thorndale Avenue, Elk Grove Village, IL 60007. 800-295-5010. Video #68A52VL100.

Soil – A Medium for Plant Growth (1993) VHS. #40.00 shipping/handling. Visual Education Productions, California Polytechnic University, San Luis Obispo, CA. 800-235-4146.

References

www.miamisci.org/ph

www.ericir.syr.edu

http://nesen.unl.edu/teacher/activities/soils

http://ofcn.org/

http://books.nap.edu/html/nses/html/6d.html

http://ltpwww.gsfc.nasa.gov/globe/index.htm