Activity 4 Rock 'N' Roll

by Annalee Hearn

Study Questions:

What is soil? How long does it take to make a spoonful of soil? How long does it take to lose a spoonful of soil?

Activity:

In this activity "Soil Conservation" students are introduced to the processes involved in soil-making, the causes and effects of soil erosion and the importance of soil conservation.

Curriculum Fit:

Grade Four - Science
- Demonstrates knowledge regarding the materials which compose the earth and crust.

Division One, Grades 2 and 3 - Language Arts
- Exploring, predicting and forecasting results or outcomes.
- Constructing, presenting and critiquing ideas and information.
- Communicating and explaining how to do things (concrete procedures)

Division One - Math
- Measuring and weighing using standard units of measurement.

Agricultural Concept:

Soil Conservation - The students will look at the slow processes involved in the formation of the soil. They will also discuss the vital importance of soil to our life-giving food cycle, and how this makes soil one of the four "corner stone" components of life on earth. (SUN - WATER - SOIL - AIR)

Purpose:

- To show ways erosion causes physical change.
- To acquaint students with the importance of soil and to make them aware that soil cannot be considered a renewable resource on a short-term basis.
- To stimulate students' creativity.
- To promote the idea that success is not the only way to learn.

Materials Required:

- Rocks, a soil sample, spoons, goggles, scale, clock or watch, any materials needed for simulations (these must all be feasible, safe, inexpensive and manageable).
- Teacher Resource Sheets - for "Be A Soil Maker"
- Student Task Sheet - data sheet

Time Required:

One or two class periods within a month **OR**
As an on-going seasonal project, i.e. glaciation=winter, roots=spring, water erosion=spring, etc.

Background — For the Teacher

A growing awareness in the agricultural industry has moved soil to the forefront - a position it always deserved but rarely received. By participating in these activities, students will be encouraged to develop an appreciation for "dirt".

"Agriculture - and by extension, human life itself - depends for its existence on a precious few centimeters of topsoil that lie like a gossamer veil upon the earth.

*"In uncultivated land, the natural weathering process can take as long as 300 years to produce 2.5 centimeters of topsoil - and five to ten times that depth of soil is needed for efficient production of most crops... The problem is that mankind's cultivation methods can remove or destroy the soil at an even faster speed when combined with the natural erosion forces of wind and water."*1

1 Will the Bounty End?, Garry Lawrence Fairbairn Western Producer Prairie Books, Saskatoon, Saskatchewan, 1985

Procedure

Preparation

1. With the Division Two science curriculum, students become aware of the physical and chemical changes occurring in soil. Students examine a spoonful of soil and are asked to determine forces in nature which could cause a rock to break down into soil-size particles. The forces mentioned should be related to the following:

Temperature: heating by day and cooling at night. The warming causes some minerals to expand more than others while cooling causes uneven contracting. The stresses eventually produce cracks.

Water: Rainwater beats down on the land and then travels oceanward - shifting, sorting and reworking the sediments that it carries.

Ice: Ice forms in cracks in rocks, causing breakdown. Also, glaciers abrasively disintegrate rocks and minerals which move under their weighty bulk. (**NOTE**: Glaciers happened millions of years ago. Other factors are ongoing now.)

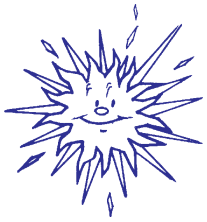
Wind: Debris carried by the wind sandblasts one particle against another.

Plants: Roots exert a prying effect on rocks which results in cracking and breaking.

Introduction

2. Through filmstrips, discussion or examples (i.e., Niagara Falls, hoodoos in the Badlands, etc.), students create a list of ways in which nature physically creates the parent materials of soil. Niagara Falls and the hoodoos are example of natural erosion. Likewise, students identify ways in which nature removes soil.

   Ask the students to brainstorm ways in which nature could change their rock into a soil ressembling their sample. Which changes are physical? Which do you think are chemical? (Take all physical answers and align them with the Mechanical Forces of Weathering.)
   a. Temperature
   b. Water, Ice, Wind
   c. Plants and Animals (Plants and animals excrete acids that cause chemical breakdown.)
3. Students are told they will create simple, safe experiments approximating all these forces. All resulting "soil" will be collected, measured and the time of production recorded. Similarly, students will time how long it takes to lose a spoonful of soil in experiments simulating wind and water erosion.



Activity

4. Have the students examine a spoonful of topsoil they have collected. Spread it out on some newsprint and look closely. What kinds of things do you find in your soil. Is soil valuable? Why or why not? Do any of you have a valuable rock? Why or why not?
5. Follow the directions on page 4.7 and have students "make some soil".
6. Once the students have created their own soil sample, have them ask such questions as: Is your soil like the soil sample? Add missing visible items (roots, etc.). Does nature work faster or slower than we do? How long do you think it would take nature to make a layer of soil that is 1.0 cm deep and produce enough soil to cover our classroom floor?
7. Having created their own soil sample, now have the students design an experiment to demonstrate wind and water erosion on their soil samples. Time how long it takes to empty the spoon in both cases.

Conclusion

8. From the results recorded on the Student Task/Data Sheet, students should discuss and evaluate the topic of soil erosion.
9. Which was faster, making or losing soil? What would farming be like if the wind or water took all the topsoil away faster than nature could replace it? Is soil valuable?

NOTE!!
A similar, but less work-intensive, activity has been related in The Living Soil: A Renewable Resource, Investigation 2 - available through Weigl Educational Publishers Limited.

Discussion Questions

1. Does nature make soil quickly or slowly?
2. Does nature remove soil quickly or slowly?
3. Is soil valuable? Why?
4. How could we protect the soil?

Evaluation Strategy

1. See the Special Teacher Resource for how lessons can be taught and student preformance can be evaluted according to individual learning styles.

Related Activites

1. Adopt-A-Rock
   a. Adoption Records
   Students select a rock from the bin. They study the rock and write a description including weight so that someone else could recognize that rock distinctly from all the others. Rocks are returned to the bin and, using description, returned to the owners. This, then, is the adopted rock. Using a photo (rock and its new parent), a rock print (need a large stamp pad), tracing or rubbing and the written description, a Rock Find Card is filled out. This card is similar to the Child Find Identification Cards and will be kept on file.
   b. Housing
   The bottom of a 2 litre milk carton is used to make a cube which will hold the rock and allow for stacking. Students decorate and design the Rock Home with a student's name clearly visible.
2. Symbolic Graphing
   Students can place their rock or rock home in the appropriate column to indicate their response to such questions as:
   - "Do you walk or ride to school?"
   - "Do you like chocolate, strawberry or vanilla ice cream best?"
   - "Put your rock beside the equipment for the game you would like to play in PE today."
3. Measuring
   In activities where students are asked to estimate, compare and weigh rocks become an easy medium for learning.

NOTE!!
Refer to the Special Teacher Resource for various learning styles that maybe used for these and other learning activities.

Resources

Soil Formation

Bland, Sue, 1992 The Living Soil: A Renewable Resource (Teacher Guide), Edmonton: Weigl Education Publishers Limited

Brady, N.C., 1984, The Nature and Properties of Soil, Tenth Edition, New York, MacMillan

Buol, S.W., F.D. Hole and R.J. McCracken, 1989, Soil Genesis and Classification, 3rd Edition, Ames: Iowa State University Press

Davis, D.B., D.J. Eagle and J.B. Finney, 1982, Soil Management, Warfedale Road, Ipswich, Suffolk: Farming Press Limited

Soil Loss

Fairbairn, Garry Lawrence, 1985, Will the Bounty End?, Saskatoon, Saskatchewan: Western Producer Prairie Books

Film Strips

SVE (Society for Visual Education Incorporated), Chicago 14, Illinois:

1. How Man Destroys Soil, A429 - 2
   "Erosive Power of Raindrops" Frames 11 to 16
   "Effects of Sheet and Gully Erosion" Frames 17 to 28
   "Cause and Effects of Wind Erosion" Frames 29 to 44

2. How Nature Defends Soil, A429 - 1
   "The Strength of Wind and Water" Frames 1 to 16
   "Natural Conditions Which Prevent Erosion" Frames 17 to 30
   "A Balance of Natural Forces" Frames 41 to 44

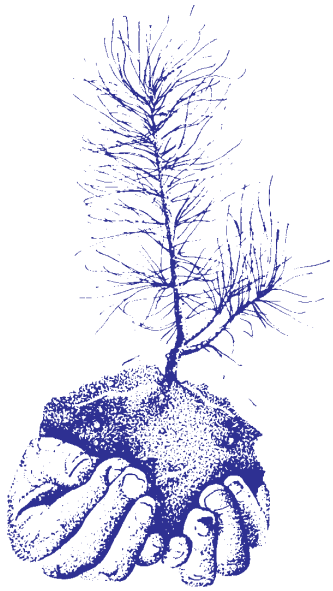
Videos:

1. "Soil: The Vanishing Act" #304 - 3
   Alberta Information Services Division
   J.G. O'Donoghue Building
   7000 - 113 Street, Edmonton, Alberta, T6H 5T6

2. Hughes, Susan, Chickadee 13 no. 4 Ap ' 91 p. 6 to 7 "What's the Secret Word" (also in French Coulicou 9 no. Avr '92 p 6 to 7)

Soil Theme of SNOOP Resource
Weigl Educational Publishers Limited
2114 College Avenue
Regina, Saskatchewan
S4P 1C5

Conserving Soil for the Next Generation
Student Book and Teacher Guide.
Agriculture in the Classroom
Alberta Agriculture, Food & Rural Development
2nd Floor, 7000 - 113 St., Edmonton, Alberta
T6H 5T6



DATA SHEET

Soil Making

Force	Simulation	Amount	Time

Soil Loss

Force	Simulation	Time

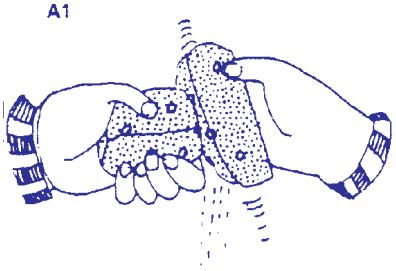
Be a Soil Maker!

Adapted from Foodworks: An Ontario Science Centre Book

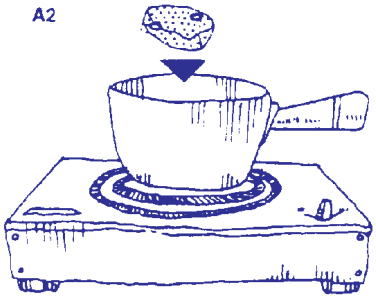
Purpose:

- To determine the effects of temperature and acid on rock.
- To predict and determine the relationship between soil and plant growth.

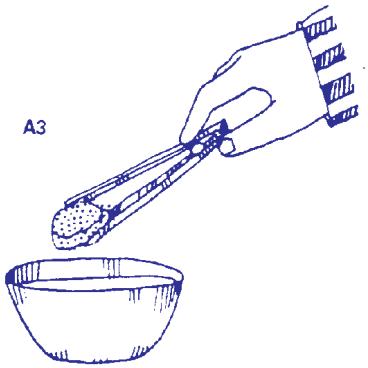
A1



A2



A3



Materials:

- several small pieces of sandstone rock
- 2 small pieces of limestone
- a hot plate or alternative heat source
- small pot
- pan of ice water
- tongs
- 75 mL of vinegar
- hammer
- safety goggles
- old cloth
- handful of peat moss
- 2 flower pots
- potting soil
- clear glass jar
- paper towel
- radish seeds
- water

Procedure

Part A:

1. Take two pieces of sandstone and rub them together to make 5 mL of soil. Notice how long it takes to make even a few fine particles. Nature takes much longer!
2. Place a small piece of sandstone in a pot and heat over the hot plate.
3. Pick up the sandstone with a pair of tongs and drop it into a pan of ice water. Record your observations.
4. Place a piece of the limestone a nd the vinegar in the small pot. Heat on the hot plate and record your observations.

Part B:

5. Put on the safety goggles.
6. Completely wrap rocks in cloth.
7. Pound the rocks with the hammer until they are smashed into tiny bits about the size of salt grains. It will take you 5 to 10 minutes of pounding.
8. Pour smashed rock into a flower pot. Add an equal amount of peat moss and mix well.
9. Plant 5 to 6 radish seeds approximately 0.5 cm deep.
10. Moisten with a measured amount of water and place in a window sill.
11. Plant another 5 to 6 radish seeds in potting soil. Add the same amount of water as in step #10 and place in the same window sill.
12. Keep both pots damp by watering with equal amounts of water at identical times (approximately over 3 to 4 days).
13. Finally dampen paper towels and line glass jar.
14. Place 5 to 6 radish seeds between the paper towel and the glass jar, and place it in the window sill with the flower pot.

Note: Plant growth experiments are often not used because it usually takes 3 or 4 weeks before conclusions can be drawn, and because classrooms don't always have adequate space available. However, if carried out properly, plant growth experiments can produce startling results, and really drive home the concepts. They are worth the time invested!

Be A Soil Maker! (Part Two)

Objective:

• To simulate the process of soil formation and weathering processes.
• To set up a plant growth experiment, and predict and describe the relationship between plants and soil.

Time Required:

- Part A - 30 minutes
- Part B - 30 minutes, plus
- 3 to 4 weeks to grow seeds

Setting: Indoors

Materials:
(Per group of students)

• several small pieces of sandstone rock
• 2 small pieces of limestone
• a hot plate or alternative heat source
• small pot
• pan of ice water
• tong
• 75 mL of vinegar
• hammer
• safety goggles
• old cloth
• handful of peat moss
• 2 flower pots
• potting soil
• clear glass jar
• paper towel
• radish seeds
• water

Preparation:

In Part A of this activity, students will conduct two tests to show how rock is weathered by both chemical and physical processes. In Part B, they will be pulverizing rock with a hammer and setting up a plant growth experiment. The rock should be tightly bound in the cloth and all students should wear safety eye glasses whether they are hammering or watching the rock being crushed. You will need to find a suitable location for the hammering, as well as space for the plants to grow in your classroom. Alternatively, students could take their plant seeds home and care for the pots as a homework assignment.

Radish seeds were chosen because they are fast growing. Bean seeds should not be used because they store enough energy to sprout without soil.

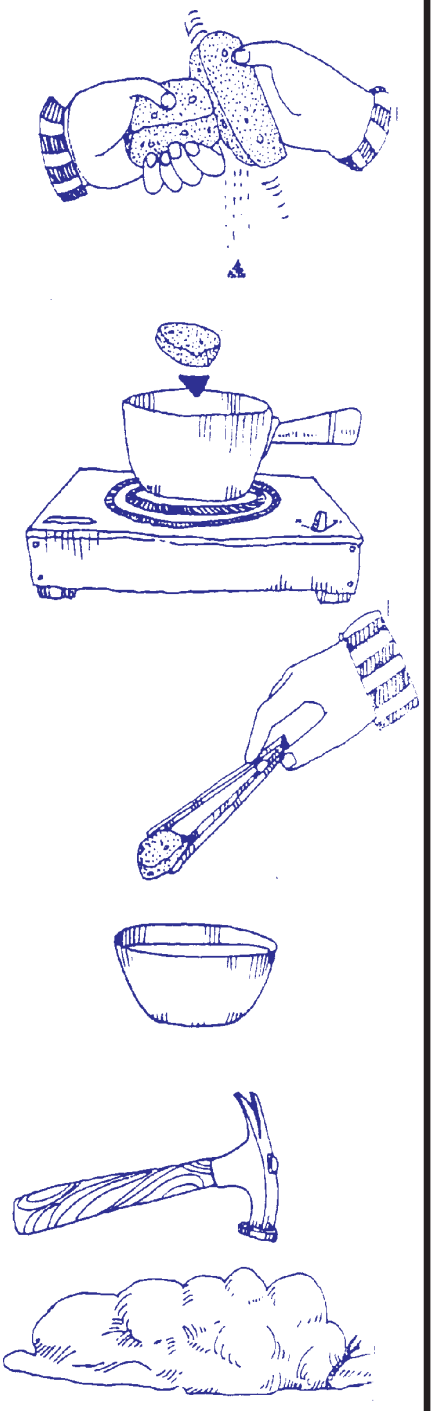
• Limestone and sandstone can be bought from a supplier such as Boreal Laboratories, or contact:

Aggregate Producers Ontario
325 Eddystone Avenue
Downsview, Ontario
M3N 1H8
(416) 743-5121

for the location of a quarry close to you. Your local Ministry of Energy and Resources office may also be able to help.

Variations:

Pure sand could be substituted for the crushed rock procedure. Try planting radish seeds in sand, a sand and peat mixture, and potting soil which has adequate phosphorus or nitrogen levels. Compare your results.



SOIL MAKER: Discussion Questions

Q From your tests in Part 1, what could you conclude about the importance of temperature in soil formation?

A Temperature causes rock to break apart into smaller pieces. Warm temperatures also stepped up the process of chemical reactions as shown in the effect of heating the vinegar and limestone.

Q What would happen if you continued soaking the limestone in the hot vinegar? What do the two experiments have to do with soil formation?

A Small bubbles should form on the surface of the rock. These bubbles are carbon dioxide (CO_2) being released from the limestone as it undergoes a chemical change in contact with the acidic vinegar.

All the limestone would eventually break down if the limestone was left to soak in the hot vinegar. These two experiments simulate physical and chemical weathering as the processes occur to help make soil.

Q Human beings have the greatest single effect on physical weathering. Can you think of ways in which we speed up the process of breaking up rock?

A Quarrying, dynamite, mining, earth moving and construction.

Q In Part B of this activity, what soil component does the smashed rock represent? The peat moss?

A The crushed rock represents the soil's mineral matter derived from parent rock. The peat moss in intended to represent the soil organic matter.

Q Is this material you made really soil? Explain.

A While the mixture the students created resemble the real thing, and is capable of supporting plant growth, true soil is actually the naturally occurring material at the surface of the earth, a living ecosystem produced through the action of the soil forming factors over thousands of years.

Q Do you think the radish seeds will be able to grow to maturity in this mixture? Why or why not?

A The peat moss and the rock fragments should contain most of the nutrients necessary for plant growth; therefore, the seeds should grow.

Q Will the radish seeds grow to maturity in the potting soil? Why or why not?

A Yes. Potting soil is prepared so that it will be able to support vigorous plant growth.

Q Do you think the radish seeds will grow to maturity on the damp cloth. Why or why not?

A The radish seeds store enough energy and nutrients to spout roots; however, it is doubtful that they will grow to maturity. As they grow bigger, they will lose their source of nutrients and material support to hold up their stem, leaves and root.

Q Once you have tabulated your results from the growth experiment, summarize what it is that plants need from soil?

Q People in underdeveloped nations (e.g., Africa) do not have enough food to eat. Why don't we make soil (as in Part B of this activity) and feed more people?

Allow student to do their own thinking and develop their own responses.

Brain Activity

Taking into Account Learning Styles

Right Brain

- Sensory experience
- feel rock with eyes closed or pass rocks in dark room to see if student can identify own
- smell rock
- listen as rock falls in water, on carpet, in sand
- taste (Stone Soup)
- Does your rock look different when it is wet?

Left Brain

- Poetry writing
- simple poetry (Haiku, Shape poems)
- Describing - as in Rock Find
- Compare two rocks
- Group write
- Journals

Teacher Activities Which Take into Account Learning Styles

Right Brain

- Display a rock collection
- Mind map/cluster futures for the rocks

Left Brain

Design task cards for student activities which recognize different learning styles and include Bloom's taxonomy

Student Activities Which Take into Account Learning Styles

Right Brain

- Experiments
- Create music, models, recipes, tools
- Make a game
- Personalize your rock

Left Brain

- Label
- Organize
- Classify
- Make Stone Soup
- Problem Solve

Outcome Activities Which Take into Account Learning Styles

Right Brain

- Science/Ag. Fair
- Present a dinner showcasing produce from Alberta soil.
- Field trip.

Left Brain

- Compose Stories, Poems
- Plan experiments
- Analyze results
- Projects (i.e., how long does it take soils to break down?)