

Creating a miniature Grand Canyon: A demonstration of soil erosion by water

Target Grade Level: 1st-2nd

Created and Adapted by:
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UNIVERSITY OF MONTANA GK-12 PROGRAM

1. CONTRIBUTOR'S NAME: JEFF PIOTROWSKI

2. NAME OF INQUIRY: "Creating a miniature Grand Canyon: A demonstration of soil erosion by water"

3. GOALS AND OBJECTIVES:

a. Inquiry Questions: What causes soil erosion?

b. Ecological Theme(s): Conservation of soil

c. General Goal: Understand soil erosion, its causes, and solutions

d. Specific Objectives:

Academic: Students learn the causes and problems associated with soil erosion and some basic preventive methods

Procedural/technical: Students learn the use of basic lab tools (funnels, stands, beakers)

Social: All students are encouraged in group discussion during the demonstration.

Communication: Students are asked to draw and explain their observations in writing

e. Grade Level: first and second

f. Duration/Time Required: 2 hour

→ Prep time 1 hour

→ Implementing Exercise During Class 30 min

→ Assessment 30 min

4. ECOLOGICAL AND SCIENCE CONTEXT:

a. Background (for Teachers):

Erosion is one of the greatest threats to agriculture and ecosystems today. Over 1/3 of the world's arable land has been lost to erosion within the last 40 years. This inquiry is designed to educate kids on erosion and how traditional agriculture techniques disrupts soil stability and promotes erosion. New techniques are being employed to prevent erosion, such as no-till or low-till farming. These practices leave a litter layer on agriculture fields, preventing water and wind from eroding soil. This inquiry demonstrates how no-till farming and soil aggregation prevents erosion.

b. Background (to present to Students):

Teacher should present to the kids what erosion is and its causes (wind, water, ice, etc). The teachers should explain traditional tillage farming can promote erosion and show pictures of the dust bowl and gully erosion near farms. The discussion should lead to what may prevent erosion and how organic matter may play a role.

5. MOTIVATION AND INCENTIVE FOR LEARNING:

Students get to cause erosion and make small-scale canyon, which many find exciting
Relevance by discussion of places they see erosion and how to stop it in their own yards

6. VOCABULARY:

erosion: (i) The wearing away of the land surface by rain or irrigation water, wind, ice, or other natural or anthropogenic agents that abrade, detach and remove geologic

parent material or soil from one point on the earth's surface and deposit it elsewhere, including such processes as gravitational creep and so-called tillage erosion; (ii) The detachment and movement of soil or rock by water, wind, ice, or gravity. The following terms are used to describe different erosion types, processes, and mechanisms:

natural erosion: Wearing away of the earth's surface by water, ice, or other natural agents. Under natural environmental conditions of climate, vegetation, etc., undisturbed by man.

weathering: The breakdown and changes in rocks and sediments at or near the Earth's surface produced by biological, chemical, and physical agents or combinations of them.

tillage: The mechanical manipulation of the soil profile for any purpose; but in agriculture it is usually restricted to modifying soil conditions and/or managing crop residues and/or weeds and/or incorporating chemicals for crop production.

no-tillage (zero tillage) system: A procedure whereby a crop is planted directly into the soil with no primary or secondary tillage since harvest of the previous crop; usually a special planter is necessary to prepare a narrow, shallow seedbed immediately surrounding the seed being planted. No-till is sometimes practiced facilitate seeding and early root growth, whereby the surface residue is left virtually undisturbed except for a small slot in the path of the subsoil shank.

arable land: Land so located that production of cultivated crops is economical and practical

soil organic matter: The organic fraction of the soil exclusive of undecayed plant and animal residues.

litter: The surface layer of the forest floor which is not in an advanced stage of decomposition, usually consisting of freshly fallen leaves, needles, twigs, stems, bark, and fruits.

aggregation: The process whereby primary soil particles (sand, silt, clay) are bound together, usually by natural forces and substances derived from root exudates and microbial activity.

7. SAFETY INFORMATION: NONE

8. MATERIALS LIST (including any handouts or transparency masters):

Metal stand with three clamps

Sand

farm soil (or other soil with low organic matter)

composted soil

Small pieces plant litter (1 cup)

Four trays (2"H x 4"W x 5"L) with a 1" x 1" section removed from one wall The tops of pipette tip boxes are perfect

Funnel
Grass seeds
Beaker
Large tub to capture water
Students note books

9. METHODS/PROCEDURE FOR STUDENTS:

a. Pre-investigation work:

This is the most time intensive portion of the exercise. Loosely pack the three different soils into the trays. Place a layer of litter atop a fourth tray of farm soil. Position the tray on an incline so that any water that falls on top of them runs off through the section removed into a container. Position a funnel above the incline using the stand and clamps. Use tape or paraffin to regulate the flow of water coming from the funnel. It should be a small, gentle stream (this make take a few tries). Have a beaker of water ready to pour into the funnel. Before the demonstration the kids should be asked to make predictions on which soil will erode the greatest.

b. Investigation work:

This is simple a demonstration. Let the children choose which soil to test first. Each time pour half a beaker of water into the funnel and watch the erosion take place. The kids really get a kick out of this. After the each "run" the soil eroded can be captures and weighed after its dries during a follow-up discussion. There should be a discussion of why certain soils eroded more than others. Following the demonstration the children are asked to draw their observations and try to explain the differences they saw. A final discussion should be relevant to their lives and how they may prevent soil erosion in their own yards.

10. ASSESSMENT:

The children's drawings and explanations serve to assess how well the understood the concepts.

11. EXTENSION IDEAS:

This experiment could be followed up with trays containing plants, and discussion about how roots stabilize soil. Also the trays could be larger with rocks and other more natural obstacles. This may need to be designed as an outside experiment.

12. SCALABILITY

A more in depth experiment could involve the different soil stabilization effects of different plant species (root types). Also the students could predict and test if different litter types prevent erosion differently. Finally the students could be asked to make a soil that has the greatest water stability using sand, rock and organic matter.

13. REFERENCES:

<http://www.soils.org/sssagloss/>

14. LIST OF EXPERTS AND CONSULTANTS

<http://soils.usda.gov/education/>

<http://tpwww.gsfc.nasa.gov/globe/>

15. EVALUATION/REFLECTION BY FELLOWS AND TEACHERS OF HOW IT WENT:

The kids were really engaged during this experiment. They loved seeing the soils wash away and had good insights into erosion prevention. Some students has very detailed drawings and explanations.