

ECOS Inquiry

1. Contributor's Name: Joss McKinnon

2. Name of Inquiry: So Many Soils, Why are They Different?

3. Goals and Objectives:

a. Inquiry Questions: How is soil formed? What factors impact the type of soil present in a particular location?

b. Ecological Theme(s): Soil formation and differentiation.

c. General Goal: To introduce students to the process of soil formation and the factors that affect it.

d. Specific Objectives: Observe the transportation of materials through the soil profile. Examine the effects of increased rainfall, litter, mineral content, and time on this process.

e. Grade Level: 4-5

f. Duration/Time Required:

→ **Prep time:** 1 Hour

→ **Implementing Exercise During Class:** 45 minutes

→ **Assessment:** 10 minutes

4. Ecological and Science Context:

a. Background (for Teachers):

The formation of soil in the environment is governed by five major factors:

1) Parent Materials: The geologic or organic precursors to the soil.

2) Climate: Primarily precipitation and temperature.

3) Biota: Living organisms, especially native vegetation, microbes, soil animals, and human beings.

4) Topography: Slope, aspect, and landscape position.

5) Time: The period of time since the parent materials became exposed to soil formation.

Soils are often defined as “dynamic natural bodies having properties derived from the combined effects of climate and biotic activities, as modified by topography, acting on parent materials over periods of time”. In other words the particular soil at a location has been formed through the interaction of the five soil forming factors, and an alteration to any of the first four factors will result in an alteration in the soil present (given sufficient time).

b. Background (to present to Students):

Because the students will have already been exposed to different soil types in a previous inquiry (A Tour of Soils), a general explanation of the influence of the five soil forming factors will provide the students with sufficient background knowledge for this investigation.

5. Motivation and Incentive for Learning:

Soil represents the intersection between geologic materials and the biologic organisms that live on or near the earth's surface. Because of this, soil is the foundation of all terrestrial (non-aquatic) ecosystems throughout the world. As such, any attempt to study these ecosystems must include some attention to the role of soil, and the various factors that have influenced its formation. Additionally this investigation will allow the children to *escape* the classroom and get outside, and the colorful, dynamic nature of the experiment should ensure their interest.

6. Vocabulary:

Aspect: The direction that a slope faces (e.g., north or south).

Biota: The plant and animal life of a region or area.

Clay: Soil particles that are less than 0.002 mm in diameter.

Climate: The weather of a region or area averaged over a long period of time.

Parent Materials: The geologic or organic materials that undergo weathering to produce soil.

Sand: Soil particles that are between 0.05 and 2.0 mm in diameter.

Silt: Soil particles that are between 0.002 and 0.05 mm in diameter.

Slope: The angle of a surface as it deviates from horizontal, usually measured as percent, numerical ratio, or degrees.

Time: In this case, the period of time since parent materials became exposed to soil formation.

Topography: Refers to the lie of the land, or other characteristics of physical geography in a region; in this case slope, aspect, and landscape position.

Translocation: The movement of materials, either vertically or horizontally, through the soil, often linked with the movement of water.

Weathering, chemical: Changes produced in rocks and minerals through chemical processes (dissolving, acidic reactions, oxidation/reduction reactions, etc.).

Weathering, physical: produced in rocks and minerals through physical processes (temperature changes, abrasion by water, ice and wind).

7. Safety Information:

Nothing to note.

8. Materials List (including any handouts or transparency masters):

Clear plastic cups with holes in the base and 1.0 cm increments marked on the sides.

Paper chips (~1cm²)

Food coloring (red and green)

Water

Gypsum sand (white)

Data sheet handouts

9. Methods/Procedure for students:

a. Pre-investigation work:

Think about the various soil types that were seen in the previous inquiry (A Tour of Soils). What were some of the major differences between each soil type? What factors might account for these differences?

b. Investigation work:

1) What evidence (data, samples) do students collect?

Students (in groups of 4 or so) will conduct an experiment that will illustrate the impact of a change in one of the soil forming factors (biota, climate or parent material) over time. This will be accomplished through the use of chips of paper soaked in food coloring, which will represent minerals in the parent material (red) and dead leaves on the surface (green). The soil system will be represented by a sand filled cup which has red paper scattered throughout, and a specified number of green pieces will be added to the top prior to each watering. The students will alter either the amounts of one color of paper, or alter the amount of water added to the system for each period of soil development. As water is added the food coloring will leach off of the paper and translocate to a new position in the “soil”. Students will quantify this “soil development” on their data sheet for each period.

2) How do students present the evidence (data)?

Students will present their data on the data sheet provided. Following the experiment each group should discuss their findings and present a brief explanation to the rest of the class.

3) What conclusions are drawn from the evidence students collect?

Following the presentations students should have an understanding of the potential influence of each of the three soil forming factors on soil development, and should also see the importance of time as it relates to each.

4) Include examples of data sheets.

The data sheet is attached at the end of the inquiry.

10. Assessment:

The teacher will monitor experiments and will review all data sheets. Once the groups have completed their experiments and presentations, the class will discuss the overall results and ecological implications.

11. Extension Ideas:

Following this investigation it might be beneficial to return to the soil pits visited during the Tour of Soils inquiry in order to further cement the connection between the soil forming factors and the resulting soil that has been formed. This could lead to a new discussion of the factors that might differ between each site and the resulting differences in each soil.

12. Scalability:

This investigation can be scaled up to be more appropriate for high school students by focusing more on the specific nutrients/compounds that are undergoing this translocation process, and perhaps by adding a new element to the experiment involving uptake by plant roots. In addition, students might make some more quantitative measurements of water and dye leaching out from the system, and even attempt to set it up using combinations of sand, silt and clay to mimic actual textural classes of natural soil.

This investigation can be scaled down to be more appropriate for younger students by making it a demonstration project illustrating the transportation of materials through the soil system over time, but removing the experimental aspect.

13. Science Standards Accomplished:

Grade 4:

Unifying Concepts and Processes: Systems, order, and organization; Constancy, change, and measurement.

Science as Inquiry: Abilities necessary to do scientific inquiry, Understandings about scientific inquiry.

Physical Science: Properties of objects and materials.

Life Sciences: Organisms and environments.

Earth and Space Science: Properties of earth materials, Changes in the earth and sky.

Science in Personal and Social Perspectives: Changes in environments.

Grade 5:

Unifying Concepts and Processes: Systems, order, and organization; Constancy, change, and measurement.

Science as Inquiry: Abilities necessary to do scientific inquiry, Understandings about scientific inquiry.

Physical Science: Properties and changes of properties in matter.

Life Sciences: Populations and ecosystems.

Earth and Space Science: Structure of the earth system.

Science in Personal and Social Perspectives: Populations, resources, and environments.

History and Nature of Science: Nature of science.

14. References:

Brady, N.C., and Weil, R.R. 2002. The Nature and Properties of Soils, Thirteenth Edition. Prentice Hall, Upper Saddle River, NJ.

www.wikipedia.com

15. List of Experts and Consultants:

16. Evaluation/Reflection by Fellows and Teachers of how it went:

SO MANY SOILS

DATA SHEET

Names of Group Members

1. Which soil forming factor did your group decide to alter? Describe how you made these alterations.

2. What were your results?

	Cup #1	Cup #2	Cup #3
Year 1			
Year 2			
Year 3			
Year 4			

Year 5			
Year 6			
Year 7			
Year 8			
Year 9			
Year 10			

3. Describe the trend you noticed in the results, what was the effect of your alterations, what was the effect of time?