



Teacher note: This experiment focuses on how nutrients and pH in soils can impact plant growth. However, it can be adapted to compare other abiotic factors and how they impact plant growth. Try comparing sandy, loamy, and clay soils or various amounts of light or water.

Title: Soil Nutrient Comparison
Grade Level: 9-12

GPS/CC Standards:

Habits of Mind

SCSh1
SCSh3
SCSh4
SCSh6

Environmental Science

SEV1
SEV2

Botany

SB02
SB05

Ecology

SEC1
SEC4
SEC5

Biology

SB4

Nature of Science

SCSh8

Materials

Teacher note: All soil amendments listed are readily available online or in your local garden store. Most soil amendments are sold in large quantities. Consider asking your local garden store about smaller sample sizes or donations, or sharing these resources with other teachers, your school garden manager, etc.

- Pots for planting
- Standard planting soil
- Radish seeds
- Source of Phosphorus (bone meal, rock phosphate)
- Source of Nitrogen (urea, corn gluten meal)
- Source of Potassium (kelp meal, muriate of potash)
- Acidifier (soil acidifier)
- Basic additive (garden lime)
- Soil test kit that tests for N, P, K and pH levels
- Measuring cup
- Water
- Ruler

Time Needed: 50 minutes to set up, periodic checks throughout 28 days, 50 minutes to report

Goal: Students will learn how different abiotic factors impact plant growth.



Objectives:

Students will be able to...

- Recognize abiotic factors that characterize soil, including nutrients and pH levels.
- Describe various nutrient cycles.
- Recognize human impact on nutrient cycles.
- Note difference in soil characteristics regionally across the state.
- Identify sources of soil fertilizers used in agriculture.
- Take detailed notes and make observations throughout an experiment.
- Write a comprehensive and thoughtful lab report.

Lesson Outline:

1. Set up experiment with students as a class, in small groups, or individually. It will take about a month to complete the experiment.
2. Conduct experiment alongside teaching biogeochemical/ nutrient cycles and learning about abiotic and biotic factors within a Biome.
3. Highlight differences in the soil characteristics across the state of Georgia and what factors may have influenced this. How does this impact plant life and agriculture?
4. Highlight how humans and agriculture impact nutrient cycles. Where do fertilizers come from? Are they renewable or nonrenewable resources? What happens when excess nutrients are added to the soil?
5. After completing a unit on nutrient cycles and abiotic factors in biomes, have the students write a lab report applying what they've learned to the experiment.

Experiment Outline:

1. Determine what abiotic factors you will test. You can select any of the nutrients and/or pH levels. Each factor should have its own planting pot(s). Make sure they are labeled. Be sure to include a control.
2. Allow students to create different soil mixtures with various nutrient additives. The control should have nothing added to it. All pots should be kept in the same place so that temperature and sunlight remains consistent for all plants.
3. Plant radish seeds into the containers. Each container should be planted with the same number of radish seeds and the same seed spacing. At the time of planting, use the soil tests to test the nutrient levels/ pH of the soil and record on observation chart. Students should have a different observation chart for each planted pot.
4. Frequently observe the radish plants and fill out observation chart. If possible, take pictures during growth. When watering plant, use a measuring cup so that each pot receives the same amount of water.
5. 25-28 days after planting, perform another soil test, record the results, and then harvest the radishes. Label each individually with a number indicating from which pot they were harvested. Make note of the diameter (use string then hold string up to ruler), height, etc. of the radishes and on the post-harvest observation chart. Wash and taste the radishes to see if different factors influence the taste. Each pot should have its own post-harvest observation chart.



Post-Harvest Observation Chart

Abiotic factor being observed:

Harvest date:

Soil Test Results at Harvest	
Date	
P	
N	
K	
pH	

Plant success rate: _____ (plants harvested/ seeds planted)

Plant	Diameter	Height	Taste	Other Observations
Radish 1				
Radish 2				
Radish 3				
Radish 4				
Radish 5				
Average				



Lab Report Guidelines

Title Page: Report title, your name, date, class

Abstract: In a brief paragraph, describe why you did this experiment, what was being tested, and your conclusions.

Introduction: Brief background on topic. Why are nutrient cycles/ soil pH important? Why did you choose to test what you tested? How do the various factors you tested normally cycle? What are some things that impact each factor you're testing? What were your hypotheses going into the experiment?

Materials: Be specific about everything you used during your experiment.

Methods: Be specific about everything you did during this experiment.

Data and Results: Include all of your observations. Include germination rate (number of plants harvested / number of seeds planted), plant height at various times, when and how much you watered, any necrosis or plant death, pictures during experiment, etc. Include post-harvest results, such as diameter or any other unique observations. Consider turning data from your observation table into graphs (line graph of plant height over time, bar graph comparing diameters of radishes, etc).

Discussion: Why? Reason possible explanations for what you found. What were some potential sources of error in this experiment? What are some other abiotic factors you could study that may have an impact on plant growth? How did the control pot compare to the other experimental pots? What was the most limiting factor for radish growth? What can you conclude about radish nutrient requirements based on this experiment? If you had collected seeds from the most successful radish plant in each planter and planted them again under the same conditions, repeating the process for several months and radish generations, what would you expect to happen and why?

Sources Cited: Include any textbooks or reading materials used in class and any additional research.