

Soil Search, Sample, & Analysis

Grade Level: 4-8

Lesson Overview

In this lesson, students will prepare soil samples from a variety of areas to test the pH levels.

Student Objectives

1. Recognize that physical differences are present from different soil areas.
2. Observe and record data from an experiment.
3. Recognize that chemical differences are present in soils from different areas.

Materials

- ✓ Each group will need:
 - small Ziploc plastic bag
 - masking tape
 - 4 oz. jar, with lid
 - 5 vials, with lids
 - 1 funnel
 - 1 coffee filter
 - 1 cotton balls
 - indicator solution
 - 1 medicine dropper
 - 1 teaspoon
 - distilled water
- ✓ Each student will need:
 - Soil Reaction Student Worksheet
 - Soil pH Student Worksheet

Vocabulary

- **acidic pH** - pH below 7.
- **alkaline pH** - pH above 7.
- **neutral pH** - pH at 7.
- **pH** - the measure of the acidity or alkalinity of a substance.
- **soil** - the outer portion of the Earth's surface; the foundation of every living thing.

Background Information

Just like plants have varying light and temperature requirements, they also may have differing soil pH preferences for ideal growth.

Farmers need to be aware of their soil's pH so that the time, effort, and expense of growing their crop is optimized. Some crops will naturally deplete nutrients from the soil over time. Many times, a soil test is completed to ensure that the healthy enough to grow a successful crop.

Soil that is not within the preferred range for a specific plant can be amended (think of gardeners that change the hydrangea bloom color from white, pink, or blue, by adding the appropriate amendments to the flower's soil). A crop nutrition specialist can be helpful to producers to make sure that their soil has the appropriate amount of nutrients for a productive growing season.

Procedure

Collection of Soil Samples

1. Pass out a Ziploc bag and masking tape to each group.
2. Tell the students that each group needs to collect one soil sample from this list (it will work best if each group has a different location – the teacher may choose to assign rather than have groups choose).
 - Close to a house foundation
 - Garden
 - Near a road
 - Farm field
 - Park or playground
 - Pasture/near livestock or a dog park
 - Near a water source (lake, pond, creek, etc.)
 - Ditch
 - Flower bed
 - Edge of a sports field (if allowable)
3. Have students write their group number and the location from where the sample was collected on the bag using the masking tape as a label.
4. Instruct students to clear the soil area to be sampled of any leaves or debris.

5. Students should scoop up several teaspoonfuls of soil, place them into the Ziploc bag, and close it.

Note: Do not handle the soil sample with bare hands, as this can contaminate the samples.

Soil Sample Preparation

1. Pass out the following to each group:
 - 4 oz. jar, with lid
 - 4 vials, with lids
 - 1 funnel
 - 1 coffee filter
 - 1 cotton balls
 - 1 teaspoon
 - Distilled water
 - Masking tape
2. Each group should label a 4 oz. jar and 4 vials with the location of the soil sample using masking tape.
3. Add one level teaspoon of soil from the Ziploc bag to the jar.
4. Add enough distilled water to cover the soil completely.
5. Screw the cap on each jar and shake for 15 seconds.
6. Allow the soil to settle for one minute.
7. Fold a circle of filter paper or coffee filter in half once, then again. Press the folds.
8. Open the folded circle by separating one sheet from three.
9. Place the cone in the funnel and then place a cotton ball in the cone.
10. Place the funnel into vial one and wet the paper with a small amount of distilled water.
11. Carefully pour enough of the liquid from jar one into the funnel to half fill it.
12. Allow about $\frac{3}{4}$ inch of liquid to filter into the vial.
13. Discard the filter paper.
14. Share vial with sample with 3 other groups in the class.

Alternative procedure(s):

1. Teacher can prepare each of the soil samples and share with groups to proceed with the soil reaction color test.

2. Each group can bring in multiple soil samples and prepare as stated above and complete the soil reaction color test.

Soil Reaction Color Test

1. Pass out the following to each group:
 - Indicator solution
 - 1 medicine dropper
 - 1 empty vial
 - Each group should still have:
 - 1 vial with their original sample
 - Vials with samples from 3 other groups
 - Distilled water
2. Each group should place $\frac{3}{4}$ inch of distilled water in the empty vial.
3. Add two drops of indicator solution to each of the four vials. Note: For safety reasons, it is suggested that the teacher handles the indicator solution.
4. Record the color observed in each of the five vials.
5. Compare the color of the liquid in each vial with the color chart provided and estimate the corresponding "pH."
6. After completing the Soil Reaction Color Test students will complete Soil Reaction and Soil pH student worksheets.

Extension Activities

1. Replicate this experiment by investigating various household products in place of soil. Examples: apple juice, orange juice, flour, vinegar, baking soda, antacids, etc.
2. Visit a soil lab and/or interview a soil technician. Some possible questions to ask: How are soil test performed? How are the results mapped? Are there other tests that are utilized?
3. Understanding the Soil Triangle is a math lesson that coordinates well with this lesson.

Additional Resources

- Illinois Agriculture in the Classroom Soil Interactive Ag Mag:
http://www.agintheclassroom.org/TeacherResources/AgMags/Soil%20Ag%20Mag_2019_Online_Interactive.pdf
- Illinois Agriculture in the Classroom Soil Reader
http://www.agintheclassroom.org/TeacherResources/TerraNova/Soilnews_clr.pdf

- Properties of Soil video: <https://www.youtube.com/watch?v=Pu8uw5JPLEI&feature=youtu.be>
- Claude’s Got the Scoop on Soil: <https://web.extension.illinois.edu/soil/>
- National Resource Conservation Service web site: <https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/edu/>
- Smithsonian *Dig It* site too <https://forces.si.edu/soils/>
- Soil Science of America soil: <https://www.soils4teachers.org/>
- Soil Health Quiz: <https://www.proprofs.com/quiz-school/story.php?title=mte1mduwoaih7n>

Standards

Illinois Science Standard

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Illinois English Language Arts Standard

RST 4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics. L 4 Determine or clarify the meaning of unknown and multiple meaning words and phrases based on grade 6.

The **M**ultidisciplinary **A**gricultural Integrated Curriculum (mAGic) was created in 2004 under the leadership of the Illinois State Board of Education (ISBE) and the Facilitating Coordination in Agricultural Education Project (FCAE). Funding was made available through the FCAE grant budget from the agricultural education line item of the ISBE budget. This revision, as printed, was developed in April 2021.



These mAGic lessons are designed to bring agriculture to life in your classroom. They address the Illinois Learning Standards in math, science, English language arts and social studies.

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Soil Reaction Worksheet

	Color <small>(from indicator solution)</small>	pH	Acid or Base	Crop <small>(from chart below)</small>
Distilled Water				
Sample 1				
Sample 2				
Sample 3				
Sample 4				

Normal growth pH range	Crop
6.5 – 7.5	Alfalfa
5.0 – 6.5	Apples
6.3 – 7.0	Barley
6.0 – 7.0	Birdsfoot trefoil
6.0 – 7.5	Cabbage
5.8 – 7.0	Clovers
5.8 – 7.0	Corn
5.5 – 6.5	Cotton
5.5 – 7.0	Cucumbers
6.0 – 7.5	Flaxseed
5.5 – 6.5	Grain Sorghum
5.8 – 7.0	Grasses
6.0 – 6.5	Green beans
5.8 – 7.0	Oats
5.5 – 6.5	Onions
5.5 – 6.5	Peanuts
5.0 – 5.5	Potatoes
5.5 – 6.5	Rice
5.0 – 7.0	Rye
6.5 – 7.5	Soybeans
6.5 – 7.0	Sugar Beets
6.3 – 7.0	Wheat

*Information compiled from Mosaic Crop Nutrition, Cornell University Cooperative Extension, Iowa State University Extension, Oregon State University, and SFGate.

Name _____

Soil pH Worksheet

1. Why do you think the distilled water was tested?

2. What role does the distilled water play in this activity?

3. Which one of your soil samples has a pH value that falls into the
 - a. acid pH range?

 - b. neutral pH range?

 - c. alkaline pH range?

4. Think of some reasons that may be used to explain the differences or similarities in the pH ranges of your three soil samples.

Soil pH Worksheet - ANSWER KEY

1. Why do you think the distilled water was tested?

It is the control for the experiment because it has a neutral pH (7).

2. What role does the distilled water play in this activity?

The distilled water acts as a dissolving agent for the mineral matter in the soil sample. Since it has a neutral pH (7), it does not alter the pH of the soil sample.

3. Which one of your soil samples has a pH value that falls into the

- a. acid (less than 7) pH range?

Answers will be dependent upon sample.

- b. neutral (7) pH range?

Distilled water

- c. alkaline (more than 7) pH range?

Answers will be dependent upon sample.

4. Think of some reasons that may be used to explain the differences or similarities in the pH ranges of your three soil samples.

Some reasons can include: amount of lime (lime is more alkaline) amount of sulfur (sulfur is more acidic)

pHydrion

pHydrion

One Drop
Indicator Solution 1-11

Use 1 drop in test tube (4 ml)
Compare color with chart

