Forestry Suppliers Lesson Plan

Soil pH

Forestry Suppliers' Soil Analysis F.I.E.L.D. Kit™
Fundamental Investigation of the Environment Leading to Discovery™
Study Kit Correlated to National Science Education Content Standards

If you're interested in soil studies for classroom activities, consider the Forestry Suppliers' Soil Analysis F.I.E.L.D. Kit. Use the kit for the exercises outlined in this Lesson Plan, as well as other related activities (see "Further Studies" section for a few ideas).

This F.I.E.L.D. Kit is available exclusively from Forestry Suppliers and includes some of the items used in this lesson plan. All kit items may also be purchased individually. Call our Sales Department at 1-800-647-5368 or visit us on the web at www.forestry-suppliers.com.

Fields of Study:
- Earth Science
- Mathematics

National Science Education Content Standards Correlation

Grades	A	B	C	D	E	F	G
K-4	✓	✓			✓		✓
5-8	✓	✓			✓	✓	✓
9-12	✓	✓			✓		✓

Soil Analysis Kit Contents Stock Number 36845		Required For This Lesson Plan			
Qty.	Description	K-4	5-8	9-12	Stock Number
1	Soil Color Book, GLOBE Earth Colors				77369
1	Soil Texture Kit				77330
1	Soil N-P-K Kit				77960
1	Soil Thermometer				89028
1	Soil Sample Bags, 18 oz.				79227
1	Soil Sample Tube	✓	✓	✓	76971
1	Hydrion pH Papers, 0-13	✓	✓	✓	78105

Grades K-4

Background

Some of our favorite foods make our tongue curl up because they are so SOUR, like a dill pickle! Other fun foods have a "bite" of their own because of their somewhat bitter flavor. There is a scientific reason for this: these foods are either acidic or basic. Other substances besides foods have these and other characteristics; for example, soap. Soap of any kind is very slippery and if you ever by accident get a little bath soap in your mouth, (YUK!) it has a very bitter taste. Bases are very bitter and cause surfaces to become slippery. Acids are very sour and, if very strong or concentrated, can cause a burn on the skin. Strong bases can burn the skin, too. Some substances are not really an acid or a base, like pure water; however, many of the substances around us can be identified as either acidic or basic, even the dirt in our backyard! A special name is given to the acid or base characteristic that a substance has: it is called the pH of a substance. Scientists have come up with a way to measure the pH by using special strips of paper called pH paper. When the paper touches the substance being tested it turns a specific color to tell you if the substance is an acid or a base.

The activity found in this lesson plan will teach you how to measure the pH of soil. This information is very important to gardeners and farmers; even those who grow just a few tomatoes in their backyard. Knowing the pH of the soil helps the gardener know exactly what types of vegetables or flowers will grow well in that spot! Have fun!

Procedure

1. Select 3 test sites; places from which you want to collect soil.
2. Dig approximately 6 inches down into the area and place the bottom half of the sample into the plastic bag and label according to the site.*
3. Place one tablespoon of soil from the collection bag into a small plastic cup. Add 1/4 cup of distilled water.
4. Swirl the soil and water mixture three times.
5. Place the edge of a 2-inch piece of pH Hydrion paper into the mixture.
6. Observe the color change of the pH paper.
7. Try to match the resulting color to the colors listed on the outside of the pH Hydrion paper package.
8. The colors match with a correlated pH number. This number is the pH value of the soil.
9. If the number is less than 7, the soil has an acidic nature.
10. If the number is more than 7, the soil has a basic nature.
11. Repeat the procedure or test using soil collected from different test sites.
12. Compare your results to see if there are any differences in the pH of different areas tested.

* *NOTE: The teacher or instructor may use a soil sampling tube which is an easy way to retrieve the first six inches of soil in a concise manner.*

Further Studies

- Do different types of plants, trees or flowers grow in the different areas where you collected soil? (K-4)
- If the pH values were different, could one pH soil type be better for some plants? (3-4)
- How can the pH value of the soil be changed? (3-4)
- Call your local plant nursery or store and ask them about the importance of soil pH. (3-4)
- Using your school or public library or the Internet, find out what plants prefer acidic or basic soil types. (3-4)
- Using a hand held magnifier, observe the three soil samples for differences in particle size and texture. (K-4)
- Correlated Lesson Plan Series activity, Determining Moisture Content of Soil. (3-4)

Content Standards Covered:

A Science as Inquiry
- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

B Physical Science
- Properties of objects and materials

E Science and Technology
- Abilities of technological design
- Understandings about science and technology

G History and Nature of Science
- Science as a human endeavor

Rubric

- Students know the difference between an acid and a base by definition.
- Students know how to use pH Hydrion™ paper to determine the numerical pH value.
- Students understand that different soils have different pH values and can support different types of plants depending on the needs of the plants.
- Students can repeat the sequential steps of the experiment.

Assessment

- Have students prepare a storyboard showing the steps of their experiments.
- Orally quiz students concerning the difference between an acid and a base.
- Have students list the foods they have tasted in the past, which can be categorized as either an acid or base.
- Allow students to safely taste foods you have provided and categorize as an acid or base.

These lesson plans are provided for the benefit of science educators and can be freely downloaded from our web site at www.forestry-suppliers.com. If you have an idea or other suggestions for future lesson plans, we'd like to hear from you! Send an e-mail to fsi@forestry-suppliers.com.

Required Materials

The following items are required to complete all the activities in this lesson plan. Available from Forestry Suppliers, Inc.

- Soil Sample Bags (pk 100) **79147**
- Hydrion pH Paper **78105**

Supplied by Teacher/Student(s)

- Soil collected from five different test sites
- 1 gallon distilled water

Optional Items

Optional Items available from Forestry Suppliers, Inc., that can be used to enhance this lesson plan.

- Folding Pocket Magnifier **61122**

Grades 5-8 Middle Educational

Grades 5-8

Background

At an early age our taste buds indicate to us whether something we eat is sour or bitter. These characteristics of a food can be described as acidic or basic and are due to the "chemical" nature of a substance.

Some acids are rather weak and some are very strong. For example, small amounts of weak acids are found in our mouths and stomachs. These acidic solutions serve to help break down and digest the food we consume every day. A weak base is one of the major components found in dishwashing liquid and bath soap. Acids and bases are important in industry. Industrially, one of the most important acids is sulfuric acid. It is used in petroleum refining, steel processing and fertilizer production. Phosphoric and nitric acid are used in fertilizer production, too.

It is important to understand the role of the acidic or basic nature of the soils in which food crops and plants are grown. Some plants prefer acidic soils whereas others grow best in basic soil. The acidic or basic nature of the soil can even affect the color of the leaves and flowers as well as the overall health of the plant.

How do scientists or even farmers know whether the soil in which they plant seeds or young plants is basic or acidic? They can use special test paper strips or a meter to measure what is called the "pH" of the soil. Scientists devised a "pH scale" which determines whether a substance is an acid or a base. This pH scale is a numerical scale or a number line. The numbers on the scale range from 0 - 14, allowing 7 to be the mid-point. Any substance which has a pH value of less than 7 is considered an acid, and a pH value greater than 7 is a base. This leaves a pH of exactly 7 being neutral.

0————————7————————14
ACID———NEUTRAL———BASE

How are pH values determined? Simple. One can use a special pH paper (called Hydrion™ pH Paper or pH test paper) which, when placed in a solution, turns a specific color depending upon the pH value of the substance. The color of the test strip is matched to a color chart, which gives the pH value. A pH tester can also be used to measure the pH of soil, water, or other substances. A pH tester is an instrument that has a probe, which is inserted into a soil or liquid sample and gives a "readout" concerning the pH of the substance tested. Knowing the pH of the soil can help a farmer know what soil type is best in which to grow particular plants, vegetables, or flowers.

Procedure

1. Select 3 test sites; places from which you want to collect soil.
2. Dig approximately 6 inches down into the area and place the bottom half of the sample into the plastic bag and label according to the site.*
3. Place one tablespoon of soil from the collection bag into a small plastic cup. Add 1/4 cup of distilled water.
4. Swirl the soil and water mixture three times.
5. Place the edge of a 2-inch piece of pH Hydrion paper into the mixture.
6. Observe the color change of the pH paper.
7. Try to match the resulting color to the colors listed on the outside of the pH Hydrion paper package.
8. The colors match with a correlated pH number. This number is the pH value of the soil.
9. If the number is less than 7, the soil has an acidic nature.
10. If the number is more than 7, the soil has a basic nature.
11. Repeat the procedure or test by gathering soil from a different area and testing.
12. Compare your results to see if there are any differences in the pH of different areas tested.
13. Sprinkle a small amount of the soil sample on a white piece of paper or on a white index card.
14. Using the magnifying lens, look for the shape and texture of the soil particles.
15. Repeat steps #11 and #12 with soil from each collection site.
16. Compare your results to see if there are any differences in the different soil samples.

** NOTE: The teacher or instructor may use a soil sampling tube which is an easy way to retrieve the first six inches of soil in a concise manner.*

Further Studies

- Do different types of plants, trees or flowers grow in the different areas where you collected soil?
- Using your school or public library or the Internet, find out what plants prefer acidic or basic soils.
- Extend your soil study by testing and observing the soil samples concerning the texture and particle size by using a soil texture test kit.
- Call your local plant nursery or plant store and ask about the importance of soil pH.
- Find information concerning the industrial uses of acids and bases.
- Using a pH meter, test the soil pH and compare this to the pH values resulting from using the pH paper.
- Observe or test:
  1 Color comparison of soil samples
  2 Temperature differences among samples taken at the site
  3 Specific texture differences.

Content Standards Covered:

A Science as inquiry
- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

B Physical Science
- Properties and changes of properties in matter

E Science and Technology
- Abilities of technological design
- Understandings about science and technology

F Science in Personal and Social Perspectives
- Science and technology in society

G History and Nature of Science
- Science as a human endeavor
- History of science

Rubric

- Students know the difference between an acid and a base by definition.
- Students know how to use pH hydrion paper to determine the numerical pH value.
- Students understand that different soils successfully support specific plant life depending upon the pH level.
- Students can successfully repeat the experiment steps.

Assessment

- Orally quiz students concerning the difference between an acid and a base.
- Have students list the foods they have tasted in the past, which can be categorized as either an acid or base.
- Have students prepare a summary concerning the pH differences and the texture differences found in the different soil samples.
- Have students design a similar experiment involving pH differences among household products or foods.

These lesson plans are provided for the benefit of science educators and can be freely downloaded from our web site at www.forestry-suppliers.com. If you have an idea or other suggestions for future lesson plans, we'd like to hear from you! Send an e-mail to fsi@forestry-suppliers.com.

Required Materials

The following items are required to complete all the activities in this lesson plan. Available from Forestry Suppliers, Inc.

- Soil Sample Bags (pk 100) **79147**
- Hydrion pH Paper **78105**
- Union Trowel **33413**

Supplied by Teacher/Student(s)

- Soil collected from five different test sites
- 1 gallon distilled water

Optional Items

Optional Items available from Forestry Suppliers, Inc., that can be used to enhance this lesson plan.

- LaMotte Soil Texture Kit **77330**

Grades 9-12

Background

Many of the foods we enjoy have an acidic or basic nature. Citrus fruits contain acid, which give them a desirable tart or sour taste. Many common household products are basic in composition, such as cleaners and soaps. Weak bases found in bath soaps help create a slippery effect on surfaces; this is experienced when washing your hands. Bases have a bitter taste that we may have experienced as young children when we accidentally got a little soap solution in our mouth when we washed our face. Basic solutions are sometimes called alkaline. Acids, weak and strong, have important industrial uses. Sulfuric acid is important in petroleum refining, steel processing as well as in the process of fertilizer production. Weak acids are found in saliva and gastric juices.

Chemically, acids are defined as substances when mixed with water form hydronium ions, H3O+. Bases are defined as substances which form hydroxide ions, OH-, when mixed with water. A color reaction with a special paper (called litmus paper) physically defines a solution as acidic or basic. Blue litmus paper turns red when exposed to an acidic solution and red litmus paper turns blue when in contact with a basic solution. To more specifically define an acidic or basic substance, scientists devised a numerical scale, called a pH scale, to categorize substances as an acid or base. Numerically, the scale is from 0 to 14, with 7 being the midpoint. Any solution or substance having a pH value of less than 7 is known as an acid and above 7 is considered a base. Seven is considered neutral. A special test paper, pH Hydrion, is used to numerically measure pH. Depending on the acidic or basic nature of the test solution, the paper turns a specific color which can be matched to a standard color chart correlated with pH values. A pH meter can also be used to measure the pH of a solution or substance. The meter consists of a probe, which is placed in the solution and the meter displays a digital readout of the pH.

0————————7————————14
ACID———NEUTRAL———BASE

Agriculturally, the pH value of soil is an important factor or consideration for farmers. Particular crops and plants require a specific pH to thrive and produce high yields. The pH of the soil can even affect the color of leaves or flowers. Whether it is growing tomatoes in a small garden or soybeans over many hundreds of acres, knowing and maintaining the correct soil pH is a must. By conducting the following experimentation, one can gain a better understanding of acids and bases and how pH is measured.

Procedure

1. Select 5 different soil-testing sites; make observations of the surroundings, which may lend to the possible resulting differences in pH of the soils tested.
2. Vertically dig 6 inches into the site and place the sample retrieved at that depth into the plastic bag and label.
3. Weigh out approximately 10 grams or measure about 1 tablespoon of the soil and place into a plastic cup or beaker.
4. Add 60 ml or 1/4 cup of distilled water.
5. Swirl the soil and water mixture 3 times; use a clean stirring rod or spoon to thoroughly mix the water and soil.
6. Place the edge of a 2-inch piece of pH Hydrion paper into the mixture.
7. Observe the color change of the pH paper.
8. Try to match the resulting color to the colors listed on the outside of the pH Hydrion paper package.
9. The colors match with a correlated pH number. This number is the pH value of the soil.
10. If the number is less than 7, the soil has an acidic nature.
11. If the number is more than 7, the soil has a basic nature.
12. Repeat the procedure or test by completing steps 3 through 11 using the other soil samples.
13. Compare your results to see if there are any differences in the pH of different areas tested.

Further Studies

- Using the Soil Analysis F.I.E.L.D. Kit, test for the following differences between the different soil test sites:
  a. Soil Texture
  b. Soil Color
  c. Temperature of soil at site
- Compare the moisture content of the selected soils by conducting a soil moisture analysis as outlined in the Lesson Plan, Determining Moisture Content of Soil.
- Contact your local Soil and Water Conservation Agency for information concerning soil pH as well as the local plant nursery.
- Research the following acid/base theories:
  a. Bronsted-Lowery
  b. Arrenhius
  c. Lewis
- Research and define the following terms:
  a. Buffer
  b. Acid-base neutralization
  c. Blood pH

Content Standards Covered:

A Science as inquiry
- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

B Physical Science
- Structure and properties of matter

E Science and Technology
- Abilities of technological design
- Understandings about science and technology

G History and Nature of Science
- Science as a human endeavor
- Historical Perspectives

Rubric

- Students should understand the differences between an acid and a base.
- Students should be able to repeat experiment using other substances, such as household products.
- Students should be able to make correlations between different test sites and possible pH differences.

Assessment

- Quiz students concerning the theoretical differences between acids and bases and have them give examples.
- Have students use pH paper and a pH meter to test the pH values of selected solutions.
- Have students cite acid-base neutralizations reactions, which are common to everyday life, example: using an antacid to relieve heartburn.

These lesson plans are provided for the benefit of science educators and can be freely downloaded from our web site at www.forestry-suppliers.com. If you have an idea or other suggestions for future lesson plans, we'd like to hear from you! Send an e-mail to fsi@forestry-suppliers.com.

Required Materials

The following items are required to complete all the activities in this lesson plan. Available from Forestry Suppliers, Inc.

• Soil Sample Bags (pk 100)	79147
• Hydrion pH Paper	78105
• Union Trowel	33413
• LaMotte Soil Sampling Tube	76971

Supplied by Teacher/Student(s)

- Soil collected from five different test sites
- 1 gallon distilled water

Optional Items

Optional Items available from Forestry Suppliers, Inc., that can be used to enhance this lesson plan.

• 100 ml Beaker	53609
• 100 ml Graduated Cylinder	53643
• Oakton pH Testr 1	76164
• Electronic Balance	94003