Environmental Science Lab

SOIL ANALYSIS

OVERVIEW

Soil is one of the earth's most important, yet least appreciated, resources. It performs a valuable role in land ecosystems. In order for a community of producers and consumers to become established on land, soil must be present. Furthermore, soil quality is often a limiting factor for population growth in such systems. Soil is a complex mixture of inorganic materials, organic materials, microorganisms, water and air. Its formation begins with the weathering of bedrock or the transport of sediments from another area. These small grains of rock accumulate as a layer on the surface of the earth. There they become mixed with organic matter called humus, which results from the decomposition of the waste products and dead tissue of living organisms. The soil formation process is very slow (hundreds to thousands of years), so it can be very detrimental to a community if the soil is lost through erosion or its quality degraded in any way. Soil contains important primary plant nutrients such as nitrogen, potassium and phosphorus. Water and air are also trapped in its pore spaces. These are all necessary ingredients for the growth of plants. In this lab activity you will determine textural and compositional characteristics of a soil sample.

1. You will first determine the soil texture. This is a measure of the proportions of sand, silt, and clay in the soil. You will shake a soil and water mixture in a graduated cylinder and allow the sand, silt and clay to settle out in separate layers

2. Next you will use a commercial soil testing kit to determine soil pH. This is an important factor in determining soil fertility. Most plants prefer a certain soil pH range.

3. You will then use the soil testing kit to determine the content of three plant nutrients: nitrogen, potassium and phosphorus. These are the primary macronutrients needed by plants. They can become depleted in soils due to human activity such as farming.

4. Finally, you will determine the overall health of the soil and clean up the lab.

TIME REQUIREMENTS

This lab activity requires one 50-minute class period.

LAB EQUIPMENT AND MATERIALS

A list of equipment and materials needed to complete this activity is given below.

Equipment	**Amount Needed**
Soil test kit (Garden Guide, LaMotte)	1
Graduated cylinder (clear, 50 mL)	1
Materials	**Amount Needed**
Soil sample	>20 mL
Plastic wrap (10 cm x 10 cm)	1 square
Rubber band	1
Newspaper	1 sheet

LAB PROCEDURE

Hints for a successful lab:

⇒ Plan your time wisely. Some activities require a sample to sit for ten to thirty minutes. Begin a new activity while waiting for another activity to finish.

⇒ Read the instructions with the soil testing kit carefully.

⇒ Do not put soil down the drain. It will clog the pipe.

Prepare the soil samples

1. Remove about 20 mL of the soil sample and set it aside for determination of the soil texture.

2. Spread out the rest of the soil onto a sheet of newspaper.

3. Remove unwanted foreign material from the soil such as twigs, leaves, and stones.

4. Crush the soil gently to break up any clumps.

5. Dry the soil dry until it is ready to be used.

Determine soil texture

1. Place the set aside 20 mL of soil sample in the 50 mL graduated cylinder.

2. Add water until the total volume of soil and water is about 40 mL.

3. Cover the top of the graduated cylinder with a piece of plastic wrap and secure it with a rubber band.

4. Invert the cylinder several times until the soil is thoroughly suspended in the water. You may have to shake the cylinder to mix the water and soil thoroughly.

5. Place the cylinder on the table and let the soil material settle for at least thirty minutes. The different soil materials will settle to the bottom at different rates depending upon their particle sizes: sand size > silt size > clay size.

6. Estimate the volume of the sand, silt and clay layers using the marks on the graduated cylinder. There should be at least three reasonably distinct layers in the graduated cylinder representing sand (bottom), silt (middle) and clay (top). There may also be a dark humus layer above the clay layer, or possibly floating on top of the water.

7. Record the volumes of the three layers and the total of all three on the data worksheet.

Determine soil pH

1. Use soil that is drying on the newspaper for this test.

2. Determine the pH of the soil following the procedure provided with the soil test kit. Note: During this test you must allow the soil to settle for about ten minutes.

3. Record your result on the data worksheet.

Determine primary soil nutrients

1. Use soil that is drying on the newspaper for this test.

2. Determine the nitrogen, potassium and phosphorous contents of the soil sample following the procedure provided with the soil test kit. Note: During each of these tests you must allow the soil to settle for about ten minutes.

3. Record your results on the data worksheet.

Cleanup lab

1. Dump unused soil in an appropriate area outside.

2. Soil used for the tests hould be placed in the compost bin (or garbage). Do not put soil down the sink drain!

3. Return equipment and soil test kit materials to your teacher.

LAB REPORT / ANALYSIS QUESTIONS

Provide answers to the following questions using complete sentences.

1. The proportions of what three particles are used to determine soil texture? Which of these particles has the smallest surface area? Which has the largest?

2. Using the soil texture triangle (Fig. 1), determine the soil type of this sample. What is a soil with 20% clay, 40% silt, and 40% sand called?

3. Looking at the Soil Texture Triangle (Fig. 1), which soil type has the greatest:
   a. water retention ability?

   b. water percolation rate?

4. What role does humus play in soil fertility?

5. Why is pH such an important aspect of soil fertility?

6. What are some natural sources of the nitrogen, potassium and phosphorous found in soil?

7. How are the three primary plant nutrients used by living organisms?

8. By what process is atmospheric molecular nitrogen (N_2) converted into a form that plants can readily absorb through their roots?

9. What are some possible sources of error in this experiment?

10. Evaluate the fertility of the soil used in this lab activity based upon your results.

END OF LAB

DATA WORKSHEET						
Soil Texture Test						
Sand Vol.	**Silt Vol. (mL)**	**Clay Vol.**	**Total Volume**	**Sand %**	**Silt %**	**Clay %**
Soil Type:						
Soil pH Test						
Soil pH:		**Alkaline, Neutral, Basic:**				
Soil Nitrogen Test						
Soil Nitrogen:						
Soil Potassium Test						
Soil Potassium:						
Soil Phosphorus Test						
Soil Phosphorus:						

Fig. 1 Soil texture triangle.