



Testing Soil Nutrients (N-P-K)

Grade Level: 6-12

Essential Skills: 1, 2, 4, 5

NGSS: MS-LS1-5, MS-LS2-5, MS-LS1-4, HS-LS2-4, HS-ESS3-2

CCSS: WHST.6-8.1, WHST.6-8.2, SL.8.1,

Math: 6.RP.3, 7.RP.3,

Time: 2 class periods

Materials: Soil Testing Kit*

- One nitrogen, phosphorus and potassium comparator with capsules.*
- One pipette*
- paper cups*
- Spoon or shovel*
- Activity Page: Testing Soil Nutrients (N-P-K)*
- Masking Tape
- Marker
- Paper Towel
- Liquid Measuring Cup
- Jar with lid
- Distilled Water

***Materials Available from Oregon Agriculture in the Classroom.**

[AITC Library Resources:](#)

More Lessons:

Fertilizers and the Environment
Know your Nitrogen
Soil Horizons & Oregon's State Soil
Water Filtering and Soil
From Rocks to Soil
Earth as an Apple & Soil Conservation

Description:

Students will discover that plants need an adequate amount of nutrients to grow and stay healthy. Plants uptake nutrients from the soil, so it is important to test soil regularly to determine if there are enough nutrients to support plant growth. The soil test kit will help students identify whether soils in their garden, yard, park, etc. are fertile or deficient in nutrients. Keep in mind that all plants need nutrients, but requirements vary depending on the type of crop, shrub, tree, etc.

Background:

Most soils have an abundance of nutrients, but sometimes nutrients can diminish or become depleted when they are not replaced after being used up by the plant. Nitrogen, phosphorus and potassium (N-P-K) play a vital role in plant growth. Nitrogen is important for growth, phosphorus stores and transfers energy to be used for reproduction and developing root systems and potassium is responsible for disease resistance. Nutrients can be replaced by adding manure, fertilizer, organic matter and/or compost to the soil.

Directions:

Part I: Preparing Soil Samples

1) Divide students into five groups. Have each group use a spoon or small shovel to gather soil samples in the paper cup. Ensure they avoid touching the soil with their hands, as this may alter test results.

Teacher Note: Encourage each group to get a sample from different areas in the garden or around trees and shrubs in order to have the best overall representation of soil nutrients.

2) Dump the soil out on a paper towel to allow soil to dry naturally if needed. Use this time to break up clumps and remove small stones before testing.

3) Place 1/4 cup of soil into a clean jar and add 1 1/4 cups of distilled water.

4) Place the lid on the jar and shake or stir the soil and water continuously for one minute.

5) Using a piece of masking tape, label the jar with the names of students in the group.

6) Set the mixture aside and allow it to stand until it settles. This usually takes 30 minutes to 24 hours depending on the type of soil.

7) Have students refer to the worksheet and hypothesize if each test will result in soil being depleted, deficient, adequate, sufficient or in surplus amounts for each nutrient.



Part II: Testing Nitrogen, Phosphorus and Potassium

1) Provide each group with their testing kits and have them carefully collect their soils samples. Making as little movement as possible have them take their jars back to their groups and avoid disturbing the settled soil.

2) Have students select the appropriate comparator and matching capsule for each test. For example, students will use the purple capsule to test the amount of nitrogen in the soil. The nitrogen comparator has a purple cap and chart.

Purple = Nitrogen

Blue = Phosphorus

Orange = Potassium

3) Use the pipette to fill both the test and reference chambers with liquid from the soil and water mixture. Do not include sediment. Make sure to fill the comparator to the marked line.

4) Work with a partner, one holding the comparator with the liquid and the other partner should carefully separate the two halves of the appropriate capsule and pour the powder into the test chamber. (Hint: lightly squeeze one side of the capsule and twist the other side to gently pull apart the capsule.)

5) Put the cap back on the comparator, making sure it's sealed. Shake thoroughly.

6) Wait exactly 10 minutes for the color to develop. If the blue color has settled to the bottom of the phosphorus test chamber during the 10 minute period, shake the tube to remix the color into the solution.

7) Compare the color of the solution in the test chamber against the chart and solution in the reference chamber. Repeat the steps 2-7 for the nitrogen, phosphorus and potassium test. Continue on to Part III to identify next steps in ensuring the soil has the proper nutrients needed for plant health.

Part III: Analyzing Fertilizer Needs

1) Have students analyze their results with the "N-P-K Fertilizer Recommendations" chart on their worksheet.

2) Students will determine the amount of fertilizer recommended for each type of plant listed in the chart based on the test results of their soil.

Part IV: Calculating Nutrients in Fertilizer

1) Using Agrium's Rainbow Plant Food as an example, show students how to calculate the amount of nutrients in the bag. Agrium's Rainbow Plant food is 10-10-10 (N-P-K) the first value represents the nitrogen which is 10% of the weight of the fertilizer, the second value is the phosphorus which is 10% of fertilizer, and the final value is the potassium at 10%.

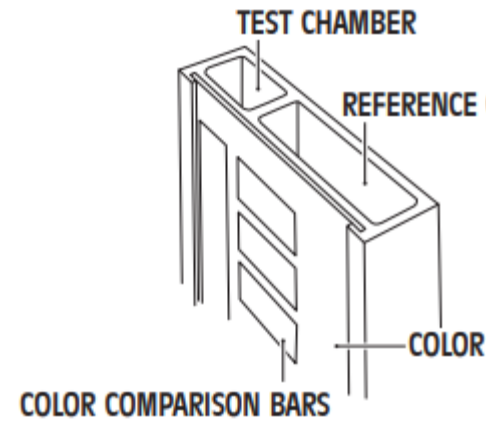


Fig. 1. Comparator Diagram: Leaf Luster Products, Inc. "rapitest Soil Test Kit instructions." p.1.

2) Demonstrate to students how to calculate the amount of N-P-K in a 50 lb bag of Agrium's Rainbow Plant Food 10-10-10.

Calculating Nutrients:

_____ (lbs fertilizer bag) x _____ (percentage of nutrients) = _____ lbs of nutrient in bag

Nitrogen:

50 lbs x .10 = 5 lbs of Nitrogen in Agrium's Rainbow Plant Food

Phosphorus:

50 lbs x .10 = 5 lbs of Phosphorus in Agrium's Rainbow Plant Food

Potassium:

50 lbs x .10 = 5 lbs of Potassium in Agrium's Rainbow Plant Food

3) Have students complete the calculations on Part IV: Calculating Nutrients in Fertilizer on their worksheet.

Part V: Calculating Fertilizer Application Rates

Using the fertilizer recommendations for lawn that you collected in Part III from your soil test results, have students calculate the total amount of fertilizer needed to maintain a healthy lawn in the scenarios listed on their worksheets in Part V. (See Example Calculation Below)

Formulas:

Rate of nitrogen per 1,000 sq. ft / % of nitrogen in fertilizer = amount of product per 1,000 sq. ft.

Amount of product per sq. ft x the number of sq feet in the lawn = total amount of fertilizer needed.

1 acre= 43,560 sq. ft

Example:

How many pounds of fertilizer is needed to reach desired amount of nitrogen at 1lb/1000 sq. feet application rate? You have a 8,000 sq ft lawn and are using a fertilizer with a nutrient analysis of 24-6-12.

1 lbs. / .24 =4.2 (round to the nearest tenth) per 1,000 sq. ft.

4.2 x 8 = 33.6 lbs. of fertilizer

This lesson was adapted from the materials of the following groups:

Luster Leaf, [Rapitest Soil Test Kit](#)

Natural Resources Conservation Service

Maintaining a Healthy Lawn in Western Oregon, Oregon State University Extension Service



Testing Soil Nutrients (N-P-K)

Student Name: _____

Part I: Preparing Soil Samples

- 1) With your group, use a spoon or small shovel to gather a soil sample in the paper cup. Avoid touching the soil with your hands, as this may alter test results.
- 2) Dump the soil out on a paper towel to allow soil to dry naturally if needed. Use this time to break up clumps and remove small stones before testing.
- 3) Place 1/4 cup of soil into a clean jar and add 1 1/4 cups of distilled water.
- 4) Place the lid on the jar and shake or stir the soil and water continuously for one minute.
- 5) Using a piece of masking tape, label the jar with the names of students in the group.
- 6) Set the mixture aside and allow it to stand until it settles. This usually takes 30 minutes to 24 hours depending on the type of soil.

Hypothesize what you think will happen as a result of each test. Do you hypothesize the nitrogen, phosphorus and potassium tests will result in depleted, deficient, adequate, sufficient or in surplus amounts of each nutrient? Why?

N:

P:

K:

Part II: Testing Nitrogen, Phosphorus and Potassium

1) Carefully grab your soil sample making as little movement as possible to avoid disturbing the settled soil.

2) Using the testing kit, select the appropriate comparator and matching capsule for each test. For example, you will use the purple capsule to test the amount of nitrogen in the soil. The nitrogen comparator has a purple cap and chart.

Purple = Nitrogen

Blue = Phosphorus

Orange = Potassium

3) Use the pipette to fill both the test and reference chambers with liquid from the soil and water mixture. Do not include sediment. Make sure to fill the comparator to the marked line.

4) Work with a partner, one holding the comparator with the liquid and the other partner should carefully separate the two halves of the appropriate capsule and pour the powder into the test chamber. (Hint: lightly squeeze one side of the capsule and twist the other to gently pull apart the capsule.)

5) Put the cap back on the comparator, making sure it's sealed. Shake thoroughly.

6) Wait exactly 10 minutes for the color to develop. If the blue color has settled to the bottom of the phosphorus test chamber during the 10 minute period, shake the tube to remix the color into the solution.

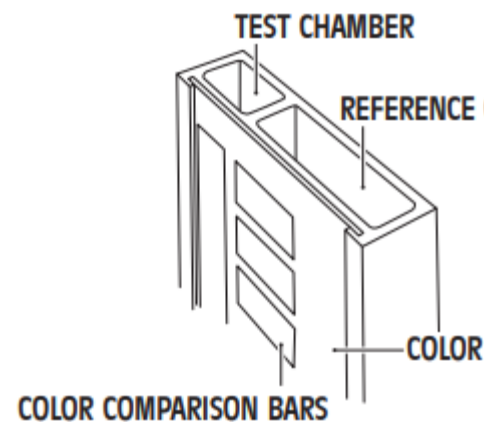


Fig.1. Comparator Diagram: Leaf Luster Products, Inc. "rapitest Soil Test Kit instructions." p.1.

7) Compare the color of the solution in the test chamber against the chart and solution in the reference chamber. Record your test results in the chart below. Repeat the steps 2-7 for each nutrient: nitrogen, phosphorus and potassium.

Nutrient	Color (What it looks like in the Comparator after adding the capsule)	Test Results (Depleted, Deficient, Adequate, Surplus/Sufficient)
Nitrogen (N)		
Phosphorus (P)		
Potassium (K)		

Part III: Analyzing Fertilizer Needs

The chart below bases its application rates using three fertilizer types Nitrate of Soda (16-0-0), Triple Superphosphate (0-46-0) and Muriate of Potash (0-0-60). The numbers in the chart represent the rate of application using oz/100 sq. feet.

FEEDING ESTABLISHED PLANTS AND BEDS

Based on your test results, apply the appropriate fertilizer(s) in the amounts recommended in the following chart.

RECOMMENDATIONS FOR N, P AND K RESULTS

	(0) Depleted			(1) Deficient			(2) Adequate			(3&4) Surplus / Sufficient
	N	P	K	N	P	K	N	P	K	
Lawn	22.0-22.5	0.75-1.0	4.75-5.0	14.0-14.5	1.0-1.5	2.25-2.5	3.75-4.0	0	0	N/A
Fruit	14.0-14.5	6.5	13.5-14.0	7.75-8.0	4.0-4.25	8.75-9.0	3.75-4.0	2.25	4.75-5.0	N/A
Flower	14.0-14.25	6.5	13.5-14.0	7.75-8.0	4.0-4.25	8.75-9.0	3.75-4.0	2.25	4.75-5.0	N/A
Shrubs (flowering)	14.0-14.25	8.25-8.5	13.5-14.0	7.75-8.0	4.0-4.25	8.75-9.0	3.75-4.0	1.0-1.25	4.75-5.0	N/A
Shrubs (foliage)	22.0-22.5	10.5-10.75	8.75-9.0	14.0-14.5	5.25-5.5	4.75-5.0	3.75-4.0	2.25	2.25-2.5	N/A
Veggies (root)	14.0-14.25	12.0-12.25	8.75-9.0	14.0-14.5	5.25-5.5	4.75-5.0	3.75-4.0	3.0	2.25-2.5	N/A
Veggies (leafy)	28.25-29.0	10.25	8.75-9.0	14.0-14.5	5.25-5.5	4.75-5.0	7.75-8.0	2.25	2.25-2.5	N/A
Tree	14.0-14.5	10.25	8.75-9.0	7.75-8.0	5.25-5.5	4.75-5.0	3.75-4.0	2.25	2.25-2.5	N/A
General Feed	22.0-22.5	8.25-8.5	8.75-9.0	10.5-11.0	4.0-4.25	4.75-5.0	3.75-4.0	1.0-1.25	2.25-2.5	N/A

The recommendations are based on the following fertilizer sources: Nitrate of Soda (16% N), Triple Superphosphate (46% P₂O₅) and Muriate of Potash (60% K₂O). The amounts listed are in oz. / 100 sq. ft. (Ounces referred to are by weight, not volume.) If you wish to use other fertilizer, simply check the package for the percentage of nutrients for N, P, & K and adjust the application level accordingly.

Source: "Fertilizer Recommendations." rapitest Soil Test Kit, Luster Leaf Products, www.lusterleaf.com/img/instruction/1601-soiltestkit_instructions.pdf.

Using the chart above, determine the amount of fertilizer needed in lb/ acres based on your soil's nutrient test results. (1 acre= 43,560 sq. ft, 1 oz = .0625 lbs)

<u>Crop</u>	<u>Nitrogen (N)</u> Nitrate of Soda (16-0-0)	<u>Phosphorus (P)</u> Triple Superphosphate (0-46-0)	<u>Potassium (K)</u> Muriate Potash (0-0-60)
Lawn			
Fruit			
Flower			
Shrubs (flowering)			
Shrubs (foliage)			
Veggies (root)			
Veggies (leafy)			
Tree			
General Feed			

Part IV: Calculating Nutrients in Fertilizer

The numbers on a fertilizer bag represent the amount of nutrients contained in the bag by percentage of the weight. For example, Agrium's Rainbow Plant Food is 10-10-10 (N-P-K) the first value represents the nitrogen which is 10% of the weight of the fertilizer, the second value is the phosphorus which is 10% of the weight of the fertilizer, and the last value represents the potassium which is valued at 10% of the weight of the fertilizer.

Calculating Nutrients:

_____ (lbs of fertilizer bag) x _____ (percentage of nutrients) = _____ lbs of nutrient in bag (round answers to the nearest tenth)

1. Calculate the amount of N-P-K in a 50 lb. bag of 19-26-5.

N:
P:
K

2. Calculate the amount of N-P-K in a 25 lb. bag of 15-9-12.

N:
P:
K

3. Calculate the amount of N-P-K in a 40 lbs. bag of 7-1-2.

N:
P:
K:

Part V: Calculating Fertilizer Application Rates

Using the fertilizer recommendations for lawn that you collected in Part III from your soil test results, calculate the fertilizer application rates needed to maintain a healthy lawn in the following scenarios.

Formulas:

Rate of nitrogen per 1,000 sq. ft / % of nitrogen in fertilizer = amount of product per 1,000 sq. ft.

Amount of product per sq. ft x the number of sq feet in the lawn = total amount of fertilizer needed.

1 acre= 43,560 sq. ft

1) You have a 8,000 sq foot lawn that is thin and weak. How many total pounds of fertilizer would you need to apply to meet the nitrogen needs?

2) You have a 10,000 sq foot lawn that is generally healthy and needs fertilizer to maintain its healthiness. How many total pounds of fertilizer would you need to apply to meet the nitrogen needs?

3) You have .75 acre lawn that is weak and thin. How many total pounds of fertilizer would you need to apply to meet the nitrogen needs?