Unit E: Basic Principles of Soil Science

Lesson 3: Understanding Soil Color

Student Learning Objectives: Instruction in this lesson should result in students achieving the following objectives:

1. Identify physical features used to differentiate between soils.
2. Identify colors used to describe surface soils.
3. Explain factors that determine surface soil colors.
4. Identify colors used to describe subsoil.
5. Explain factors that determine subsoil colors.
6. Explain how parent material, age, and slope affect soil color..

Recommended Teaching Time: 2 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has been developed for use with this lesson plan

List of Equipment, Tools, Supplies, and Facilities:

Writing surface
PowerPoint Projector
PowerPoint Slides
Transparency Master
Sample of soil
Copies of Student Lab Sheet
Magnifying glasses
Plastic or metal sieves

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide 2):

- Bright-colored
- Color
- Deciduous hardwood forest
- Dull-colored
- Humus
- Mottle-colored
- Native vegetation
- Structure
- Tall prairie grass
- Texture

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Bring to class a sample of very dark or black soil and a sample of very light, grayish soil. Place them in front of the class. Ask students how the soils are

different. Which of the two soils would be most productive? Does color affect productivity? Discussion of these questions should lead into the lesson content.

Summary of Content and Teaching Strategies

Objective 1: Identify physical features used to differentiate between soils.

(PowerPoint Slide 3)

I. Soils have many features that are used to recognize differences between them. They include:
   A. ***Texture***—coarseness or fineness of soil particles
   B. ***Structure***—the way in which soil particles are held together
   C. Depth of horizons—the depth of each soil
   D. ***Color***—refers to the darkness or lightness of the soil color

****Divide the class into groups of 3 or 4. Have each group develop a list of features they believe make soils different from each other. It may help to provide samples as they develop their lists. After 3–5 minutes, bring the class together to share ideas.**

Objective 2: Identify colors used to describe surface soils.

(PowerPoint Slide 4)

II. Colors associated with surface soils are dependent on the amount of organic matter found in them. Colors may be classified as:
   A. Very dark—approximately 5% organic matter
   B. Dark—approximately 3.5% organic matter
   C. Moderately dark—approximately 2.5% organic matter
   D. Light—approximately 2% organic matter
   E. Very light—approximately 1.5% organic matter

****Give each student a color chart for estimating organic matter. You may have to print of TM: E3-1, if you don't have soil charts available. Students can also look at PowerPoint Slide 5 to see a soil chart. Students should be able to see a wide range in color from the 5% organic matter section to the 1.5% organic matter section. Have each student bring in a sample of topsoil from home or provide a variety of samples. Have them determine the colors and amount of organic matter for each of the samples using LS: E3-1**

Objective 3: Explain factors that determine surface soil colors.

(PowerPoint Slide 6)

III. The amount of organic matter is the factor used to determine the color of the surface soil. The amount of organic matter is determined by the kind of native

vegetation. ***Native vegetation*** refers to the type of plant material that grew on the soil.

(PowerPoint Slide 7)

A. ***Tall prairie grass***—grasses had abundant roots, which filled the top .3 to .6 meters of the soil. Only partial decay of the roots over a long period of time gave the high organic matter content to prairie soils. These soils are high in ***humus***, a type of organic matter that results from the partial decay of plants and animals. They tend to be dark to very dark.

(PowerPoint Slide 8)

B. ***Deciduous hardwood forests***—a shallow layer of partially decayed leaves, twigs, and fallen logs accumulated on the surface. Because they were on the surface, they decayed more rapidly than those of the prairie grass. This left only a thin, moderately dark top layer. As these soils have been worked, they have been mixed with the lighter soil underneath to produce a lighter color.

****Ask students what is meant by native vegetation. Ask them to identify the type(s) of plants they believe once grew in their area and other parts of the region. Use text materials or the notes above to discuss how the soils formed from the two types of native vegetation differ. Ask if the characteristics of the soil for a particular type of native vegetation is consistent with the soil found in their particular area.**

Objective 4: Identify colors used to describe subsoils.

(PowerPoint Slide 9)

IV. Subsoil colors are associated with natural drainage of the soils. This is the drainage condition that existed when the soil was forming. Subsoil colors are classified as:

A. ***Bright-colored***—brown, reddish brown, or yellowish brown
B. ***Dull-colored***—gray or olive gray
C. ***Mottle-colored***—clumps of both bright and dull colors mixed together

****Using a soil probe, take samples from different areas. Access soils from the subsoil. Even better, a local farmer might be willing to dig a few holes in a field to observe various subsoils. Dig holes in different locations. Help students to see the difference in subsoil colors**

Objective 5: Explain factors that determine subsoil colors.

(PowerPoint Slide 10)

V. The color of subsoil is determined by the status of iron compounds. These are determined by the type of drainage found in the soil as it formed.

(PowerPoint Slide 11)

A. Good drainage provides subsoil that is bright in color. This is because the iron found in these soils has been oxidized. This can be compared to

metal that oxidizes or rusts when both moisture and air are present. Rust has a bright or orange color.

(PowerPoint Slide 12)

B. Poor drainage provides subsoil that is dull or gray in color. This is because the iron found in those soils has not been subject to air or oxygen. The iron compounds do not oxidize. This leaves a grayish color.

(PowerPoint Slide 13)

C. Somewhat poor drainage provides subsoils that are mottled. This is because the soil was saturated with moisture for certain periods. This leaves a gray color in some soil clumps. Since the soil was comparatively dry during other periods, it left a bright color in other soil clumps.

**** As you are teaching Objective 4, discuss with students the reasons why the subsoil takes on different colors. Find two pieces of similar unpainted metal. For a period of a few days, allow one of the pieces to become wet or damp. Place the other piece in the bottom of a pail of water for the same period of time. Students should see that the metal allowed to be wet and dry will oxidize or rust. Whereas, the metal that is kept under water will not. Explain that the iron will only oxidize if both moisture and air are present. Relate these findings with the iron compounds found in the soil. The status of the iron compounds in the soil indicates the type of natural drainage found in the soil.**

Objective 6: Explain how parent material, age, and slope affect soil color.

(PowerPoint Slide 14)

VI. In addition to organic matter and drainage, soil color may also be affected by other factors:

(PowerPoint Slide 15)

A. Parent material. The color of a soil is associated with the kind of material from which it is formed. Soils that are developed from sand or light-colored rock will be lighter. Those developed from darker materials such as peat or muck, will be darker in color.

(PowerPoint Slide 16)

B. Age. Some soils can be younger than others. As soils age, much of the darker color is lost due to the weathering process. This causes the soil to lose organic matter.

(PowerPoint Slide 17)

C. Slope. Soil on top of hills is usually lighter in color than the soil in depressions or on level ground. This is partly due to the darker topsoil being washed off the hills. This leaves the lighter subsurface or subsoil exposed.

(PowerPoint Slide 18)

Also, there tends to be moisture on lower land. This allows more abundant growth of plants in the lower areas, which in turn provides more organic matter and a darker color to lower soils.

****Ask students to determine how they believe parent material, age, and slope would affect the color of soil. Students should be able to refer to information previously presented in order to apply it to characteristics of soil and soil color.**

Review/Summary: Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions on PowerPoint Slide 19 can also be used as a review.

Application: Application can involve the following student activity using the attached lab sheet: Determining Surface Soil Color—LS: E3-1

Evaluation: Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is attached.

Answers to Sample Test:

Part One: Matching
1=e, 2=d, 3=a, 4=c, 5=f, 6=b

Part Two: Completion
1. organic matter
2. drainage
3. mottle
4. organic matter
5. oxidizes

Part Three: Short Answer
1. Soil on slopes tends to erode which leaves behind the lighter color soil found beneath the surface soil. Also, less moisture on slopes compared to lower or more level areas, allows less plant growth. This in turn leaves less organic matter.

2. The decaying leaves, twigs, etc. accumulated on the surface. This enabled them to decay more rapidly than the roots within the soil of the prairie grass.

3. a. poor drainage
   b. somewhat poor drainage
   c. good drainage

Sample Test Name_____

Test

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Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

a. tall prairie grass	c. dull-colored	e. humus
b. texture	d. structure	f. native vegetation

_____ 1. A type of organic matter.
_____ 2. Arrangement of soil particles into clusters or peds.
_____ 3. Vegetation that provided a deep, dark plow layer of soil.
_____ 4. Used to describe soils that developed under a poor drainage situation.
_____ 5. Term describing the type of plants once grown naturally in a particular area.
_____ 6. The coarseness or fineness of the soil particles.

Part Two: Completion

Instructions. Complete the following statements.

1. Colors found in the surface layer of soils are determined by the amount of _____ found in them.

2. Subsoil colors are determined by the degree of _____ present when they were forming.

3. Subsoil colors that show clumps of both bright and dull colors mixed together within a particular area are said to be _____ colored.

4. As soils age, the color of the soil tends to become lighter since the amount of _____ declines.

5. When an abundant amount of air was present in the subsoil while it was forming, the iron compounds in the soil _____; giving them a brighter color that those deficient in air.

Part Three: Short Answer

Instructions. Use the space provided to answer the following questions.

1. Explain how slope has an affect on soil color.

2. Explain why soils formed under a deciduous hardwood forest tend to be lighter in color and have shallower organic matter than those formed under the tall prairie grass.

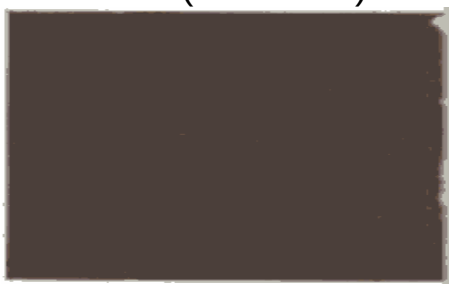
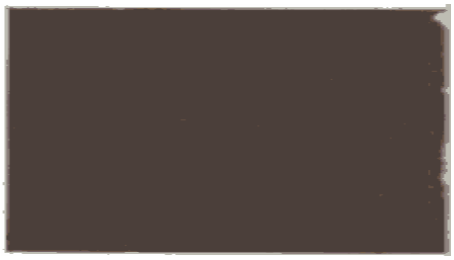
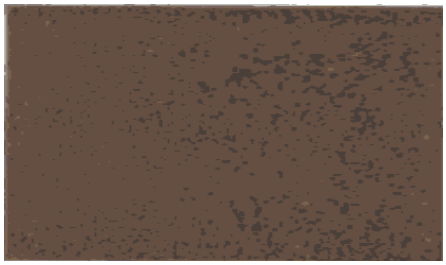
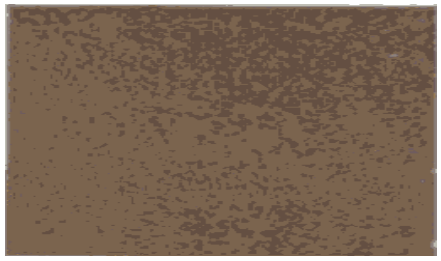
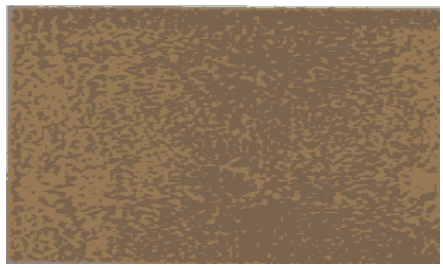
3. Given the following subsoil colors, determine the type of drainage present while the soil was forming:
   a. Dull-colored—

   b. Mottle-colored—

   c. Bright-colored—

TM:E3-1

Soil Color Chart

Organic Matter Average	Range	Color (Moist Soil)
5%	3 ½% to 7%	
3 ½%	2 ½% to 4%	
2 ½%	2 to 3%	
2%	1 ½% to 2½%	
1 ½%	1 to 2%	

Strong Sunlight may eventually cause these colors to fade.

LS:E3-1 Name_____

Lab Sheet

Determining Surface Soil Color

Purpose:
Estimate the organic matter content of mineral soils using a color chart.

Materials:
Surface soil samples
Color charts for estimating organic matter in mineral soils
Bottle of water

Procedure:
1. Take a sample of soil from the plow layer or surface layer.
2. Use moist soil—neither wet nor dry. If the sample is dry, moisten it with the bottle of water.
3. Find the chart color the sample most closely matches.
4. Read the associated organic matter content.
5. Identify the color of the soil sample using the following key:
    a. 5% organic matter—Very Dark
    b. 3½% organic matter—Dark
    c. 2½% organic matter—Moderately Dark
    d. 2% organic matter—Light
    e. 1½% organic matter—Very Light

Sample #1:
A. How much organic matter is in the sample?

B. What is the color of the sample?

Sample #2:
A. How much organic matter is in the soil?

B. What is the color of the soil?