Lesson 2: Understanding Physical Properties of Soil

Georgia Performance Standards:..... AG-NR-4
ACADEMIC STANDARDS. ELA9LSV1, ELA9LSV2, SESh2, SCSh9, SES3, SEV2 SES4, SSWG1

Objectives:

1. Describe the importance of soil texture.
2. Explain soil structure and determine why it is important.
3. Appraise soil based on its color.
4. Describe soil characteristics and how they affect the uses of land.

Teaching Time: 3 Hours

Grades: 9-12

Essential Question: What are the physical properties of soil?

Unit Understandings, Themes and Concepts:

Students will learn about soil texture, structure, and color, and how these characteristics are related to functionality.

Primary Learning Goals:

Students will be able to explain the relationship between a soil's physical characteristics and its usability.

Students with disabilities: For students with disabilities, the instructor should refer to the individual student's IEP to insure that the accommodations specified in the IEP are being provided within the classroom setting. Instructors should familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation within any given instructional activity or requirement.

Assessment Method/Type:

____ Constructed Response	____ Peer Assessment
_X__ Combined Methods	____ Selected Response
____ Informal Checks	____ Self Assessment

References:

The National Council for Agricultural Education. *Applied Environmental Science*. Alexandria, VA. 1996.

This link will get you to the needed teaching materials for this Lesson:
http://www.teamaged.org/council/index.php/professional-growth-series

Powerpoints:

Physical_Properties_of_Soil_Nancy_Williams.ppt
Organic_Matter_Darrin_Holle.ppt
Soils_3_Organic_Matter_Casey_Osksa.ppt

Materials and Equipment:

See above reference for materials.

Georgia Performance Standards:

AG-NR-4. Students will describe the properties of soil and nutrient analysis, determine the capability of the land and the effects of erosion, and describe soil stewardship in Georgia.

a. Explain the development of soil and how it functions.
b. Describe soil characteristics and how they affect the use of land.
c. Differentiate between mechanical and vegetative soil erosion control.
d. Identify government agencies and programs and their involvement in soil conservation.

Academic Standards:

ELA9LSV1 *The student participates in student-to-teacher, student-to-student, and group verbal interactions.*

ELA9LSV2 *The student formulates reasoned judgments about written and oral communication in various media genres. The student delivers focused, coherent, and polished presentations that convey a clear and distinct perspective, demonstrate solid reasoning, and combine traditional rhetorical strategies of narration, exposition, persuasion, and description.*

SCSh2 *Students will investigate the flow of energy and cycling of matter within an ecosystem and relate these phenomena to human society.*

SCSh9 *Students will enhance reading in all curriculum areas.*

SES3 Students will explore the actions of water, wind, ice, and gravity that create landforms and systems of landforms (landscapes).

SEV2 Students will demonstrate an understanding that the Earth is one interconnected system.

SES4 Students will understand how rock relationships and fossils are used to reconstruct the Earth's past.

SSWG1 The student will explain the physical aspects of geography.

TEACHING PROCEDURE

Introduction and Mental Set

Show soils that have different texture, structure, and color using soil samples and profiles.

Ask the students these questions as they examine the soils:

- If you were an agricultural producer, would all soils work equally in producing crops, vegetables, and livestock?
- Would all soils work equally well for building foundations?
- What is the difference in soils and their capabilities?
- Why do soils have differences in color? What do the colors tell us?

Discussion

Please see the reference for Handouts and Transparency Masters.

1. **What is soil texture and why is it important?**
   - A. Transparency Master 1: Size of Sand, Silt, and Clay Particles
   - B. Transparency Master 2: Size of Soil Particles
   - C. Transparency Master 3: Textural Triangle
   - D. Handout 1: Textural Triangle
   - E. Transparency Master 4: Characteristics of the Various Soil Classes
   - F. Transparency Master 5: Permeability Related to Nutrient Capacity

- Soil texture is the relative proportions of the various soil particles (sand, silt, and clay) found in a soil. It determines how a soil feels.

- Soil Particle Sizes

  gravel – over 2mm

  sand – 2.0 mm to .05 mm

silt - .05 mm to .002 mm

clay - .002 mm and smaller

- Textural Classes

sandy soils - contain more than 70% sand
silty soils - contain more than 80% silt
clay soils - contain more than 40% clay
loam soils - contain an intermediate mixture of sand, silt, and clay

Soil texture is important because it determines the soil's ability to hold nutrients, store water, provide for plant root growth and development.

Clay soils tend to have a high ability to hold nutrients; however, they are very low in permeability.

Sandy soils tend to be very low in ability to hold nutrients, however they are very high in permeability.

Silty soils are moderate both in ability to hold nutrients and permeability.

Permeability is the ease with which gases, liquids, or plant roots penetrate or pass through a bulk mass of soil or a layer of soil.

2. **What is soil structure and why is it important?**
Transparency Master 6: Kinds of Soil Structure

Soil structure is the arrangement of soil particles into aggregates, or peels. Soil structure is soil particles being cemented into clumps by some natural cementing agent such as: clay, organic matter, or iron and aluminum oxides to form aggregates.

Soil aggregates that occur naturally in soil are peds, while clumps of soil caused by tillage are called clods. Peels are relatively large, ranging from the size of a large grain of sand to several inches. Spaces between clay particles may be tiny, but the spaces between peels may be large. Good structure can therefore improve air and water movement and make it easier for roots to grow while maintaining good water holding capacity within the peels.

3. What does soil color indicate?

Transparency Master 7: Drainage Classification
Chart explains how to put soils in a drainage class using color and topography.

Brown to Black - dark soil colors result from organic matter or dark parent materials. Black soils can arise from three situations which can be distinguished by smell.

- Organic matter can reach high levels in soils that are usually water logged. Such soils often have a sour, oily smell.
- Dark parent materials will affect the color of young soils. A faint chalky odor often describes these soils.
- Organic matter can also reach high levels in adequately aerated soil. These soils have the earthy smell of good soil.

White to Light Gray – this color may indicate that the chemicals of the soil, especially organic ones, have leached out. It may be seen in heavily leached sandy soils. White colors may also be due to accumulations of lime, gypsum, or other salts.

Yellow to Red - these are the colors of iron oxides, most commonly seen in warm climates. Red color is from iron oxide (rust). Red color indicates good drainage because there is enough

oxygen in the soil to form the oxide. Yellow is from an iron oxide that includes some water (the mineral limonite), indicating the soil is slightly less well drained than a red soil.

Bluish-Gray - this is the color of unoxidized iron and indicates a lack of oxygen in the soil. The lack of oxygen results from water-logging, so a bluish-gray color indicates poor soil drainage. The occurrence of this color is called gleying.

Mottled Colors the soil shows patches of different colors, often spots of rust, yellow, and gray. Mottling suggests that the soil is waterlogged for part, but not all of the year.

4. How do we determine the texture, structure, and color of a soil?

A. Student Activity 1: Determining Soil Texture Using a Graduated Cylinder

B. Student Activity 2: Determining Soil Texture Using the Feel Method

The **texture** of a soil can be determined by using a graduated cylinder in which sand, silt, and clay settle in layers and then can be measured. It can also be determined by kneading the soil in your hand which is called the "ribbon test" or "feel method".

Structure can be determined by examining the soil through a microscope.

Color can be determined with the naked eye. It is best to look at the soil in sunlight so you can get a true color. Dark soils should be smelled to determine the source of organic matter or parent material.

5. What affect do soil characteristics have on the uses of land?

For **agricultural purposes** the ideal soil contains 10-20% clay, 40%

sand, and 40% silt which would make it a loam. Its color should be dark brown or black indicating a fair amount of organic matter derived from good aeration. It would also be ideal if the soil had a granular or crumb structure.

6. Activity

A. Obtain soil samples of several different textures and practice the ribbon test. Try to identify the samples.

B. This activity demonstrates how mulch effects soil temperature. Use three containers filled with eight inches of moist soil and mulch one with organic matter, one with plastic, and one bare. Place the containers in full sunlight. Insert soil probe thermometers at two and eight inches deep. Record soil tempertaure over time. Compare the effects of the mulch on the soil.

SUMMARY

Soil texture encompasses the concepts of soil particles, specific surface, and textural classification. Soil texture has great influence on soils agricultural and engineering productivity as well as soils susceptibility to erosion. Soil is texturally classified by its percentages of sand, silt, and clay.

Structure of soil is the shape it forms in aggregates due to natural cementing agents such as clay, organic matter, and certain mineral chemicals. Examples of aggregate structures formed in soil are crumb, granular, platy, blocky, prismatic, and columnar.

Color is an indication of drainage, content, and parent materials in soil. Knowledge of soil color can indicate land drainage, and therefore how to properly use the land.

The combination of these soil characteristics determine a soils capabilities, and understanding them will help us properly use the land.

Evaluation

Written test and lab activities as per the reference book.

Individual Learning Activity

Lesson: Understanding Physical Properties of Soil

Assignment: Choose one of the topics below and research it. Write a report on your findings that answers the question or explains the concept and shows why it is relevant to your life.

1. Describe the importance of soil texture.
2. Explain soil structure and determine why it is important.
3. Appraise soil based on its color.
4. Describe soil characteristics and how they affect the uses of land.

Minimum Requirements:

1. Paper must be typed in 12 point font and at least one page in length. The paper may be double-spaced.

2. At least two credible references must be properly cited.

3. All work must be original. No plagiarism! Any use of another's ideas without giving credit will result in a zero.

4. Papers will be graded on content (amount of good information, accuracy, etc.) and mechanics (grammar, spelling, and punctuation.)

Due Date:

Points/Grade Available:

Individual Learning Activity Rubric

Content - offers current information on the topic chosen, thoroughly covers each aspect of the question, and demonstrates understanding and mastery of the lesson. The paper should include information and issues of state and local importance.	35 pts.
Critical Analysis - logical process of analyzing and reporting information that examines and explains the topic selected. The paper should go beyond simply listing facts and must include why the concept is relevant to the student's life.	25 pts.
Organization- The paper should have an orderly structure that demonstrates a logical flow of ideas.	15 pts.
Mechanics- spelling, grammar, punctuation, font size, double spacing, citation, etc. Essentially, the paper should meet all specifications and be executed following rules of proper written English.	15 pts.

Group Learning Activity

Lesson: Understanding Physical Properties of Soil

Assignment: Choose one of the topics below and research it. With your group, prepare a presentation to teach the class your concept.

1. Describe the importance of soil texture.
2. Explain soil structure and determine why it is important.
3. Appraise soil based on its color.
4. Describe soil characteristics and how they affect the uses of land.

Your presentation should include the following:

1. **A lesson plan outlining exactly what your group will teach and how the information will be taught**
2. **A Power Point of at least twelve slides**
3. **Notes containing the information the class will be responsible for (these can be printed and given to the class, written on the board, or part of the Power Point). A copy of the notes will be turned in to the instructor.**
4. **Some type of interactive activity for the class (game, problem solving activity, interactive model, etc.)**
5. **Your group must also prepare an assessment for the class. This assessment can be written or oral, but should show the instructor that the class understands and has retained the material being taught.**

Due Date:

Points/Grade Available:

All work must be original. No plagiarism! Any use of another's ideas without giving credit will result in a zero.

Group Learning Activity Rubric

Lesson Plan – The group submits a thorough, detailed lesson plan highlighting the content and organization of their lesson.	10 pts.
PowerPoint – The group presents a Power Point of at least twelve slides that contains information and pictures vital to the lesson with additional information or examples for enhancement.	20 pts.
Interactive Activity – Some type of interactive activity is used to help teach the lesson. The activity should contribute to the mastery of content and involve the entire class in some way.	15 pts.
Assessment – A fair, thorough assessment is prepared and administered based on the information presented to the class. Poor grades on the assessment by a few members of the class are excusable, but if the entire class has difficulty, the points awarded in this category may be lowered at the discretion of the instructor.	15 pts.
Content – The group should cover the concept (within reason) in entirety. The group may study actual lesson plans to help decide what should be emphasized.	25 pts.
Overall Effect – The group is prepared, enthusiastic, and interesting, and the lesson flows smoothly.	15 pts.

Presentation Learning Activity

Lesson: **Understanding Physical Properties of Soil**

Assignment: **Choose one of the topics below, research it, and prepare a presentation that answers the question or explains the concept and shows why it is relevant to your life.**

1. Describe the importance of soil texture.
2. Explain soil structure and determine why it is important.
3. Appraise soil based on its color.
4. Describe soil characteristics and how they affect the uses of land.

Minimum Requirements:

Oral Report Option

1. **Write a paper on one of the topics and orally present your work to the class.**
2. **Paper may be double-spaced and should be at least one page in length, resulting in a two to five minute presentation.**
3. **At least two references must be properly cited.**
4. **The presentation of the report will be graded secondary to the content of the paper.**

PowerPoint Option

1. **Presentation should be at least ten slides in length**
2. **Presentation should include at least four photos.**
3. **Presentation should be two to five minutes in length.**
4. **Grammar and spelling will be graded by the same standards as any other written assignment.**

5. **At least two references must be properly cited.**

Poster Option:

1. **Prepare a poster that answers/explains one of the topics. You will present your poster to the class.**
2. **Your poster should include both text and graphics that help communicate your research.**
3. **At least two sources of information should be properly cited on the back of the poster.**
4. **Neatness and appearance of the poster will be graded.**
5. **Poster presentation should last two to five minutes.**

Due Date:

Points/Grade Available:

For all presentations: All work must be original. No plagiarism! Any use of another's work or ideas without giving proper credit will result in a zero.

Presentation Learning Activity Rubric

Content- offers current information on the topic chosen, thoroughly covers each aspect of the question, and demonstrates understanding and mastery of the lesson. The presentation should include information and issues of state and local importance.	40 pts.
Critical Analysis/Organization – The presentation shows a logical process of analyzing and reporting information that examines and explains the topic selected. The presentation should go beyond simply listing facts and must include why the concept is relevant to the student's life.	20 pts.
Presentation – The student makes a genuine effort to present, not just read the material. The student should present with confidence using techniques like eye contact and voice inflexion to make his or her point. Although content takes precedence over presentation, the experience of successfully presenting in front of a class is part of the basis of this assignment.	25 pts.
Mechanics- spelling, grammar, punctuation, font size, double spacing, citation, etc. Essentially, the presentation should meet all guidelines set forth and should be executed in proper written English. For the poster, this includes neatness and appearance.	15 pts.

Teacher Notes

Essential Question: What are the physical properties of soil?