

Soil Science Curriculum

Content and lab derived from the USDA-NRCS Guides for Educators. Go to www.nrcs.usda.gov/soils for the Guides and additional pictures and diagrams. This lesson plan was adapted for South Dakota from the University of Nebraska Institute of Agriculture and Natural Resources, CROPWATCH.

January 2018

Soil Health Measurement

Approximately 180 minutes

Objectives

By the end of the lesson, students will know or be able to:

- Define soil health, soil series, and erosion
- Describe two methods to assess soil health
- Create a model that represents signs of erosion
- List and describe causes of erosion
- Explain the role of soil management in determining soil health
- Determine percent slope of a specific land area
- Explain how climate impacts soil
- Explain how longitude and latitude impact soil
- Identify environmentally sensitive areas
- Determine when to properly sample soil
- Determine where to sample soil
- Explain the guidelines for selecting sampling sites
- Explain the need for collecting multiple samples
- Use the South Dakota Soil Health Card

Preparatory Work

- Make necessary copies
- Obtain necessary supplies
- Review South Dakota Soil Health Card
- Determine where Building a Soil Erosion Model Activity will be completed to plan accordingly with time and supplies
- Determine where soil samples will be taken, where soil health will be measured, and the location of slope measuring

Materials

- 4 Soil Samples
- Guided Notes Page – one per student
- 2 Balls
- Several marking flags
- Shovel
- Soil probe
- Plastic bags
- Markers
- South Dakota Soil Health Card – one per student

Enroll the Participants *(Approximately 5 minutes)*

Present four very different soil samples to the class. Have them individually rank the samples best to worse. Discuss students' rankings of the soil samples.

- Why did you rank 1 before 2, 2 over 3, and 3 over 4?
- Why is student A's ranking so different from student B?
- Are some soils really better than others?

Soil Health Measurement

Provide the Experience – Soil Health and Health Assessment *(Approximately 5 minutes)*

Instruct students to work as a class to brainstorm a list of characteristics of “good soil”. Allow the class a few minutes and discuss their list. After a short discussion inform students that this lesson will allow them to identify and measure soil health.

Label the Information *(Approximately 2 minutes)*

Instruct students to capture the definition of soil health and two methods of assessment.

Soil health integrates the physical, chemical, and biological components of soil and their interactions.

There are two fundamental ways to assess soil health:

- Take measurements periodically over time to monitor changes or trends in soil health
- Compare measured values to a standard or reference soil condition

Demonstrate the Relevance *(Approximately 5 minutes)*

Lead students through a discussion about soil health. Consider using the following questions to help guide the discussion:

- Why is soil health important?
- Who monitors soil health?
- What factors affect soil health?
- How is soil health assessed?

Provide the Experience – Describe the Role of Soil Management, how Climate, Longitude and Latitude Impact Soil, and Identify Environmentally Sensitive Areas

(Approximately 5 minutes)

When going to the doctor, before a diagnosis can be made patients must provide doctors with important information. Ask students what this information is called. *Answer: medical history.* Lead the class in a brief discussion on medical history.

- What is included in a medical history?
- Why is this important to doctors?

Just as doctors need a medical history for diagnosing people, soil scientists need information about a site before recommendations can be made.

Soil Health Measurement

Label the Information *(Approximately 10 minutes)*

Instruct students to complete the graphic organizer about field or site characterization using the following information:

Field or site characterization is important information for evaluating soil health.

Soil series is the name of soil found in the county soil survey.

Signs of erosion include gullies, rills, development of pedestals, exposed areas of subsoil, wind damage or plants.

Management history includes a description of past and present land and crop management; kind, amount and method of fertilization; prior tillage; and land leveling.

Slope and topography includes percent slope at sampling sites and note any hills, knolls, ridges, potholes, depressions, etc.

Location of field includes a record of longitude and latitude.

Climatic information includes the precipitation and high and low average temperatures for each month.

Location of environmentally sensitive areas includes location of ponds, creeks, wetlands, or other environmentally fragile sites.

Demonstrate the Relevance *(Approximately 10 minutes)*

As students complete their graphic organizers, instruct students to complete “Why is this important?” bubbles on their graphic organizer. Invite students to share their responses to each of these questions with the class. Guide students through a brief discussion of site characteristics using the graphic organizers as a guide.

Provide the Experience – Create a Model and Describe the Causes of Erosion

(Approximately 5 minutes)

Ask the class to define erosion in a picture; give them a few minutes to draw their definition. After a short time, ask a few students to show their pictures.

Inform students that this lesson will also allow them to take a closer look at erosion and how it affects soil health.

Soil Health Measurement

Label the Information *(Approximately 10 minutes)*

Instruct students to record the definition, causes, and characteristics of erosion. Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity.

Type of Erosion	Causes	Picture or Example
Water Erosion	<ul style="list-style-type: none">• Lack of protection against raindrop impact,• Decreased aggregate stability,• Long and steep slopes,• Intense rainfall or irrigation events when plant or residue cover is at a minimum,• Decreased infiltration by compaction or other means.	
Mechanical Erosion	<ul style="list-style-type: none">• Removal by harvest of root crops,• Tillage and cultivation practices that move soil downslope.	
Wind Erosion	<ul style="list-style-type: none">• Exposed surface soil during critical periods of the year,• Occurrence of wind velocities that are sufficient to lift individual soil particles,• Long, unsheltered, smooth soil surfaces.	

Demonstrate the Relevance *(Time varies)*

Provide students with the “Demonstrating Erosion” activity guide and review the activity and rubric. Set a due date for the activity and any parameters that are specific to your students’ needs and your classroom. Determine whether the activity will be completed in the classroom or as homework to be completed outside of the classroom and plan accordingly. Upon completion of the project encourage students to present their erosion model to the class.

Provide the Experience - Determine Slope *(Approximately 5 minutes)*

Set a ball on a flat surface another on an incline. Watch the ball on the incline roll down and the one on a flat surface stay put. Ask students why this happened. Look for a student to answer “slope”. Guide a discussion about the importance of slope in soil health. Look for ideas such as the steepness and length of the slope influence the speed with which water runs off a field and the amount of soil carried away in the runoff water. The steepness of the slope also affects the ease of cultivation, use of farm machinery, and suitability of the site for septic tank disposal fields, homesites, playgrounds, paths, trails, golf courses, streets, and roads.

Soil Health Measurement

Label the Information *(Approximately 15 minutes)*

Instruct students to capture the slope information in their Guided Notes.

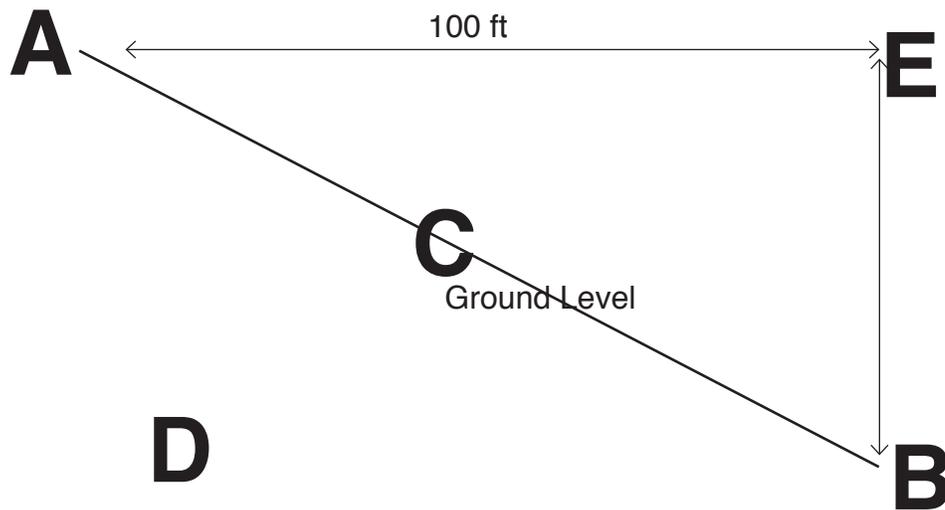
Slope is the steepness of the land usually measure in a percentage.

Draw a diagram to represent slope.

Instruct students to complete the practice slope calculations in their Guided Notes. Review the correct answers with students to gauge their understanding.

Demonstrate the Relevance *(Approximately 4 minutes)*

Select an area for students to practice slope measurements. Create several sites by placing two marking flags 100 feet apart at each site. Encourage students to estimate the slope difference between the two flags.



Flags are 100 feet apart (A and B). From the approximate center of the 100 feet (C), step about 15 steps toward the low side of the slope (D). With a straight edge or using your arm extended at the ground level of (A), swing your body keeping straight edge or your arm level, locating point (E) directly above flag (B). The measurement of (E) to the ground is percent, or foot of fall, in elevation from (A) to (B).

Note: There are several “tricks” to measuring slope. Consider asking an experienced land judging coach or agricultural instructor for advice and other strategies. Also, GPS devices can be helpful to accurately determine the slope of an area.

Soil Health Measurement

Provide the Experience – Determine When and Where to Sample and Discuss Soil Sampling Guidelines *(Approximately 5 minutes)*

Instruct students to work in a group of three to create a recipe for sampling soil and it is important to include materials needed and specific instructions. After a few minutes, invite a few groups to share their recipes.

Label the Information *(Approximately 10 minutes)*

Encourage students to capture the soil sampling guidelines in their Guided Notes. Discuss soil samples as students record the information.

When to sample?

- Annual sampling of a field is recommended
- Sample when the climate is most stable and there have been no recent disturbances such as after harvest or the end of the growing season

Where to sample?

- Consider rows, soil type, management, plant growth, salt affected areas, erosion, slope, and drainage
- Select sample sites that are representative of the field
- For trouble spot assessment, select areas that are representative to trouble spots
- When comparing management systems, make sure sites selected for comparison have the same soil type
- When making changes to soil, make sure samples are taken after each change

How many samples?

- Sample number will depend on the variability of the field
- Take a minimum of three samples on any one soil type

Demonstrate the Relevance *(Time varies with site location)*

Allow students to make a soil sampling plan for an area and collect samples in small groups. Show students the field that they will be using for sampling and measuring soil health. Allow students to determine when to sample, where to sample, and how many samples to take, using the guidelines from their notes. Instruct students to visit the site and record their plan for collecting soil samples. After each group has recorded their soil sampling plan, instruct the group to justify their plan to another group. Then, allow them to collect samples. Remind students to label each sample in a plastic bag.

Label the Information *(Time varies)*

Instruct students to record their observations on the soil health card during evaluation.

Soil Health Measurement

Demonstrate the Relevance *(Approximately 5 minutes)*

When the class finishes collecting data and completing the card, lead a discussion on soil health. Consider using the following questions to guide the discussion:

- Who might use the soil health card?
- Why is it important for South Dakota to have its own soil health card?
- What are the benefits of using the soil health card?
- Do you think using this card will provide soil managers with enough information to make informed soil management decisions?
- What other data might soil managers need to know about a site?

Review the Content *(Approximately 10 minutes)*

What am I? Instruct students to create two riddles from the information in this lesson. They must present their riddle to two different partners with the partners trying to solve the riddle. Consider using the example below to help guide students.

*I am caused by one of the most important life sustaining substances on earth but destroy soil.
What am I? Answer: Water erosion.*

Celebrate Student Success *(Approximately 3 minutes)*

Thank students for their engagement and participation. Congratulate them on their ability to evaluate soil health. Explain that this skill will be useful throughout their lives, if they plant a field or garden or build a house, fence, or even a swing set. Congratulate them on their ability to successfully measure slope and erosion and begin determining soil class in the land evaluation contest. Preview information in the next lesson.

Soil Health Measurement

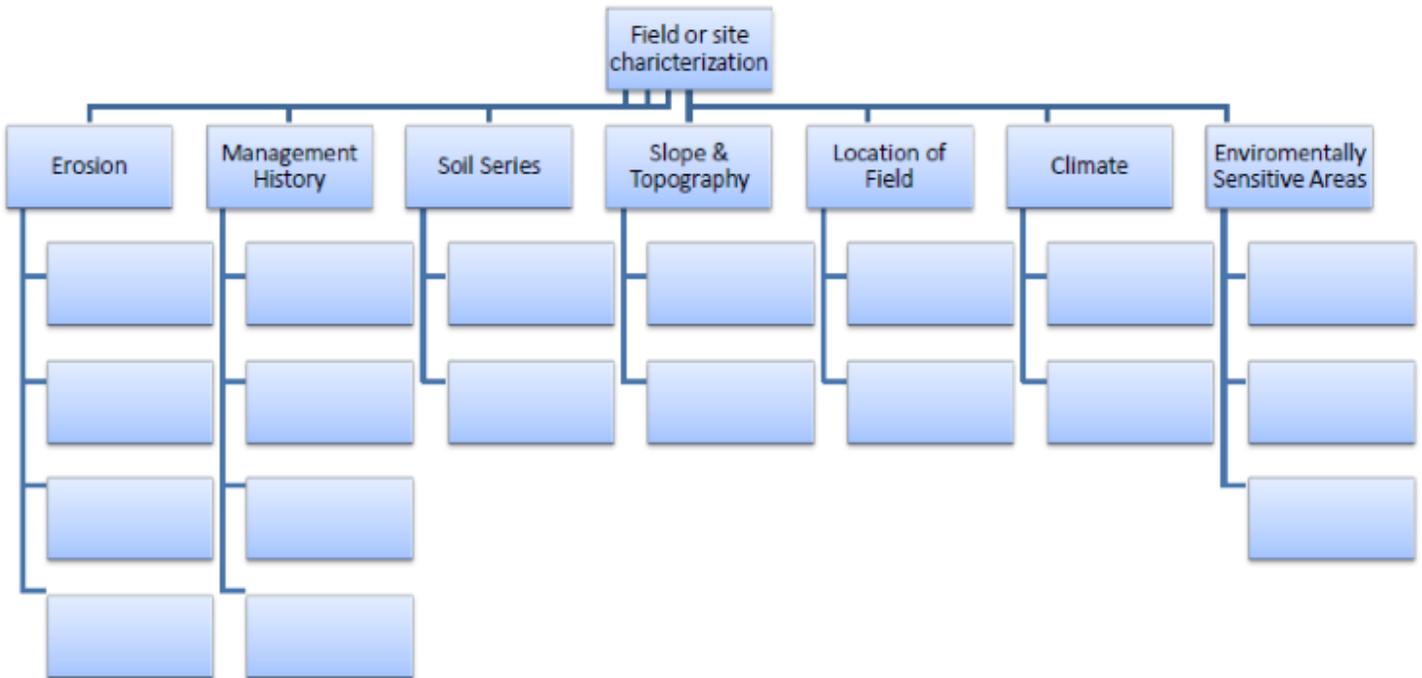
Guided Notes: Mearuring Soil Health

Notes completed by _____

Characteristics of "good soil":

Soil Health:

Assessing soil health:



Soil Health Measurement

• Management History

• Soil Series

• Signs of Erosion

• Slope and Topography

• Location of Field

• Climate

• Environmental Sensitivity

Soil Health Measurement

Erosion is?

Type of Erosion	Causes	Picture or Example

Soil Health Measurement

What is slope?

Diagram slope:

Soil Health Measurement

Determine the slope percentage in each of the following problems:

- A.** Flag 1 – elevation 30 feet
Flag 2 – elevation 0 feet
Distance – 100 feet

- B.** Flag 1 – elevation 5 feet
Flag 2 – elevation 0 feet
Distance – 100 feet

- C.** Flag 1 – elevation 20 feet
Flag 2 – elevation 0 feet
Distance – 50 feet

- D.** Flag 1 – elevation 3 feet
Flag 2 – elevation 0 feet
Distance – 50 feet

- E.** Flag 1 – elevation 5 feet
Flag 2 – elevation 0 feet
Distance – 50 feet

- F.** Flag 1 – elevation 12 feet
Flag 2 – elevation 0 feet
Distance – 100 feet

Soil Sampling Guidelines:

When to sample?

Where to sample?

How to sample?

Soil Health Measurement

Building A Structure : Erosion Model

Student Name: _____

Activity Due Date: _____

Using products found around your home, construct a soil erosion model that includes all three types of soil erosion (wind, water, and mechanical). Use products that accurately represent the characteristics of each soil erosion type as discussed in class and found in the resources provided to you as well as any research you conduct on the internet or in other printed resources.

Your soil profile may be a 2-D or 3-D display, edible, have movement, be stationary, or have any other creative characteristic you can imagine. The goal is that you will be able to describe each type of erosion accurately because of creating this model.

The rubric below will be used for scoring this activity.

CATEGORY	4	3	2	1
Scientific Knowledge	Explanations indicate a clear and accurate understanding of scientific principles underlying the construction and modifications.	Explanations indicate a relatively accurate understanding of scientific principles underlying the construction and modifications.	Explanations indicate relatively accurate understanding of scientific principles underlying the construction and modifications.	Explanations do not illustrate much understanding of scientific principles underlying the construction and modifications.
Plan	Plan is neat with clear measurements and labeling for all components.	Plan is neat with clear measurements and labeling for most components.	Plan provides clear measurements and labeling for most components.	Plan does not show measurements clearly or is otherwise inadequately labeled.
Construction -Materials	Appropriate materials were selected and creatively modified in ways that made them even better.	Appropriate materials were selected and there was an attempt at creative modification to make them even better.	Appropriate materials were selected.	Inappropriate materials were selected and contributed to a product that performed poorly.
Construction - Care Taken	Great care taken in construction process so that the structure is neat, attractive and follows plans accurately.	Construction was careful and accurate for the most part, but 1-2 details could have been refined for a more attractive product.	Construction accurately followed the plans, but 3-4 details could have been refined for a more attractive product.	Construction appears careless or haphazard. Many details need refinement for a strong or attractive product.

Soil Health Measurement

Determine the Slope KEY

A. 30%

B. 5%

C. 40%

D. 6%

E. 10%

F. 12%