Secondary Succession

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Grade Level
10-11

Lesson Length
3 periods x 55 Minutes

Agriculture Careers
Microbiologist, Soil Scientist, Range Specialist, Agronomist and Farmer

Nebraska Science Standards
SC.HS.15.4.D
SC.HS.10.5.E

Next Generation Science Standards
HS-ESS3-4
HS-LS4-5

Nebraska Agricultural Science Standards
AFNR.HS.3.3.g
AFNR.HS.3.3.k

Learning Environments Alignment

Learner-centered

Knowledge-centered

Assessment-centered

Community-centered

These lessons aim to help students make the connection between scientific, business, economic, environmental, and social issues and a degree in agriculture.

Learning Objectives

By the end of the unit, students should be able to:

- Describe secondary succession.
- Determine how secondary succession affects soil structure.
- Determine how management practices affect soil structure.
- Determine how flooding affects soil health and structure.
- Identify the benefits of returning to the climax community.

Materials List

- Soil Stability Lab components
- Drone (print outs from drone pics for final day)
- Map of soil samples, flags to mark soil sample locations, Ice cream buckets and shovels
- Edible Soil Lab components
- https://gen.uga.edu/documents/soil/activity/Edible_Soil.pdf
- Student computers, poster paper, and markers
- Drone, bus, and Dr. Pepper

Investigation

Students will investigate stages of farm land succession and determine soil health and structure in evolving and climax community.

Research Question(s)

- How does farmland return to native prairie or forest?
- What are benefits to soil of returning to the climax community?

Day 1: Introduction to Succession

Bell Ringer: When a field returns to rangeland, what happens to the soil?

Teacher Does: Teacher will have the student write down their response to the bell ringer questions and then facilitate a class discussion around the question.

Student Does: Students respond to the bell ringer question in writing and then participate in a class discussion.

Teacher Does: Teachers will facilitate three prearranged groups of students as they rotate through learning stations. During one rotation, teacher will provide a guided discussion (lecture) while partner teacher monitors other groups.

Student Does: Students will rotate in groups of three learning in three different ways, individual, teacher led, and group.

Rotations, every 15 minutes, all students rotate through each session in small groups.

Students will accessthe TEDedu online module where they will watch a video and complete a formative assessment, they will then utilize the link to further their research and finish the module with a discussion board.
https://ed.ted.com/on/uIW0lxLU

Teacher led discussion. *Slides are locked for editing but may be copied for personal use.*

https://docs.google.com/presentation/d/12oER4izJs406nOUOBuOepAMI2JFBXX0iQI--kSgiIwo/edit?usp=sharing

- 5 minutes, discuss and diagrams of succession
- 5 minutes regarding soil health (bacteria and fungi etc.)
- 5 minutes regarding soil peds (clods)

Rotation 3

Edible Soil activity

Create assigned soils using food resources given.

https://gen.uga.edu/documents/soil/activity/Edible_Soil.pdf

Variation: assign to predict what soil would look like for conventional tillage, no-till, and rangeland. Within group, assign that soil.

Reflect (Formative Assessment)

Following each rotation, after a 1-minute warning, students will answer three reflection questions in their small group.

Rotation 1

1. Describe beneficial and non-beneficial microorganisms.
2. Explain importance of providing for soil health.
3. Who can farmers cooperate with to improve soil health?

Rotation 2

4. Share with a partner one sentence description of each discussion point. Partner give thumbs up, sideways, or down, and discuss reasoning.
5. Repeat with other partner, new description.

Rotation 3

6. Describe components of healthy soil.
7. Describe components or limitations of unhealthy soil.
8. What careers are involved in monitoring and improving soil health?

End of class question: Explain healthy soil to your partnervolunteers will have the opportunity to explain their findings/resasonings to the larger group.

Reminder: wear closed toed shoes tomorrow for walking in a field.

Day 2: Field Trip

Bell Ringer: What would the peds of the following look like? Forest soil, range soil, no-till soil, conventional till soil? Think-Pair-Share (TPS)

Teacher Does: Teacher will ask students to answer bell-ringer at their table. Monitor answers. Call upon groups to share answers.

Student Does: Students will discuss bell ringers at their tables.

Teacher does: take all students to a field site to demonstrate collecting soil peds. Place into ice cream bucket. Distribute students at five locations to collect peds. Emphasize integrity of collection. Label buckets.

Emphasize safety when getting off bus, crossing roads, etc., and emphasize bus and guest (on the land) etiquette.

Students will travel south of Pender to fields. Break into small groups. Take soil samples (replicating method of first stop), collecting peds (not cores). Document observations at each location when collecting samples. Collect GPS location of each sample.

Sites:	1 Row-crop soil (tilled)	2 Row-crop soil (tilled) flooded	3 Row-crop soil (no-till)	4 Range Land	5 Secondary Succession Soil	6 Forest

Discuss six soil types/terrains (forest, rangeland, secondary succession range, no-till farm, conventional farm, flooded conventional farm). Locations are flagged. Collect sample at location. Collect flag upon entering bus.

Group 7 Use drone to collect photos of areas from soil samples.

Reflect (Formative Assessment)

Students will gather at one location and share findings at each station. Show peds in bucket, observing integrity of ped so as not to damage it. Drink a Dr. Pepper and celebrate being outside.

Day 3: Soil Stability & Erodibility Lab

Bell Ringer: What will happen to our soil samples from yesterday when exposed to water?

Teacher Does: Teacher will monitor bell ringer discussions and call upon students whom teacher hears the correct answers from.

Student Does: Working with partner, students will discuss bell ringer.

Teacher Does: Teacher will facilitate the prep of the lab, making sure that all 6 samples are being experimented on (ex. Assign two and let the students pick the third type of soil sample).

Student Does: Students follow and conduct Soil Stability & Erodibility Lab on 3 of the 6 soil samples.

Think-Pair-Share

Teacher Does: Teacher will facilitate think-pair-share on the discussion questions from Soil Stability & Erodibility Lab. Teacher will follow up and facilitate a pair-share discussion and record the results of the percent of water stable aggregates.

Student Does: Student will think individually about the discussion questions from Soil Stability & Erodibility Lab. Then the student will share their answers to the discussion questions with a partner. After discussing with a partner, the pairs will share their answers to the discussion questions with the

class. Next, student will share their results with a partner and record their percentages on the board. After discussing with a partner, the pairs will share their results with the class.

Sequencing Secondary Succession

Teacher Does: Teacher guides the students to the online area to find the aerial photos (taken from the field on Day 2).

Student Does: Student put aerial photos (taken from the field on Day 2) in sequence demonstrating secondary succession. Then explain the reasoning for that order.

Student Designed Assessment

Teacher Does: Next, facilitates the creation a diagram or poster demonstrating proof of meeting standard.

Student Does: Create a diagram or poster demonstrating proof of meeting standard.

See Rubric.

Student Designed Assessment Rubric							
Criteria	Ratings						Pts
Rubric	50.0 pts "I can teach this!" (I completely understand this concept. I have no questions regarding how this concept works. I can apply the concept to everyday situation. I can help others understand this concept.)	40.0 pts "I can do this!" (I understand this concept. I still have a few questions regarding how the concept works. I can usually help others understand this concept.)	30.0 pts "I get stuck." (I mostly understand this concept. I have some questions regarding how this concept works. I sometimes need help from others to understand this concept.)	20.0 pts "I can get started." (I somewhat understand this concept. I have many questions regarding how the concept works. I usually need help from others to understand the concept.)	10.0 pts "Did we learn this?" (I don't understand this concept. I don't have questions because I don't know what to ask. I need help from others to understand this concept.)	0.0 pts Did not complete a project.	50.0 pts
							Total Points: 50.0

Unit References

[List reference citations in APA format.]

Nationwide, S. (2012). Soil Microorganisms. Retrieved June 14, 2019, from https://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition/Text-Version/The-Living-Soil/Soil-Microorganisms

Appendix 1: Map of Pender Fields

Appendix 2: Edible Soil Lab

Appendix 3: Soil Stability & Erodibility Lab

Blue Ox
1
2
3
4
5
6
16
16
16
9

Edible Soil!
Essential Question:

What are the layers of soil?
At a Glance:
Learners expand their knowledge of the soil profile by making 'soil pudding'.
Background Information:
Soil takes many years to form from a starting point of bedrock or parent material, a layer of rock upon which soil accumulates. As years pass, good quality soil will develop four or more distinct layers. At the surface is the O horizon, a layer of organic material, usually partly decomposed, also called residue or leaf litter. Next is the A horizon, also called topsoil. Most plant roots grow in this layer and it holds most of the soil's nutrients. The B horizon (subsoil) contains sand and silt, and perhaps some nutrients that have dripped through (leached) from the layers above. The C horizon is partially broken down bedrock. The last layer, the R horizon, is bedrock. Some classification schemes add other layers, but this is a simple one. The deeper the O and A layers are, the richer the soil is. Soil profiles vary greatly. Good Iowa farmland has an A horizon that is 3 feet thick. A typical eroded Georgia soil may have little or no A horizon.
For simplicity in this activity we use the terms: parent material, subsoil, topsoil, and residue or leaf litter.

Location: Indoors

Objectives: *Learners will*
1) Identify the layers of a soil profile.

Skills: identification

Supplies:
- Clear plastic cups for each student
- Spoons
- Candy coated chocolate
- 2 -3 boxes of chocolate pudding (prepared)
- Gummy worms
- ½ cup+ colored sprinkles
- Chocolate sandwich cookies, crushed
- ½ cup coconut
- Yellow, brown or green food coloring

Labels/paper:
- Parent Material
- Subsoil
- Topsoil
- Organisms
- Residue or Leaf litter
- Earthworms or red wigglers

Getting Ready:
1. Prepare the pudding according to the directions on the package.
2. Place chocolate sandwich cookies into a sealed plastic bag and crush using a rolling pin. Alternatively, use a food processor to crush the cookies.
3. Add a couple of drops of food coloring to the coconut in a plastic container or baggy. Shake for 30 to 45 seconds. Pour coconut onto paper towels to dry (about an hour).

Procedure:

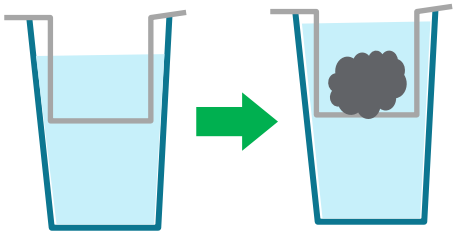
1. Review the layers of a soil profile from Lesson 1 of the soil module. Tell learners that they will be making their own edible soil profile.
2. You will first be showing the group each layer of soil and demonstrating how to make an edible soil profile. Each learner will then be able to make their own. You may have the attached diagram available for review.
3. Place each soil layer ingredient by its appropriate label
a. Candy coated chocolate = 'Parent Material'
b. Chocolate pudding = 'Subsoil'
c. Crushed chocolate sandwich cookies = 'Topsoil'
d. Colored sprinkles = 'Organisms'
e. Coconut = 'Residue'
f. Gummy worms = 'Earthworms' label.
4. Place spoons with each of the soil horizon/layer ingredients.
5. Demonstrate making the soil horizons of your edible soil.
6. Put a spoonful of candy-coated chocolates into the bottom of an individual cup; discuss what Parent Material is. Repeat this procedure with the pudding (Subsoil), followed by cookie crumbs (Topsoil), sprinkles (Organisms), coconut (Residue) and finally a gummy worm (Earthworms).
7. Allow each learner to prepare their own Edible Soil. Enjoy!

Discussion:
What are the layers of soil?
What types of organisms live in soil and aid in soil production?

Soil Stability & Erodibility Lab Name:

Materials

- ¼" hardware cloth (10" strips ~2" wide)
- Clear plastic cups or mason jars
- Tap water (to fill cups)
- Weigh boats
- Graduated cylinders (50-100 mL) OR Falcon tubes (15 mL, 30 mL)
- Squirt bottles
- Intact soil clods (~2" DIA) from different fields (pasture, tilled, no-till, lawn, etc.)
- Stopwatch or timer



Methods:

1. Set up slake tests for each type of soil available.
2. Label each cup with soil/management type. Also label an empty weigh boat for each type.
3. Bend hardware cloth sieve so it is suspended inside the cup.
4. Remove the hardware cloth sieve, then fill cup with water, about 1/2" from top.
5. Create hypotheses:
   Null hypothesis - No difference in soil stability between treatments.
   Alternative hypothesis – which will be most stable? Least? Why?

Alternative hypothesis:	

6. Observe the condition of aggregates in the clod and record their "grade" on the datasheet.

Qualitative criteria for grading dry and wet soil aggregates:

GRADE	DESCRIPTION
Very weak	No structure visible. No aggregates are intact. Soil is a puddled spot of mud.
Weak	Individual aggregates weakly visible but not well separated. Weakly cohesive.
Moderate	Individual aggregates visible. Some separation, but little integrity (fall apart easily).
Strong	Individual aggregates readily visible. Can be manually separated. Good integrity and cohesion.
Very strong	Individual aggregates unaffected by water. Integrity and cohesion virtually the same before or after wetting.

7. Place the clod on top of the sieve and gently lower it into the cup until submersed. Start stopwatch and keep the clod submersed for 1 minute.

8. While the 1 minute elapses, watch the clod and write down observations.

What is happening?

	Row-crop soil (tilled)	Row-crop soil (tilled) flooded	Row-crop soil (no-till)	Range Land	Secondary Succession Soil	Forest
Observations						

9. At 1 minute, gently remove the sieve and set it down on the empty weighboat.

10. Make observations on the wetted condition of aggregates. This is the "water stable" aggregate component of the soil. Record "grades" (see qualitative criteria for grading dry and wet soil aggregates) on the datasheet.

11. Make observations on the soil that fell through the sieve. This is the "erodible" aggregate component of the soil. Record "grades" (see qualitative criteria for grading dry and wet soil aggregates) on the datasheet.

	Row-crop soil (tilled)	Row-crop soil (tilled) flooded	Row-crop soil (no-till)	Range Land	Secondary Succession Soil	Forest
Dry aggregate grade						
Water-stable aggregate grade						

12. Quantify the water-stable aggregates on the sieve. Carefully transfer soil to a graduated cylinder/Falcon tube using the squirt bottle and allow sediment to settle (~ 5 minutes). Record the volume of water-stable aggregates remaining. You may have to pour off water if you need more room to add all the soil.

13. Repeat Step 11 to quantify the amount of soil that was eroded (left in the cup). Pour off excess water, then use squirt bottle and weigh boat to transfer erodible soil into another graduated cylinder or Falcon tube. Allow to settle, then record the volume of erodible soil.

14. Calculate the percent of water stable aggregates:

$$\% \text{ water stable aggregates} = \frac{\text{Volume of soil retained on sieve}}{(\text{Volume of retained soil} + \text{Volume of erodible soil})}$$

	Row-crop soil (tilled)	**Row-crop soil (tilled) flooded**	**Row-crop soil (no-till)**	**Range Land**	**Secondary Succession Soil**	**Forest**
Vol. water-stable aggregates remaining on the sieve (mL)						
Vol. erodible aggregates that fell through the sieve (mL)						
Total vol. of soil sample (mL)						
% Water-stable aggregates						

Discussion Questions:

1. Which soils disintegrated the fastest? Why?

2. What did you notice about soils that remained intact the longest? Were there roots? What else might be holding these soils together?

3. What does this mean for soils at risk of water erosion? How does agricultural management impact erosion?

Name:

Lab Report

Please complete the following report during the design and implementation of your experiment.

Research Problem

- Describe what you are investigating and justify why you are investigating the problem.

Hypothesis

- Formulate one or more hypotheses for your experiment.

Procedures

- Create the steps you will follow for your experiment.

Data Collection

- Describe the data that you will collect during your experiment.
- Provide graphs, tables, charts, and raw data as necessary.

Results

- Explain your results.

Conclusion

- Based on your data:
  - What can you conclude?
  - Were your hypotheses supported?
  - Were their limitations to your experiment?
  - What are new research questions that derived from this study?