



Discovering the Science of the Environment

With Support from the National Resource Conservation Service



HUMAN IMPACT ON SOILS

Grade Level(s): High School (Earth Science, Environmental, APES, Agriculture Science)

Program Duration: class periods

- Block Schedule (90 min)
 - Day 1:
 - Soil Health Lesson
 - Start Soil Testing Lab
 - Day 2:
 - Finish Soil Testing Lab
 - Human Impact on Soil Lesson
 - Day 3:
 - Human Impact on Soil Case Study
 - Unit Project Introduction and work time
- 45-50 min class periods
 - Day 1:
 - opener (bellringer)
 - Soil Health Lesson
 - Start Soil Testing Lab
 - Day 2:
 - Opener
 - Finish Soil Testing Lab
 - Day 3:
 - Human Impact on Soil Lesson
 - Human Impact on Soil Case Study
 - Day 4:
 - Unit Project Introduction and work time

Program Overview

This educational module is intended to be used to teach how humans impact soil health in the frame of sustainable agriculture. This module can be used in Earth Science, Environmental Science, APES, and Ag. The corresponding Essential Question, Student Outcome,

- **Essential Question:** How is soil a valuable resource and what are humans doing to change soil quality.
- **Outcomes: Students will be able to** - Assess the importance of soil as a renewable resource and create an action plan to reduce human impacts on soils
 - Soil health - how to determine?
 - Soil pH

- Why is soil important? Where does your food come from?
- Sustainable ag practices - no till
- Cover crop
- Growing plants lab - sampling different soils from around the town
- Farmer outreach
- Design a lab to create a no till tractor - hex bug lab
- Step one of design a farm - worms eye view (sprocket curriculum)
- Ways to reduce fertilizer use on soils
- Soil quality lab

Materials

Activity 1: Soil Health Mini Lesson & Lab	Activity 2: Human Impact on Soil Lesson	Activity 3: Human Impact on Soil Case Study
<ul style="list-style-type: none"> ● PowerPoint ● Note sheet for students or a way for them to record the info ● Soil samples from various locations - in case your students didn't bring in enough ● thermometers ● desiccation oven ● Sieve #40 & #500 ● Salad Spinner? ● Funnels ● Coffee Filters or filter paper ● rubber tubes ● Clamps ● ring stands ● evaporating dishes ● graduated cylinders ● RapiTest Soil Test Kits 	<ul style="list-style-type: none"> ● Student note sheet or discussion guide as we go through each human impact ● Whiteboards 	<ul style="list-style-type: none"> ● Digital copies of the case study students can download and annotate digitally through Notability or some other note taking app ● Physical copies of the case study students can highlight and write on with partners

Introduction - 10 min

Depending on how many days it takes your class to get through this module, you may need more than one bellringer. Below are a list of 4 possible bellringers/discussion questions to prime your class to think about the importance of soil health.

1. Bring in some random food items - ask the following questions
 - a. which food item would no longer be able to be produced if the soil in the Midwest was ruined?
 - b. What do plants need in order to grow?
 - c. What problems are there currently with our soils? Think back to the Dust Bowl Lesson
- 2.

Soil Health Mini Lesson and Lab - 90 min (2- 45 min classes)

Materials

- PowerPoint
- Note sheet for students or a way for them to record the info
- Soil samples from various locations - in case your students didn't bring in enough
- thermometers
- desiccation oven
- Sieve #40 & #500
- Salad Spinner?
- Funnels
- Coffee Filters or filter paper
- rubber tubes
- Clamps
- ring stands
- evaporating dishes
- graduated cylinders
- RapiTest Soil Test Kits

Instructions and/or Summary of Activity

Purpose: To give direct instruction about soil health in order to understand each part of the lab. To give students a hands-on lab experience observing soil qualities and problem solving skills for how to increase soil nutrients and overall health. This lab will reinforce for students that not all soils are suitable for the crops grown in them. It will also reinforce how humans alter soils to grow what they need.

Instructions:

1. Go through the Soil Health PowerPoint
 - a. have students take down notes to reference during their lab.

2. To get started on the lab students will need soil samples. Part of these samples will need desiccated (dried out) for 24 hours prior to the start of the lab. Make sure to either prepare these early or make the lab take two days.
3. The Soil testing lab includes all of the following tests
 - Soil temperature - measured when soil sample was collected
 - Microorganism survey
 - Desiccation and Moisture Content (Day 1 put sample in oven - Day 2 record data)
 - pH
 - Nitrogen
 - Phosphorus
 - Potash (potassium)
 - Permeability
 - Density
 - Texture (10-min setup on Day 1; get results on Day 2)
4. The lab is outlined in the Soil Testing Lab and PowerPoint.
5. At the conclusion of the lab students will choose a crop grown in their region and analyze their soil sample to see what would need changed in order to grow that crop.
6. This analysis is very important if you plan to do the Build a Farm PBL at the end of the unit as it prepares students to think about what soil requirements crops need.

Human Impact on Soil Lesson - 45 minutes

Materials

- Student note sheet or discussion guide as we go through each human impact
- Whiteboards

Purpose: To have students explore different impacts on the soil system. Many students may not come from agricultural backgrounds. This lesson acts as direct instruction and a discussion of how these farming and soil management practices might have a larger impact.

Instructions:

1. Display the lesson.
2. Create a note sheet for students to use to keep their thoughts in order.
3. Alternatively split up the human impacts to each group in the class and have them answer the discussion question on a whiteboard.
4. Have the class do a gallery walk and learn about ways humans are impacting soils and what the larger impacts are on the food system, water system and sustainability.

Human Impact on Soil Case Study- 45 min

Materials

- Digital copies of the case study students can download and annotate digitally through Notability or some other note taking app
 - OR
- Physical copies of the case study students can highlight and write on with partners

Instructions and/or Summary of Activity

Purpose: To have students read about current events and connect them with the concepts learned in the mini lesson. This activity is especially important in the light of scientific information being presented to the public. Students (and some adults) struggle with unpacking scientific information when reading a news article. This aligns with SEPS.8: Obtaining, evaluating, and communicating scientific information.

Instructions:

5. Pass out the Case study to students - either by digital means or actual paper copies
6. Using the methods in the teacher directions, or your own annotation methods, teach/remind the students how to annotate text and read critically.
 - a. It may be useful to practice with your students on a couple of paragraphs before setting them loose. Especially if they have done very little of this type of reading and annotating in your class or their English class.
7. Students can answer the discussion questions individually or as a group
8. Question 10 asks students to compose a letter using Claim, Evidence, Reasoning. If you have never taught this skill or had your students practice it, you may need to review the skill and help your students compose the letter.
 - a. You can have students brainstorm their letter with a group, and write it individually
9. **NOTE:** There are going to be many more opportunities in this and other modules to practice this skill. The purpose is to have students get better at it over time so they can do really well articulating thoughts and using evidence to back up their claim by the time they do the project and take the assessment.

Wrap-up

Depending on how many days it takes your class to complete the module, you may need more than one wrap up activity. Below are 4 possible wrap up activities to get your class processing what they learned that day.

1. When doing the Case Study or the Lab Questions, always feel free to use those questions as classroom discussion. Especially the Claim, Evidence, Reasoning questions. Have students Think, Pair, Share their responses. Ask for alternate responses.
2. 3, 2, 1 Exit Ticket - Have students write three new words they learned and their definitions, Describe 2 main topics from the day, and ask 1 question they still have
3. Have students write a Newspaper Headline and 1 paragraph article incorporating something they have learned from class that day and how it affects their life. Make sure to tell them about appropriate reading levels for newspapers and discuss audience
4. Vocabulary work - reference the list of vocab words you took down at the beginning of the module. Can we define any more. Do we have words we need to add to the list?

Possible Vocabulary/Terminology

<ul style="list-style-type: none">● Soil● Dirt● Igneous Rocks● Metamorphic Rocks● Sedimentary Rock● Rock Cycle● Erosion● Weathering	<ul style="list-style-type: none">● Soil Horizon● Top Soil● Elluviation● Leaching● Percolation● Humus●	<ul style="list-style-type: none">● Nitrogen Fixation● Assimilation● Runoff● Ground Water●
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Indiana Science Standards

Indiana Science Standards

- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
- MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future

- catastrophic events and inform the development of technologies to mitigate their effects.
- MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems
- HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
- HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
- HS-ENV1-2.* Use a computational representation to illustrate that humans are part of Earth's ecosystems and how human activities can, deliberately or inadvertently, alter ecosystems
- HS-ENV2-7.* Analyze computational tools and other technologies that allow for the management of natural resources. Evaluate the trade-offs of these tools regarding human physical and cultural needs versus sustainability and biodiversity.
- HS-ENV4-2. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-ENV5-2. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- HS-ENV5-3. Design, evaluate and refine a technological solution that reduces impacts of human activities on natural systems.
- HS-ENV5-4. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
- APES: ERT-4.B Describe the characteristics and formation of soil.
- APES: ERT-1.D Explain the steps and reservoir interactions in the carbon cycle.
- APES: ERT-1.E Explain the steps and reservoir interactions in the nitrogen cycle
- APES: ERT-4.C Describe similarities and differences between properties of different soil types.
- APES: STB-1.E Describe sustainable agricultural and food production practices
- Ag: IAFNR-4.3 Identify the physical qualities of the soil that determine its use
- Ag: IAFNR-5.1 Explain interrelationships between natural resources and humans necessary to conduct conservation practices in natural environments
- Ag: IAFNR-5.2 Summarize the relationship between natural resources, ecosystems and human activity
- Ag: IAFNR-5.3 Identify natural resources and their importance to the local community.
- Ag: IAFNR-9.1 Examine and categorize current applications and gains achieved in applying biotechnology to agriculture.

Additional Resources:

<https://cees.iupui.edu/education/discovering-science-environment>

Additional Comments

This module is intended to be used with the Weathering & Erosion module and the Matter Cycles in Soil Module found on [insert CEES website here]