

How Does Your Garden Grow? (8th Grade)

Conservation, Ecosystems, and Soil Health

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Grade Level	8th Grade	**Time Frame**	4-5 class period(s)
Subject	Science	**Duration**	300 minutes

Essential Question

Why should we care about soil health?

Summary

This middle school lesson is adapted from the high school lesson "How Does Your Garden Grow?" Students will explore principles of soil health, soil chemistry, and nutrient cycles by testing and analyzing soil samples. Students will also explore humanity's impact on soil health and create public service announcements that explain threats to soil health and how to avoid or mitigate those threats.

Snapshot

Engage

Students examine photographs of healthy and unhealthy soils and crops and theorize what caused the differences between the images.

Explore

Students gather soil samples and test the pH and nutrient levels of the samples then discuss the properties of healthy soil.

Explain

Students participate in a digital breakout activity and gather information about soil chemistry then make connections between soil health and nutrient cycling.

Extend

Students research the impact of human population growth on soil health.

Evaluate

Students create a PSA about threats to soil health and practices that can mitigate the threat.

Standards

ACT College and Career Readiness Standards - Science (6-12)

IOD403: Translate information into a table, graph, or diagram
EMI404: Identify similarities and differences between models

Next Generation Science Standards (Grades 6, 7, 8)

MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Oklahoma Academic Standards (8th Grade)

8.LS1.5 : Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Attachments

- H-Chart—How Does Your Garden Grow_(8th Grade) - Spanish.docx
- H-Chart—How Does Your Garden Grow_(8th Grade) - Spanish.pdf
- H-Chart—How Does Your Garden Grow_(8th Grade).docx
- H-Chart—How Does Your Garden Grow_(8th Grade).pdf
- Lesson Slides—How Does Your Garden Grow (8th Grade).pptx
- Soil Hand Texture—How Does Your Garden Grow_(8th Grade) - Spanish.docx
- Soil Hand Texture—How Does Your Garden Grow_(8th Grade) - Spanish.pdf
- Soil Hand Texture—How Does Your Garden Grow_(8th Grade).docx
- Soil Hand Texture—How Does Your Garden Grow_(8th Grade).pdf
- Soil Investigation—How Does Your Garden Grow_(8th Grade) - Spanish.docx
- Soil Investigation—How Does Your Garden Grow_(8th Grade) - Spanish.pdf
- Soil Investigation—How Does Your Garden Grow_(8th Grade).docx
- Soil Investigation—How Does Your Garden Grow_(8th Grade).pdf
- Threat Research—How Does Your Garden Grow_(8th Grade) - Spanish.docx
- Threat Research—How Does Your Garden Grow_(8th Grade) - Spanish.pdf
- Threat Research—How Does Your Garden Grow_(8th Grade).docx
- Threat Research—How Does Your Garden Grow_(8th Grade).pdf
- Window Notes—How Does Your Garden Grow_(8th Grade) - Spanish.docx
- Window Notes—How Does Your Garden Grow_(8th Grade) - Spanish.pdf
- Window Notes—How Does Your Garden Grow_(8th Grade).docx
- Window Notes—How Does Your Garden Grow_(8th Grade).pdf

Materials

- Lesson Slides (attached)
- Soil Investigation handout (attached; one per student)
- Soil Hand Texture handout (attached; one per group)
- Window Notes handout (attached; one per student)
- H-Chart handout (attached; one per student)
- Threat Research handout (attached; one per student)
- Soil samples (collected during the lesson)
- Gloves
- Paper towels or disinfectant wipes
- Mineral-free water (e.g., DI water)
- Soil test kit or chemical test strips
- Student devices with internet access
- Sticky notes in three different colors

- Posters
- Markers

15 minutes

Engage

Teacher's Note: Lesson Versions

There are three different versions of this lesson available. Each lesson has similar Engage, Explore, and Explain phases, but the Extend and Evaluate phases address different standards.

This version of the lesson addresses the Oklahoma Academic Standard 8.LS1.5, an eighth grade science standard. Follow the links below to access versions of this lesson appropriate for sixth grade, seventh grade, and high school grades.

- How Does Your Garden Grow? (6th Grade) addresses standard 6.ESS2.1.
- How Does Your Garden Grow? (7th Grade) addresses standard 7.LS2.3.
- How Does Your Garden Grow? is for high school grades 9–12.

Use the attached **Lesson Slides** to facilitate this lesson. Display **slide 2** and introduce the title of the lesson, then display **slides 3–4** and introduce the essential question and learning objectives.

Display **slide 5** and introduce the Photo Deconstruction activity to students. Explain to students that they will see four photographs on the next slide. Tell students to study the four photos and consider the following questions:

- What do you observe in each photo?
- What are some causes of the things you observed?
- What do the healthy plants have that the unhealthy plants do not have?

Tell students that as they study the photos they should attempt to answer all three questions in a single-sentence summary.

Show **slide 6** containing a series of photographs of soil and plants in different soil conditions. The images illustrate the following:

- Healthy, harvested wheat field
- Bare field
- Plants growing in healthy soil
- Plants growing in unhealthy soil

Invite students to share out any observations and guide a class discussion on the images.

Teacher's Note: Guiding the Discussion

Ideally, students should conclude that soil is a critical component in growing healthy plants. If they do not arrive at this conclusion, guide the conversation towards what the plants are growing in. Explain that while plants do not require soil to grow, in these cases soil is the source of many necessary plant nutrients.

After the discussion, display **slide 7**. Ask students to summarize what they think they know about all four images in a single sentence. Explain their sentences should capture the main information they gained from the discussion. Invite volunteers to share their summaries.

30 minutes

Explore

Teacher's Note: Investigation Preparation

Prior to the activities featured in this phase of the lesson, have students collect soil samples from various garden sites around campus. Lead students in collecting soil from multiple sites so there are multiple samples to compare. You may even encourage students to bring soil samples from home. This process will need to be done at least one day in advance, as the soil samples will need to sit in a solution overnight.

Part 1: Assessing Soil Chemistry

Display **slide 8** and draw students' attention to the soil samples. Inform students that they will be analyzing each soil sample using common soil chemistry tests. Explain to students that they will be testing the soil pH as well as the nitrogen level, phosphorus level, and potassium level.

Show **slide 9** and explain the process for preparing the soil samples.

Begin by having students create the soil solution. Instruct them to add 100 mg of soil and 200 mL of water to a beaker or other container. Ensure that they measure both the soil and water correctly.

Instruct students to stir the mixture using stirring sticks or rods. Ensure that students use a new or different stirring utensil for each soil sample.

Once each mixture has been prepared, allow them to sit overnight.

In the following class period, resume the lesson by displaying **slide 10**. Review portions of the lesson from the previous class period and stress to students that soil is important to plant health.

Pass out one copy of the **Soil Investigation** handout to each student. Additionally, provide each student with a **Soil Hand Texture** handout to assist them with the texture portion of the soil investigation. A copy of the Soil Investigation table can be seen below.

Soil Sample	Texture	pH	Nitrate (NO_3)	Nitrite (NO_2)	Phosphorous (P)	What are some possible issues you notice?

Explain the procedure for testing soil samples. This procedure may vary based on the types of soil test kits you purchased. Review the specific directions with students. Tell students that they should dip their test strips into the sample solution, allow 50–60 seconds for the test strip to change color, then compare the color of the test strip to the color chart. Tell them that each measurement should then be recorded in their Soil Investigation tables.

Additional Steps for Test Strips

If you are using test strips that require color comparison, like nitrogen test strips, you may need to filter the water sample before collecting data. Use a double or triple layer of coffee filters to filter the sample until it is clean enough to test. You may need to filter it three times or more depending on how murky the water is.

Tell students that they should document their process and results as they test the samples. They may do this by taking photos using tablets or their phone camera, if your classroom allows student devices. Explain to students that they will incorporate these pictures in their final presentations.

Instruct students to begin testing their soil samples. As they test the samples, walk around the room and assist students with the testing process. Answer any questions they may have and guide them in making observations about their samples, if necessary.

After the testing process is complete, display **slide 11** and explain the clean-up process.

Teacher's Note: Clean-Up Procedures

Slide 11 provides basic clean-up procedures. You may choose to edit the slide to add any clean-up procedures specific to your classroom.

Part 2: Investigating Soil Health

Display **slide 12** and introduce the next part of the lesson to students. Explain that students will explore several online resources to learn more about soil properties and soil health.

Transition to **slide 13** and pass out the **Window Notes** handout to each student. Tell students that they will explore resources about soil health in a HIVE collection board. As they read each source, they will take Window Notes over soil health, but will leave the Nutrient Cycles portion of the handout empty. Direct students to access the Explore Sources HIVE and begin reading through the resources.

Part 3: Discussion

After students have read the sources, display **slide 14** and introduce the discussion portion of the lesson. On the class board or on a large sheet of paper, create an Anchor Chart for each quadrant of the Window Notes. Consider including diagrams or drawings of soil horizons as part of the chart.

Display **slide 15** and begin a class discussion on students' window notes. Use the following questions on the slide to guide the discussion:

- What is soil?
- How do we describe soil?
- How do we know if soil is healthy?
- What are the benefits of having healthy soil?
- What soil management practices or strategies would improve soil health?

25 minutes

Explain

Teacher's Note: Breakout Guide and Answers

Prior to this activity, visit the How Does Your Garden Grow? Breakout to familiarize yourself with the content and answers to the locks. The answers to the locks are provided below:

Number Lock answer: 18—This answer is found in the article linked in the first picture at the bottom of the page. The article is about nutrients essential for soil growth. The number refers to the number of essential nutrients.

4 Letter Lock answer: CNOP—This answer is found by taking the first letter of every nutrient cycle in the green box in the middle of the page.

Picture Lock answer: 6.5—This answer is found in the image linked to the third picture at the bottom of the page. When the image is revealed, students will see the number circled at the top.

Color Lock answer: GBORYWP—This answer is found in the activity linked to the second picture at the top of the page. Students will make a copy of the Google Sheets document and complete a vocabulary activity. When the activity is completed, it will reveal the answer.

Transition to **slide 16** and introduce students the breakout rooms activity. Display **slide 17** and direct students to the How Does Your Garden Grow? Breakout resource. Instruct students to form groups and collaborate to find the keys to the four digital locks at the bottom of the website. Explain that students should read all of the articles and images on the website and use information about how nutrients are cycled to find the keys to the digital locks. Instruct them to summarize the information they learn in the Nutrient Cycles quadrant of their Window Notes as they work. Explain that they may make additional notes or add more "windows" to their handout if necessary. Allow students time to complete the activity.

Display **slide 18**. Pass out three differently-colored sticky notes to each student and introduce the Three Sticky Notes activity. Begin by having students summarize what they learned in the breakout activity using a single word. Display **slide 19** and have students summarize the breakout activity using a short phrase.

Instruct students to use the information they gained from the breakout activity to create a new anchor chart for the Nutrient Cycles window on their Window Notes handout.

Display **slide 20** and invite students to share out their words and phrases. As students share, add any new information to the three anchor charts created during the discussion from the Explore phase of the lesson.

Misconceptions, Vocabulary, and Notes

If the entire class is struggling with content details or information from the Explore activities, consider providing a brief lecture and instructing students to take notes. You may consider a lecture in which you fill in gaps in knowledge, address misconceptions, or assist students in developing definitions for content-specific vocabulary.

Display **slide 21** and direct students' attention to their third sticky note. Assist them in synthesizing the many concepts from the activity, paying extra attention to the connections between the knowledge they gained from the activities during the Explore and Explain phases of the lesson. Guide students to make the following connections about soil and nutrient cycles:

- Nutrient cycles and soil health are related. For example, nutrient cycles support healthy soil and unhealthy soil may disrupt nutrient cycles.
- Soil management practices support or supplement natural nutrient cycles.
- Soil management practices impact soil health.

After supporting students in making these connections, instruct them to summarize how nutrient cycles, soil health, and soil management practices relate to each other using one sentence.

30 minutes

Extend

Display **slide 22** and introduce the H-Chart activity. Pass out one copy of the **H-Chart** handout to each students and instruct them to take notes on the following video on the left side of the H-Chart. Display **slide 23** and play the video *World Population*.

Embedded video
https://youtube.com/watch?v=khFjdmp9sZk?t=44

Display **slide 24** and instruct students to take notes on the next video using the right side of the H-Chart. Display **slide 25** and play the video *Global Land Cover Change from 8000 BP to -50 BP*.

Teacher's Note: Land Cover Change

The video on land cover change shows the amount of land that remains covered by natural vegetation. The less green the area is, the more humans have changed the landscape. The video uses BP (years before present time) as a time scale. 0 BP equates to 1950 and the video ends at the year 2000, or -50 BP. For more information, visit this article.

Embedded video
https://youtube.com/watch?v=gBTllaf12-4

Instruct students to consider how the change in human population size compares to the change in land use. Tell them to identify any threats to soil health and consider the causes, impacts, and any potential solutions. Guide them in determining the impact of human population growth on soil health.

Show **slide 26** and tell students to explain how the two videos relate to one another using the middle portion of their H-Chart. Invite students to share their conclusions with the whole class.

Display **slide 27**. Instruct students to gather in small groups and brainstorm an answer to the question, "In what ways could increased population size and land use impact soil health?" After they have had time to brainstorm, instruct them to select a potential threat to soil health from their notes or a list of your choosing, or have them search for a new threat to investigate.

Display **slide 28** and pass out the **Threat Research** handout. Instruct students to research their chosen threat and record information related to the following questions:

- How does the threat damage soil health?
- What causes the threat?
- How can the threat be avoided, mitigated, or eliminated?

You may choose to provide students with the infographics Soil Is a Non-Renewable Resource and Soils Help to Combat Climate Change to support their research.

25 minutes

Evaluate

Display **slide 29** and read aloud the quote from Penn State University. Display **slide 30** and further explain the definition and components of a Public Service Announcement (PSA).

Display **slide 31** and explain PSA assignment to students. Instruct students to create a PSA about the dangers posed to soil health. Explain that their PSA must either advocate for the benefits of improved soil health or highlight the danger their chosen threat poses to soil.

Teacher's Note: Components of the PSA

Student PSAs should address the characteristics of healthy soil and specific cause and effect details of their chosen threat. Each PSA should synthesize what students have learned about soil during the course of the lesson.

Instruct students to draft a plan for their PSA that includes the characteristics of healthy soil, the causes of their chosen threat, the effects of their chosen threat, and ways the threat can be avoided, mitigated or eliminated. Tell students that they must support the claims made by their PSA using evidence and scientific concepts from their research and information recorded in their Window Notes.

Options for Final Presentations

You may choose the format for students' final presentations of their PSAs based on the amount of class time and resources available. You may also choose to have students work individually or in groups, as long as each group member has the opportunity to present a portion of the research.

An activity like a Two-Minute Documentary would be appropriate for this activity.

Resources

- ARVE Research Group. (2011, Jan. 20). *Global land cover change from 8000 BP to -50 BP* [Video]. YouTube. https://www.youtube.com/watch?v=gBTllaf12-4
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- Food and Agriculture Organization of the United Nations. (2015). *Soil is a non-renewable resource* [Infographic]. https://openknowledge.fao.org/server/api/core/bitstreams/c43bacdd-2fb6-46d2-b9d0-6731c566be91/content
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- Shaffery, Heather. (2018). [Photograph of a hand digging in soil]. Grazinglands Research Laboratory.
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