



How Does Your Garden Grow? (MS-ESS3-4)

Conservation, Ecosystems, and Soil Health



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Grade Level	6th – 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 lesson is a middle school adaptation of the high school "How Does Your Garden Grow?" lesson. Students will explore soil health principles, soil chemistry, nutrient cycles, environmental impacts of soil quality, and human influence on soil health. Students will create public service announcements (PSA) supporting the benefits of maintaining soil health or consequences of current soil health threats.

Snapshot

Engage

Students view pictures of healthy and unhealthy soils and crops and speculate on what has caused the difference in the images.

Explore

Students test soil samples from a variety of locations to evaluate their nutrient levels and pH. Additionally, students will explore several sources to determine properties of healthy soil and practices that support it, followed by a whole-class discussion.

Explain

Students participate in a digital breakout to gather information about soil chemistry and nutrient cycles. The class will collaborate to make connections between their understanding of soil health, management practices, and nutrient cycling.

Extend

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

Evaluate

Students create a PSA detailing a specific impact of human population growth on soil health and practices to mitigate the threat.

Standards

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

MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Oklahoma Academic Standards (7th Grade)

7.ESS3.4 : Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

7.ESS3.4.1: Typically, as human populations and per-captia consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

Attachments

- [Conventional Till Winter Wheat.jpg](#)
- [Explore-Resources-2-1 - Spanish.docx](#)
- [Explore-Resources-2-1 - Spanish.pdf](#)
- [Explore-Resources-2-1.docx](#)
- [Explore-Resources-2-1.pdf](#)
- [Flow-Chart-Soil-Hand-Texture-2-2 - Spanish.docx](#)
- [Flow-Chart-Soil-Hand-Texture-2-2 - Spanish.pdf](#)
- [Flow-Chart-Soil-Hand-Texture-2-2.docx](#)
- [Flow-Chart-Soil-Hand-Texture-2-2.pdf](#)
- [H-Chart-2-9 - Spanish.docx](#)
- [H-Chart-2-9 - Spanish.pdf](#)
- [H-Chart-2-9.docx](#)
- [H-Chart-2-9.pdf](#)
- [How-Does-Your-Garden-Grow-MS-ESS3-4-2-0-8th-grade.pptx](#)
- [No Till Winter Wheat.jpg](#)
- [Old World Blue Stem July.jpg](#)
- [Soil-Investigation-Handout-2-4 - Spanish.docx](#)
- [Soil-Investigation-Handout-2-4 - Spanish.pdf](#)
- [Soil-Investigation-Handout-2-4.docx](#)
- [Soil-Investigation-Handout-2-4.pdf](#)
- [Tall Grass Prairie June.jpg](#)
- [Threat-Research-2-1 - Spanish.docx](#)
- [Threat-Research-2-1 - Spanish.pdf](#)
- [Threat-Research-2-1.docx](#)
- [Threat-Research-2-1.pdf](#)
- [Window-Notes-Handout-2-3 - Spanish.docx](#)
- [Window-Notes-Handout-2-3 - Spanish.pdf](#)
- [Window-Notes-Handout-2-3.docx](#)
- [Window-Notes-Handout-2-3.pdf](#)

Materials

- Soil samples
- Gloves
- Paper towels and/or disinfectant wipes
- Mineral-free water (e.g., DI water)
- Soil test kit or chemical test strips
- Devices with internet access

- Sticky notes
- Posters, markers, etc. for creating presentations and for Anchor Charts
- Lesson slides

Engage

Teacher's Note

There are three different versions of this lesson. The Engage through Explain are similar, but the Extend and Evaluate activities address different standards.

This version addresses MS-ESS3-4, which is an 8th grade standard in Oklahoma. Please follow the links to access the other versions as is appropriate for your class: [MS-LS2-3 Version](#) (OK 6th grade), [MS-LS1-5 Version](#) (OK 7th grade). The companion lesson for grades 9-12 is found at <https://learn.k20center.ou.edu/lesson/203>

Show **slide 4**. Review learning objective with students: Construct an evidence-based argument that explains how an increase in human population affects our consumption of natural resources and impacts soil health.

Explain the Photo/Picture Deconstruction strategy to students. Ask students to examine the photographs in next two slides and reflect on (a) what they have observed in each of the four (4) photographs; (b) the potential causes for differences they notice; and (c) what the healthy plants might have that the unhealthy plants do not.

Show **slides 5-6**. Show the series of photographs of soil and plants in different soil conditions:

- Healthy harvested wheat fields;
- Bare field;
- Plants growing in healthy soil;
- Plants growing in unhealthy soil.

Have students complete a [Photo/Picture Deconstruction strategy](#). Advise them that they will capture their responses in a single sentence.

Teacher's Note

If students do not conclude for themselves that soil is a critical component in growing healthy plants, guide the conversation toward what the plants are growing in (i.e., soil). While plants do not require soil to grow, in these cases, soil is the source of many necessary plant nutrients.

Show **slide 7**. After the discussion, ask students to summarize what they think they know about the images in one sentence. Instruct them that their summaries will capture the “big takeaway” each student got from the conversation.

Explore

Assessing Soil Chemistry

In this section, students analyze each soil sample, making sure to record the data for the most common soil chemistry tests: soil pH, Nitrogen level, Phosphorus level, and Potassium level.

All of the tests require a soil solution which should be prepared at least a day ahead of time to get better results due to the nutrients leaching into the water.

NOTE: The Explore section has three different parts to it: a lab investigation, online research, and a whole class debrief discussion.

Have students collect soil samples from possible garden sites around campus. Encourage them to collect soil from multiple sites to use as a comparison. Students may even bring soil samples from home to test.

Show **slide 9: Preparing the Soil Samples:**

1. Have students create a soil solution by adding 100 mg of soil and 200 mL of water to a beaker or other container.
2. Have the students use the stirring rod or sticks to blend the mixture.
3. Ensure that students clean the stirring rod thoroughly or use a different stirring utensil for each soil sample
4. Let the soil and water mixture sit overnight.

Show **slide 10. Testing the Soil Samples:** Once students understand that soil is important to plant health, have them test the soil types to determine the level of the nutrients present.

1. Hand out the **Soil Investigation** handout.
2. Provide each group with a Soil Test Data Sheet OR have each group create their own data table (See sample Soil Test Table below).
3. Based on the specific directions for the soil test kit you have purchased, review the procedure for soil testing with your students.
4. Have students document their process and results using tablets or their phone camera if it is a "Bring Your Own Device" (BYOD) approved environment. These pictures can be incorporated into their final presentation.

Extra Step For Test Strips

If you are using test strips that require a color comparison, it might be necessary to filter the water sample before collecting data. This is true for nitrogen test strips. Depending on how murky the soil makes the water, it is usually clean enough after 2-3 rounds of filtering through a double or triple layer of coffee filters.

Teacher Note: Texture

Give students the **Flow Chart Soil Hand Texture** handout to guide them through the texture portion of the soil investigation.

Soil Sample	Texture	pH	NITrate (NO ₃)	NITrite (NO ₂)	Phosphorous (P)	What are some possible issues you notice?

Soil Sample Data Table

Show **slide 11**. This slide contains information about clean-up for the Soil Chemistry Investigation. Add any material- and classroom-specific instructions you may have to this slide.

Investigating Soil And Soil Health

Students explore several sources to develop a basic understanding of soil properties and components of soil health.

If students have regular access to technology, they could also use Google Apps (e.g., Docs, Slides) to collaboratively fill out the Window Notes.

A variety of sources that students can use to gather information are provided in the **Explore Sources** attachment that you can share digitally with students.

Show **slide 13**. This slide is a place for you to provide any class-specific instructions for conducting the research regarding soil and soil health.

Show **slide 14**. Pass out the [Window Notes](#) handout. Have each student record important details in a Window Notes graphic organizer. Instruct them to leave the *Nutrient Cycle* box empty for now.

Explore Debrief

As a class, summarize the key points to create an Anchor Chart for each Window Notes box. The soil chemistry information can be incorporated into *Soil Properties* or *Soil Health*. Diagrams or drawings of soil horizons and details would also be helpful on an anchor chart.

Show **slides 15-16**. Some questions to guide the summary discussion could include:

- What is soil? How do we describe it?
- What criteria factor into soil health?
- What are the benefits of having healthy soil?
- What soil management practices or strategies would improve soil health?

Explain

Teacher's Note

Once students have a general understanding of soil health, transition them into developing concepts about soil nutrients specifically.

Show **slide 17**. Have students should work together to complete the [How Does Your Garden Grow? Breakout](#). Have them summarize the information they learn in the Nutrient Cycles Window Note box. Remind them to make additional notes in the other "windows" as necessary.

How Does Your Garden Grow? Breakout Answers

Following are the answers to the breakout: Number Lock: **18**, 4 Letter Lock: **CNOP**, Picture Lock: **6.5**, Color Lock: **GBORYWP**.

Show **slides 18-19**.

Ask students to use the [3-Post It Notes](#) strategy in their small groups or individually. Have them complete only the Word = __, and Phrase = __ notes. Instruct students to repeat the process they used to create the previous Anchor Charts to develop one for *Nutrient Cycles* window.

Ask students to share out their Words and Phrases as part of the summary conversation. If necessary, add any new information students discovered to the other three charts as well.

Misconceptions, Vocabulary, Notes

If the entire class is struggling with content details or missed important information during their Explore activities, this is an appropriate place for direct instruction. To fill gaps or misconceptions provide a brief lecture, having students take notes over specific concepts, or developing content-specific vocabulary.

Show **slide 20**. Help students synthesize the conceptual pieces for themselves. Have them complete the *Sentence* part of the 3-Post It Notes activity. Ask them to emphasize the connections between the information they have gathered during the Explore and Explain activities and discussions in their sentence. Guide students to make the following connections:

- The relationship between nutrient cycles and soil health (e.g., how cycles support healthy soil, how unhealthy soil might disrupt cycles);
- How soil management practices support or supplement natural nutrient cycles;
- The impact of soil management practices on soil health.

Several alternatives to class discussion or a written assignment for this portion of the Explain are suggested below.

Concept (Card) Mapping

Show **slide 21**. This [strategy](#) can be done physically or digitally. Students can create hand-drawn or digital (e.g., [MindMeister](#), [Cmaps](#)) concept maps. They can also use physical cards, either pre-made or class-generated, that they glue/tape down and draw lines to connect ideas. As a whole class you might consider using string to physically connect concepts found on the four anchor charts.

Metaphorical Thinking

Show **slide 22**. [Students create metaphors](#) based on their personal experience to help explain the connections they are making.

Cognitive Comics

Show **slide 23**. Using either a predetermined structure (e.g., three panels) or letting students choose their own, students [draw their conceptual understanding as a comic](#). These could be shared using gallery walks or brief class presentations.

Extend

Have students compare the change in human population size to changes in land use to determine the impact of human population growth on soil health. Ask them to identify any threats to soil health and research the cause(s), impact(s), and potential solution(s).

Teacher Note: Land Cover Change

The land cover change video linked below shows the amount of land in a certain area that is still covered by natural vegetation. The less green an area, the more that humans have changed the landscape. The video uses BP ("years Before Present time") as its time scale. 0 BP = 1950, so the video simulation ends at the year 2000 (-50 BP). For more information see this [article](#).

Show **slide 24**.

Give students the [H-Chart](#) handout. Have students watch two videos: (1) the [World Population](#) video (population simulation begins at 0:44) and (2) the [Global Land Cover Change](#) video.

Show **slide 25**. Ask students to explain how the two videos relate to one another (e.g., "As population increases, we use up more natural land.") using the [H-Chart](#) strategy. Instruct students to take notes on the first video on the left side of the H-Chart. Instruct them to take notes on the second video in the right side of the H. Ask them to connect the two videos to one another on the middle part of the H. Have students share out their conclusions to the whole class.

Show **slide 26**. Have students brainstorm about how increased population size and land use might impact soil health. Once they have brainstormed, have them select a potential threat to soil health from either their notes, a list you provide to them, or through their own independent research. Several useful sources include the following:

- Food and Agriculture Organization of the United Nations. (2015, Aug. 26). Our soils under threat. [Infographic]. <http://www.fao.org/resources/infographics/infographics-details/en/c/326257/>
- Food and Agriculture Organization of the United Nations. (2015, Feb. 11). Soils help to combat and adapt to climate change. [Infographic]. <http://www.fao.org/resources/infographics/infographics-details/en/c/340783/>
- Food and Agriculture Organization of the United Nations. (2015, Mar. 3). Soil is a non-renewable resource. [Infographic]. <http://www.fao.org/resources/infographics/infographics-details/en/c/278954/>
- USDA. Natural Resources Conservation Service. (n.d.). Understanding soil risks and hazards. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/?cid=nrcs142p2_053956

Show **slide 27**. Hand out the **Threat Research** handout. Give students sufficient time to research their threat of choice in order to answer the following questions:

1. How does the threat damage soil health?
2. What causes the threat?
3. How can the threat be avoided, mitigated, or eliminated?

Evaluate

Teacher's Note

For their final presentation, have students produce a PSA about specific practices that support soil health. If students are working in small groups for this portion, be sure to give each student an opportunity to explain their understanding individually for assessment purposes.

As part of reporting on the three research components from the Extend, students should address what characterizes healthy soil and the specific cause-effect details about their chosen threat as it relates to the specific content they've recorded in their Window Notes throughout the lesson.

A [Two-Minute Documentary](#) or similar format would be appropriate for this activity. The PSAs should synthesize what students have learned throughout the lesson about soil.

Slide 31 is a slide for you to provide any material- and classroom-specific instructions for PSAs/presentations.

Show **slide 28**. Ask students to create a Public Service Announcement about the dangers posed to soil health. Have them draft an outline/plan for the PSA.

Show **slide 29**. Have students create their PSA to demonstrate a stance advocating for either (a) the benefits of improved soil health or (b) highlighting the threat of not protecting the soil from their particular threat.

Show **slide 30**. Remind students to support their PSA with the following:

- Evidence and science concepts from their research
- Information recorded on their Window Notes handout.

Remind students to include the following in the PSA:

1. Characteristics of healthy soil
2. Cause of their chosen threat
3. Effects of chosen threat
4. Ways the threat can be avoided, mitigated, or eliminated

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>
- Food and Agriculture Organization of the United Nations. (2015, Aug. 26). Our soils under threat. [Infographic]. <http://www.fao.org/resources/infographics/infographics-details/en/c/326257/>
- Food and Agriculture Organization of the United Nations. (2015, Feb. 11). Soils help to combat and adapt to climate change. [Infographic]. <http://www.fao.org/resources/infographics/infographics-details/en/c/340783/>
- Food and Agriculture Organization of the United Nations. (2015, Mar. 3). Soil is a non-renewable resource. [Infographic]. <http://www.fao.org/resources/infographics/infographics-details/en/c/278954/>
- Girl Scouts of Texas Oklahoma Plains. (2012, Apr. 17). How to make a PSA. [Video]. YouTube. <https://www.youtube.com/watch?v=eywBa0xfQFw>
- Hirst, K. (2019, Jan. 25). *BP: How do archaeologists count backward into the past?* ThoughtCo. <https://www.thoughtco.com/bp-how-do-archaeologists-count-backward-170250>
- How Does Your Garden Grow: Breakout. (n.d.). <https://sites.google.com/ou.edu/gardengrowbreakout/home>
- K20 Center. (n.d.). Cognitive comics. Strategy. <https://learn.k20center.ou.edu/strategy/198>
- K20 Center. (n.d.). Concept card mapping. Strategy. <https://learn.k20center.ou.edu/strategy/123>
- K20 Center (n.d.). How does your garden grow. Lesson. <https://learn.k20center.ou.edu/lesson/203>
- K20 Center (n.d.). Metaphorical thinking. Strategy. <https://learn.k20center.ou.edu/strategy/146>
- K20 Center. (n.d.). Paired texts H-chart. Strategy. <https://learn.k20center.ou.edu/strategy/132>
- K20 Center. (n.d.). Photo or picture deconstruction. Strategy. <https://learn.k20center.ou.edu/strategy/140>
- K20 Center. (n.d.). Two minute documentaries. Strategy. <https://learn.k20center.ou.edu/strategy/177>
- K20 Center. (n.d.). Window notes. Strategy. <https://learn.k20center.ou.edu/strategy/189>
- Population Education. (2015, March 26). World population [Video]. YouTube. <https://www.youtube.com/watch?v=khFjdmp9sZk&t>
- Public Service Announcement. (n.d.). In Penn State teaching and learning with technology. <https://mediacommons.psu.edu/2017/02/14/public-service-announcement/>
- USDA. Natural Resources Conservation Service. (n.d.). Understanding soil risks and hazards. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/?cid=nrcs142p2_053956