How Does Your Garden Grow? (MS-LS2-3)

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, and environmental impacts of soil quality. Students will construct models that demonstrate the flow of matter and energy in their local ecosystem, including between living and non-living parts of the environment.

Snapshot

Engage

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

Explore

Students will 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 soil health, management practices, and nutrient cycling.

Extend

Students will construct models that demonstrate the flow of matter and energy in their local ecosystem.

Evaluate

Students further develop their ecosystem models to show where specific nutrients move between living and non-living parts of the system.

Standards

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

MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Oklahoma Academic Standards (7th Grade)

7.LS2.3 : Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
7.LS2.3.1: Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem.
7.LS2.3.2: Transfers of matter into and out of the physical environment occur at every level.

Attachments

- Conventional Till Winter Wheat.jpg
- Ecosystem-Model-6th-2-10 - Spanish.docx
- Ecosystem-Model-6th-2-10 - Spanish.pdf
- Ecosystem-Model-6th-2-10.docx
- Ecosystem-Model-6th-2-10.pdf
- 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
- Lesson-Slides-How-Does-Your-Garden-Grow-MS-LS2-3-2-1-6th-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
- 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—How Does Your Garden Grow?

Engage

Teacher's Note

There are three different versions of this lesson. The Engage through Explain sections are identical for all three lesson; however, the Extend and Evaluate activities address different standards. This version addresses (MS-LS2-3) , which is a 6th grade standard in Oklahoma.

Please follow the links to access the other versions as is appropriate for your class: MS-LS1-5 Version (OK 7th grade), MS-LS2-3 Version (OK 6th grade), MS-ESS3-4 Version (OK 8th grade).

Show **slide 5**. 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. Ask students to 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.

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 6**. 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

- All of the tests require a soil solution. Prepare at least a day before to get better results due to the nutrients leaching into the water.
- Review the specific product instructions for soil testing on the soil test kit instruction page.
- Have students analyze each soil sample, making sure they record the data for the most common soil chemistry tests: soil pH, Nitrogen level, Phosphorus level, and Potassium level.

Have students collect soil samples from possible garden sites around campus. Encourage them to collect soil from multiple sites, including samples from home, to use as comparison.

Show **slide 8. Preparing the Soil Samples:** Have students prepare the soil solution at least a day in advance of the soil testing.

1. Have the 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.

Show **slide 9. 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. Provide each group with the **Soil Investigation** handout OR have each group create their own data table (see Sample Soil Test Table below).
2. Based on the specific directions for the soil test kit you have purchased, review the procedure for soil testing with your students.
3. Have students document their process and results using tablets or their phone cameras 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 particularly 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 10**.

Teacher's Note: Clean Up

Slide 10 demonstrates the steps necessary for clean up after the Soil Chemistry Investigation. Include any material and/or classroom-specific instructions you may have to this slide. Review cleaning instructions with students, paying special attention to cautionary statements. See a demonstration here if you are unfamiliar with procedure to remove gloves safely.

1. Have students clean up any soil and water messes and wash up surfaces as necessary.
2. Have students dispose of trash and soil water in regular trash and sink unless the testing materials have specific disposal instructions.
3. Advise students to consult SDS sheets for proper disposal if any chemicals were added to the water samples. Do not pour any chemicals down the drain.
4. Advise students they should *not* pour any water that still has soil/sediment in it down drains, or the sinks will clog.
5. Demonstrate the proper way to remove gloves by turning them inside out.
6. Goggles should be wiped clean/disinfected before being put away.

Investigating Soil And Soil Health

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

If students have regular access to technology, have them use Google Apps (e.g., docs, slides) to collaboratively fill out the 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 12**. Provide any class-specific instructions for conducting the research regarding soil and soil health to students or groups in this slide.

Show **slide 13**. Have students work in groups to gather information about general soil science, soil health, and soil functions.

- Give students the Window Notes **handout.**
- Have each student record important details in a Window Notes graphic organizer.
- Ask 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 of the four Window Notes boxes. Have groups incorporate the soil chemistry information into *Soil Properties* or *Soil Health.* Encourage students to use diagrams or drawings of soil horizons and details on an anchor chart.

The purpose of this discussion is to summarize the class's research. Higher order questions should be saved for the Explain discussions when students are synthesizing information.

Have students summarize key points about soil and soil health to create an Anchor Chart for each Window Notes box:

1. Soil Properties
2. Soil Health
3. Soil Chemistry
4. *Nutrient Cycles* (hold for further instructions).

Show **slide 14**. Ask students to use these questions for discussion in whole class.

- 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 improve soil health?

Explain

Teacher's Note: Breakout Session

Now that students have a general understanding of soil health, transition them into developing concepts about soil nutrients specifically. Students should work together to complete the *How Does Your Garden Grow? Breakout*. The breakout should be completed collaboratively.

Show **slide 15**. Have students link to How Does Your Garden Grow? Breakout. Add the information from this page to the *Nutrient Cycles* Window Note box and 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 **slide 16**. Explain Three Sticky Notes strategy to students. Pass out sticky note pads to student groups.

Show **slide 17**. Ask students to use the Three-Sticky Notes strategy in their small groups or individually to complete the final box of the Window Box strategy: *Nutrient Cycles.*

Show **slide 17**. At this point have students only complete the Word = ___, and Phrase = ____ notes.

Repeat the process you used for the previous anchor charts to develop one for *Nutrient Cycles*. Ask students to share out their words and phrases as part of the summary conversation. If necessary, add any new information students discover 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, this could include providing a brief lecture, having students take notes over specific concepts, or developing content-specific vocabulary.

Show **slide 18**. Ask students to connect the conceptual pieces for themselves.

Ask students to write a single *Summary Sentence*. Advise them that their sentence should emphasize the connections among the information they've gathered during the Explore and Explain activities and discussions.

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 19**. Have students create either hand-drawn or digital (e.g., MindMeister, Cmaps) concept maps. Tell them they can also use physical cards, either pre-made or class-generated, that they glue/tape down and draw lines to connect ideas. Encourage students to use string to physically connect concepts found on the four anchor charts.

Metaphorical Thinking

Show **slide 20**. Have students create metaphors based on their personal experience to help explain the connections they are making.

Cognitive Comics

Show **slide 21**. Have students use either a predetermined structure (e.g., three panels) or their own format, to draw their conceptual understanding as a comic. Have students share their work in a Gallery Walk or brief class presentations.

Extend

Teacher's Note

Students will construct a model of matter and energy transfers in their local ecosystem or the ecosystem from which their soils were sampled.

Show **slide 22**. Use the following steps to explain the purposes of different types of organisms in an ecosystem.

1. Have students develop a list of functions performed by different types of organisms in an ecosystem based on prior knowledge and any information collected during the previous parts of the lesson (e.g., decomposers break down organic material to release carbon and nitrogen, producers take in carbon and give off oxygen during photosynthesis, etc.).
2. Have students include three tropic groups: (a) decomposers; (b) producers; and (c) consumers.

Show **slide 22**. Have students indicate which ecosystem earlier soil samples came from.

Show **slide 23.** Hand out copies of the **Ecosystem Model - 6th** handout. Ask students to construct model food webs of their school or neighborhood ecosystem on their handout.

Teacher's Note:

Students should already be familiar with this process from 5th grade (5-LS2-1). Slide 24 is intended to serve as a review of prior knowledge.

Show **slide 24.** Use the following guidelines to create the model food web:

- Have students use arrows between organisms to show the direction that matter and energy flow.
- Have students indicate what process causes matter and energy to flow.
  (e.g., consumers eating producers and bacteria fixing nitrogen in the soil are both causes of matter and energy flow).
- If soil samples were not taken from the school, then use the sample location's ecosystem instead.
- For another resource on soil food webs, click here.

Evaluate

Teacher's Note

As a concluding activity, have students add to their web models to include the environment in the flow of matter and energy within an ecosystem.

- Use **slide 26** as an example for constructing an ecosystem web.
  - Oxygen is the example element used.
  - Soil and atmosphere are only two examples of environmental elements you could ask students to include. (
    Water, rocks, sediment, humans, etc., would also be appropriate, depending on the nutrient students select.)
- Oxygen (matter) moves between
  1. living and non-living parts of an ecosystem,
     - From organisms to and from atmosphere and soil
  2. and between the non-living parts as well
     - From atmosphere to soil

Show **slide 25**. Once students have created food web models, have them add environmental elements to them to construct "ecosystem webs."

Show **slide 26**. Give your students the following guidelines to expand their food web models into ecosystem webs.

Have students select one key nutrient from their soil tests as a focus.

- Ask students to use a new color and add arrows showing the flow of their nutrient into and out of both the living and non-living parts of the system.
- Have them indicate what causes the nutrients to flow from one place to another. (For example, carbon is taken from the air into plants during photosynthesis and it enters the air and soil during decomposition.)

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Resources

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