Trees in the Wind

Growth and Development of Organisms

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Grade Level	6th – 8th Grade	**Time Frame**	3-4 class period(s)
Subject	Science	**Duration**	180 minutes

Essential Question

How does the environment influence plant growth and development?

Summary

In this lesson about the growth and development of organisms, students will gather evidence from research about specific plant phenomena, then use research and in-class investigations to explain the relationship between environmental conditions and plant growth. Activities throughout the lesson will emphasize the use of evidence to support scientific explanations and make predictions. This lesson addresses Next Generation Science Standards (NGSS) standard MS-LS1-4. (Funding provided by USDA Project No. 2012-02355 through the National Institute for Food and Agriculture's Agriculture and Food Research Initiative, Regional Approaches for Adaptation to and Mitigation of Climate Variability and Change.)

Snapshot

Engage

Students observe and generate questions about the cause(s) of unique plant growth phenomena in several environments.

Explore

Students choose a plant phenomenon to investigate, construct an initial explanation about how the environment causes the observed phenomenon, and then find evidence through research to support or refine their explanation.

Explain

Students share their phenomena with the class and construct explanations for how the local environment influenced the patterns they observed.

Extend

Students collect data from an indoor plant investigation to use as further evidence of the impact of environment on plant growth.

Evaluate

Students use their own data to support a revised explanation of the phenomena they investigated. Then they make predictions about the role of genetics in the phenomena they observed.

Standards

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

MS-LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

Oklahoma Academic Standards (8th Grade)

8.LS1.4 : Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

Attachments

- Explore Research Notes—Trees in the Wind - Spanish.docx
- Explore Research Notes—Trees in the Wind - Spanish.pdf
- Explore Research Notes—Trees in the Wind.docx
- Explore Research Notes—Trees in the Wind.pdf
- How I Know It—Trees in the Wind - Spanish.docx
- How I Know It—Trees in the Wind - Spanish.pdf
- How I Know It—Trees in the Wind.docx
- How I Know It—Trees in the Wind.pdf
- I Notice, I Wonder—Trees in the Wind - Spanish.docx
- I Notice, I Wonder—Trees in the Wind - Spanish.pdf
- I Notice, I Wonder—Trees in the Wind.docx
- I Notice, I Wonder—Trees in the Wind.pdf
- I Used to Think ... But Now I Know—Trees in the Wind - Spanish.docx
- I Used to Think ... But Now I Know—Trees in the Wind - Spanish.pdf
- I Used to Think ... But Now I Know—Trees in the Wind.docx
- I Used to Think ... But Now I Know—Trees in the Wind.pdf
- Lesson-Slides-Trees-in-the-Wind.pptx
- Phenomenon-Explanation-Trees-in-the-Wind - Spanish.docx
- Phenomenon-Explanation-Trees-in-the-Wind - Spanish.pdf
- Phenomenon-Explanation-Trees-in-the-Wind.docx
- Phenomenon-Explanation-Trees-in-the-Wind.pdf
- Plant-Growth-Observations-Trees-in-the-Wind - Spanish.docx
- Plant-Growth-Observations-Trees-in-the-Wind - Spanish.pdf
- Plant-Growth-Observations-Trees-in-the-Wind.docx
- Plant-Growth-Observations-Trees-in-the-Wind.pdf

Materials

- Lesson Slides (attached)
- How I Know It handout (attached, one per student)
- I Notice, I Wonder handout (attached, one half-sheet per student)
- I Used to Think, But Now I Know handout (attached, one per student)
- Phenomenon Explanation handout (attached, one per student)
- Plant Growth Observations handout (attached, one half-sheet per student)
- Explore Research Notes handout (attached, one per student)
- Internet-connected devices
- Plant phenomena media
- Fast-growing plants
- Materials for growing plants in various conditions

Engage

Teacher's Note: Emphasis & Sequence

This lesson is intended to formally introduce students to the idea that both genes and the environment impact the growth and development of organisms. The emphasis is on the *environmental* effects specifically. At the end of the lesson, students begin to consider how genes might also impact the phenomena they investigate. Standard MS-LS1-8 would integrate well either immediately before or after this lesson, as it asks students to consider environmental stimulus-response relationships in organisms.

Use that attached **Lesson Slides** to guide the lesson, beginning with **slide 4**. Distribute a copy of the **I Notice, I Wonder** handout to each student. (This document contains two copies of the handout per printed page. You may wish to prepare the handouts ahead of time or have students cut them as they are distributed.) Introduce the I Notice, I Wonder instructional strategy to have students make observations and ask questions about pictures of trees growing sideways rather than straight up as expected. "I notice" statements should be qualitative **observations**, not inferences. Use the information on **slide 5** and work with students to distinguish between the two. "I wonder" questions may or may not be testable or scientific, which is acceptable at this point. Use this opportunity to help students practice asking scientific questions.

Additional Examples

Several specific examples of interesting plant phenomena are provided, but different images, animations, or other unusual plant phenomena could be substituted here if you have some that you want to add.

Trees growing sideways in Redondo Beach, CA. Photo credit: Chelsea Archie

Image Source: *Ben. (2011, February 20). Slope Point. Retrieved from https://www.flickr.com/photos/55198242@N03/5460426633*

Go to **slide 6**. A whole-class list of observations and questions should be developed and shared publicly in the space provided on slide six, on a poster, a whiteboard, or another format that you prefer. There are many ways to start this dialogue, including:

- Students write each of their "notices" and "wonders" on individual sticky notes. Each student then shares at least one idea out loud and adds their sticky note to the class list.
- In small groups, students come to a consensus on one to three observations and questions they think are most important. Each group should share out while a scribe (you or a student) records the ideas.
- Facilitate a whole-class discussion for students to share and respond to one another's ideas while a scribe (you or a student) records them on the whiteboard or in the space provided in the lesson slides.

Technology Integration Options

You may want to consider integrating a technology component for this activity. Students could simply contribute to a shared Google Doc or Sheet, or you could try a free web-based app, such as Padlet or Flipgrid. Padlet allows multiple participants to contribute creatively to a shared board. You can create one with spaces for both "notices" and "wonders" for your students to share and comment on. Flipgrid allows students to record a video describing their responses ("notices" and "wonders" in this case) that other students can comment on or respond to.

Explore

Go to **slide 7**. Following the group brainstorming activity, students will research answers to the questions they developed and attempt to explain a phenomenon. To facilitate this, students should be grouped as small as possible with pairs being ideal (if technology is available). Pairs should select a plant phenomena from a short list. For example, plants that turn red in sunlight, *Impatiens capensis* (exploding "touch-me-not"), or *Mimosa pudica* sensitive plants.

Go to **slide 8**. Using these phenomena as their starting place, students should investigate the life history of their plant of choice (e.g., how they grow and reproduce, where they are found, etc.). Before beginning research, give students the Phenomenon Explanation handout (half-sheet), and have them write down their phenomenon of choice and an initial explanation for how the environment contributes to it. Next, pass out the Explore Research Notes handout, which contains questions and note-taking prompts to guide students in their research of the chosen phenomena. From here, students can expand their research to gather information that will help them construct a more accurate explanation later.

Exploration Goals

The goal of the Explore research is for students to gather enough information to develop an accurate phenomena explanation independently, even if it is incomplete or not entirely correct. When the entire class comes together for the Explain, emergent patterns in their answers and direct guidance from you will help students develop a more complete understanding of the Disciplinary Core Idea concepts of interest here.

Teacher's Note: Sufficient Explanations

Detailed mechanistic explanations aren't necessary. For example, in the case of exploding touch-me-nots, it would be enough for students to explain that as the seed pods develop, dry pressure builds up until they explode, rather than understanding the details of turgor pressure or cellular-level changes.

Explain

After students conduct their research, the class should engage in some independent/small-group and whole-group processing activities. Go to **slide 9.** An example "How I Know It" graphic organizer is shown to help students organize their ideas. The following numbered boxes detail these activities, beginning with the "How I Know It" strategy.

Keep Track Of Ideas

Give students the **How I Know It** handout. Throughout the Explain, invite students to use a How I Know It strategy to develop the graphic organizer. Ask them to record everything they know about how the environment affects plant growth based on their prior knowledge and the research they conducted during their Explore on the inside of the circle. Outside the circle (inside the square), they should provide evidence that supports the ideas they listed. These pieces of evidence could be personal learning experiences, quotes or brief summary statements with their sources, or other observations.

Share Research

Go to **slide 10**. Next, have the student groups share out their research findings. Since multiple groups will likely have the same phenomena, after the first group reports, ask the additional groups to provide any other information they found in their research. As an alternative to a group-by-group, whole-class discussion, groups who studied the same phenomenon could team up to develop a visual (poster, Google Slides presentation, etc.) representation of their collective research. The class could then share out through group presentations or a Carousel of research posters.

Developing Individual Understanding

Go to **slide 11**. As students learn about their classmates' research, they should add ideas inside the circle of their "How I Know It" graphic organizer and cite their classmates' presentations in the square outside the circle. If this is a whole-class discussion, take a few minutes after each group to allow students an opportunity to update their graphic organizers.

Go to **slide 12**. After the share-out, provide additional content details students might need that they did not discover on their own. These details will depend on the phenomena students are researching but should highlight the environmental factors involved. This is also the time to address students' misconceptions, either through direct instruction or guided questioning of the class. Revisit the class "wonders" from the Engage, and have the students answer any questions the class has uncovered in their research.

Reading For Additional Information

Go to **slide 13**. After the share-out, provide students with an opportunity to explore some additional reading resources (see a list of options provided in the two boxes below this note). Ask students to think about what environmental factors are affecting plant growth and how those factors are affecting the growth and development of plants as they read. Why-Lighting is a useful literacy strategy to facilitate this. Students should add additional ideas to their "How I Know It" graphic organizers as they read.

Teacher's Note: Reading Resources

Following are suggested resources from the site Newsela. To access these specific readings, you will need to set up an account with Newsela.

The suggested readings from Newsela (see bullet list below) emphasize general environmental impacts (e.g., climate, light, water) which students can use as additional data to support their explanations. Additionally, the reading level of each article can be adjusted to accommodate differences in students' English language and reading skills.

- Blue Leaves
- Butterflies and Climate Change
- Food in Space (Spanish version available)

Environment/genetic Interactions

If you are introducing the idea that environment and genetics interact to impact the growth of organisms, this reading details a phenomenon which students could explain with their conceptual understanding of that aspect of the Disciplinary Core Ideas for MS-LS1-5.

Class Consensus

Go to **slide 14**. Following the reading, have the class come together and develop a list of all the environmental factors affecting plant growth that they discovered. Record the list on a poster, a whiteboard, **slide 15**, etc., and leave it available to students for the Extend.

Extend

Go to **slide 16**. Provide students with an opportunity to develop investigations that explore the effects of environmental factors on actual plants. Student investigations should involve either growing their own plants or working with plants that are already established (e.g., from a nursery or garden center). Investigating with real plants for themselves provides all students with a shared concrete experience to which they can apply their understanding and collect further data. Depending on the class composition, resources available, and collection of environmental factors the students developed, the structure of these investigations will vary. Allow students to self-select their environmental factors for investigation and provide the scaffolding and boundaries appropriate for your classroom.

Some potential scaffolds and the considerations they address include:

1. limiting the number of environmental factors available for investigation—*resource limitations*
2. having each class period choose a different environmental factor and share plants for observations across all classes—*class size, resource limitations*
3. having students work in pairs or in teams with assigned roles—*class size, level of on-task behavior, resource availability*
4. developing a class consensus for investigation setup—*level of on-task behavior, prior investigation experience*
5. sharing all plants for observations across all classes—*class size*

Science And Engineering Practices

These investigations are meant to provide additional observational data for students to use as evidence to support their explanations. While this is a good opportunity to work on the practice of developing scientific investigations, it isn't necessary to emphasize experimental design at this time. Growing at least one set of unmanipulated control plants is recommended for comparison.

What Should I Plant?

Wisconsin Fast Plants are classroom-friendly plants excellent for both environmental and genetic investigations. These can be grown from seed by students or plants can be started a few days in advance by you if necessary. Plants should germinate within one to two days and develop noticeable leaves by the third day, so **the length of this investigation will depend** on how large you want the plants to grow and how long it takes for them to exhibit responses to the students' variables.

Go to **slide 17**. Students should record their plant growth observations on the **Plant Growth Observations** handout**.** After the investigations have concluded, students should revisit their ongoing "How I Know It" graphic organizers. This time, students will add final ideas from their own plant growing experiences. Go to **slide 18**. Before moving onto the Evaluate, give students time to reflect upon the content of their graphic organizers and ask any clarifying questions they still have. Student reflection should be on determining the most important ideas captured during the lesson that explain how the environment affects plant growth. These ideas will serve as the basis of their final explanations. This reflective time could be structured in many ways, including the following possibilities:

Annotation

Students might highlight, circle, or otherwise mark the ideas which they feel are the most important effects of the environment on plant growth. They might further refine their lists by deciding which sources of evidence are most reliable (e.g., readings, peer presentations). If students have not evaluated the quality of scientific information, this would be a good opportunity to work on that science practice.

Summary Graphic Organizer

Go to **slide 19**. The "How I Know It" graphic organizers may have become quite cluttered with information by this point in the lesson. Rather than annotating, students could instead create new graphic organizers that only contain the most important effects of the environment on plant growth from the most reliable sources. As with the annotation option, this is a good opportunity to work on the science practice of evaluating information.

Go to **slide 20**. Depending on how much time is devoted to this activity or the need for an explicit summary activity, a strategy such as "I Used to Think ... But Now I Know" could be used at this point in the lesson. Adding it here would allow students to reflect explicitly on what they see as the most important ways their ideas have changed since the Engage. A handout for this activity can be found in the attachments.

Evaluate

Go to **slide 21**. Revisit class questions from the Engage "wonder" statements, and try to answer any that are still left.

Go to **slide 22**. Have students revisit their initial phenomenon explanations. On their **Phenomenon Explanation** handouts**,** they should revise their original explanations or write new explanations based on their understanding of how the environment affects plant growth. The revised or new explanations should include the evidence students selected from their "How I Know It" graphic organizers in addition to the scientific details.

Explanation Vs. Argument

While we often treat arguments and explanations as interchangeable, they are two distinct scientific practices. In an explanation, students use evidence as a way to provide additional support to the scientific concept they are detailing. In this lesson, students' evidence from their graphic organizer acts as additional examples of the kind of environmental effects they are describing as part of their phenomenon explanation. In an argument, students are attempting to prove a point or convince another person; in the case of an argument, evidence is used to support a claim, and the two are connected by logical justification-based scientific concepts.

Go to **slide 23**. If the class will be continuing into genetic impacts on plant growth and development at some point following this lesson, they should also take a moment to predict how genes might play a role in explaining these phenomena. If they have sufficient background knowledge to do so, this might be extended further to predict how genes and the environment might interact to produce the phenomena.

Resources

- Ben. (2011, February 20). Slope point. https://www.flickr.com/photos/55198242@N03/5460426633
- K20 Center. (n.d.). Gallery Walk/Carousel. Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f505a54d
- K20 Center. (n.d.). How I Know It. Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f5067d68
- K20 Center. (n.d.). I Notice, I Wonder. Strategies. https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f507d1a7
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- Milwaukee Journal Sentinel. (2014, Oct. 26). Pumpkins from another planet? No, Wisconsin. Newsela. https://newsela.com/read/giant-pumpkins/id/5651/
- Smithsonian. (2018, Apr. 4). Growing food that's out of this world, literally. Newsela. https://newsela.com/read/perfecting-space-cuisine/id/41974/
- Washington Post. (2020, Jan. 9). Climate change playing havoc with monarch butterfly migration. Newsela. https://newsela.com/read/climate-change-butterflies/id/2000004174/
- Washington Post. (2016, Oct. 25). Low amounts of sunlight cause leaves on a plant in the rain forest to turn blue. Newsela. https://newsela.com/read/blue-leaves/id/23327/
- Wisconsin Fast Plants. (2019). https://fastplants.org/