

# 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 |
| **Course** | Life Science | | |

## Essential Question

How does the environment influence plant growth and development?

## Summary

In this lesson on how plants grow and develop, students will research specific plant behaviors and perform classroom investigations to learn how the environment affects plant growth. Students will focus on using evidence to explain their ideas and make predictions. (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 regarding the impact of the 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

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

**IOD403:** Translate information into a table, graph, or diagram
**IOD505:** Analyze presented information when given new, simple information
**SIN401:** Understand a simple experimental design
**SIN404:** Identify similarities and differences between experiments
**EMI401:** Determine which simple hypothesis, prediction, or conclusion is, or is not, consistent with a data presentation, model, or piece of information in text
**EMI502:** Determine whether presented information, or new information, supports or contradicts a simple hypothesis or conclusion, and why
**EMI602:** Determine whether presented information, or new information, supports or weakens a model, and why

*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

15 minutes

# Engage

### Lesson Preparation

The **I Notice, I Wonder** handout (attached) and the **Phenomenon Explanation** handout (attached) contain two copies per page. Before beginning the lesson, print and cut the handouts to match the number of students in your class.

### Emphasis & Sequence

This lesson is intended to introduce students formally 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 the attached **Lesson Slides** to guide the lesson. Introduce the lesson title on **slide 2**, the essential question on **slide 3,** and the lesson objective on **slide 4**.

Move to **slide 5**. Distribute a copy of the I Notice, I Wonder handout to each student. Introduce the I Notice, I Wonder instructional strategy and have students make observations and ask questions about pictures of trees growing sideways. Remind students that "I notice" statements should be qualitative **observations**, not inferences. Use the information on **slide 6** and work with students to distinguish between the two. Remind them that "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*

Transition to **slide 7**. Facilitate a whole-class discussion and document a class list of observations and questions by asking students to share what they wrote.

### Discussion Facilitation

There are many ways to start this dialogue, including the following:

- Students write each of their "I notice" and "I wonder" 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 Docs, Google Sheets or you could try a free web-based app, such as Padlet.

30 minutes

# Explore

Move to **slide 8**. Divide students into pairs and direct them to select a plant phenomenon from a short list. Inform them that they will be researching the questions they developed using their chosen plant phenomenon. For example, they may choose to examine plants that turn red in sunlight, *Impatiens capensis* (exploding "touch-me-not"), or *Mimosa pudica* sensitive plants.

### Optional Resource

If you need assistance creating a list of plant phenomena, consider using this article to help. Alternatively, you could share the link with students to use in their research.

Go to **slide 9** and distribute the Phenomenon Explanation handout. Instruct students to use their chosen phenomenon as their starting place to investigate the life history of their plant (e.g., how it grows and reproduces, where it is found, etc.). Before beginning research, have students write down their phenomenon of choice and an initial explanation for how the environment contributes to it on their handout.

Next, distribute the **Explore Research Notes** handout (attached), which contains questions and note-taking prompts to guide students in their research of the chosen phenomenon. From here, instruct students to 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 phenomenon 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.

### 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.

25 minutes

# Explain

Go to **slide 10** and distribute the **How I Know It** handout (attached). Introduce students to the How I Know It instructional strategy. An example How I Know It graphic organizer is shown on slide 10. Throughout this portion of the lesson, invite students to use the strategy to develop their 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 the Explore on the inside of the circle. Outside the circle (inside the square), ask them to 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.

Transition to **slide 11**. Ask each student group to share their research findings. Since multiple groups will likely have the same phenomenon, 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, have the groups who studied the same phenomenon 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 Gallery Walk/Carousel of research posters.

As students learn about their classmates' research, remind them to 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.

Move 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, and they should highlight the environmental factors involved. Take time to address students' misconceptions as well, 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.

After the share-out, move to **slide 13** and introduce students to the Why-Lighting instructional strategy. Provide students with an opportunity to explore some additional reading resources (see a list of options provided in the box below). 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. Direct them to highlight any important information they find and add additional ideas to their graphic organizers as they read.

### Reading Resources

The 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 bulleted 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.

- Low Amounts of Sunlight Cause Leaves on a Plant in the Rain Forest to Turn Blue
- Climate Change Disrupting Monarch Butterfly Migration
- Food from Outer Space; "We're Seeing the Space Salad" (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.

Following the reading, transition to **slide 14**. Have the class come together and develop a list of all the environmental factors affecting plant growth that they have discovered. Record the list on a poster or whiteboard and leave it available to students for the next portion of the lesson.

30 minutes

# Extend

Go to **slide 15**. Provide students with an opportunity to develop investigations that explore the effects of environmental factors on actual plants. Instruct students that their investigations should involve either growing their own plants or working with plants that are already established (e.g., from a nursery or garden center). Allow students to self-select their environmental factors for investigation and provide the scaffolding and boundaries appropriate for your classroom.

### Variation and Scaffolding

Investigating 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.

Some potential scaffolds and the considerations they address include the following:

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—*

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. Students can grow these plants from seed, or you can start the plants a few days in advance, 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.

Distribute the **Plant Growth Observations** handout (attached). Direct students to record their plant growth observations on the handout**.** After the investigations have concluded, instruct students to revisit their ongoing How I Know It graphic organizers. This time, have them add final ideas from their own plant growing experiences.

Move to **slide 16**. Give students time to reflect upon the content of their graphic organizers. Ask students to determine the most important ideas they captured during the lesson that explain how the environment affects plant growth. Instruct students to highlight, circle, or otherwise mark the ideas which they feel are the most important effects of the environment on plant growth. Then, ask them to 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. When students have finished their annotation, allow them to ask any clarifying questions they still have.

### Optional Alternative Reflection Activities

**Summary Graphic Organizer**

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. Use hidden **slide 17** to facilitate this activity.

**I used to think...but now I know**

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 will 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 and hidden **slide 18** can be shown to assist with the activity.

15 minutes

# Evaluate

Revisit class questions from the Engage "Wonder" statements and try to answer any questions that remain.

Go to **slide 19**. Have students revisit their initial phenomenon explanations. On their Phenomenon Explanation handouts**,** have them revise their original explanations or write new explanations based on their understanding of how the environment affects plant growth. Remind students that 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 attempt 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.

### Optional Follow Up Activity

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 using the prompts on hidden **slide 20**. 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
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