

Lessons 16–19

Surviving Seasonal Changes

Prepare

In Lessons 16 through 19, students explore how seasonal changes in an environment affect the organisms that live there. In Lesson 16, students use maps to create a visual representation of monarch butterfly sighting data to understand that migration is a response to seasonal changes in environments. These observations lead students to think about the cause and effect relationship between seasonal changes and the migration of monarch butterflies. In Lesson 17, students learn how other kinds of butterflies survive during winter. Then in Lesson 18, students explore how animals other than butterflies respond to seasonal changes in their environments. An examination of plants follows in Lesson 19. The observations students make throughout these lessons help them determine that when seasonal changes occur in an environment, some organisms are able to survive better than others in the changed environment. Students conclude that an organism's ability to survive in the changed environment affects the organism's response to the change.

Student Learning

Knowledge Statement

Seasonal changes affect the suitability of organisms to their environment, which may cause some organisms to survive less well than others.

Concept 3: Effects of Environmental Change

Focus Question

What happens to organisms when the environment changes?

Phenomenon Question

How do organisms survive seasonal changes?

Objectives

- Lesson 16: Make observations to determine that monarch butterflies migrate in response to seasonal changes in their environment.
- Lesson 17: Investigate how other butterflies survive seasonal changes.
- Lesson 18: Describe how seasonal changes affect the suitability of animals to their environment.
- Lesson 19: Investigate plants to determine that they are also affected by seasonal changes.

Texas Essential Knowledge and Skills Addressed

- 3.2A **Plan and implement descriptive investigations, including asking and answering questions, making inferences,** and selecting and using equipment or technology needed, to solve a specific problem in the natural world. (Addressed)
- 3.2B **Collect and record data by observing and measuring using the metric system** and recognize differences between observed and measured data. (Addressed)
- 3.2C **Construct** maps, graphic organizers, simple tables, **charts,** and bar graphs using tools and current technology to organize, examine, and evaluate measured data. (Addressed)
- 3.2D **Analyze and interpret patterns in data to construct reasonable explanations based on evidence from investigations.** (Addressed)
- 3.2F **Communicate valid conclusions supported by data in writing, by drawing pictures, and through verbal discussion.** (Addressed)
- 3.3A **Analyze, evaluate,** and critique scientific explanations by **using evidence, logical reasoning, and experimental and observational testing.** (Addressed)
- 3.4 **Collect, record, and analyze information using tools, including** cameras, computers, hand lenses, **metric rulers,** Celsius thermometers, wind vanes, rain gauges, pan balances, graduated cylinders, beakers, spring scales, hot plates, meter sticks, magnets, collecting nets, **notebooks,** and Sun, Earth, and Moon system models; timing devices; and materials to support observation of habitats of organisms such as terrariums and aquariums. (Addressed)
- 3.9A **Observe and describe the physical characteristics of environments and how they support populations and communities of plants and animals within an ecosystem.** (Addressed)
- 3.10B **Investigate and compare how animals and plants undergo a series of orderly changes in their diverse life cycles** such as tomato plants, frogs, and lady beetles. (Addressed)

English Language Proficiency Standards Addressed

- 2E Use visual, contextual, and linguistic support to enhance and confirm understanding of increasingly complex and elaborated spoken language.
- 3F Ask and give information ranging from using a very limited bank of high-frequency, high-need, concrete vocabulary, including key words and expressions needed for basic communication in academic and social contexts, to using abstract and content-based vocabulary during extended speaking assignments.

Materials

		Lesson 16	Lesson 17	Lesson 18	Lesson 19
Student	Analyze Sighting Maps: flipbook maps (1 set per student), colored pencils or markers	●			
	Science Logbook (Lesson 16 Activity Guide)	●			
	Butterfly Life Cycle Cards (1 set per student pair)		●		
	Science Logbook (Lesson 17 Activity Guide)		●		
	Science Logbook (Lesson 7 Activity Guide B, Lesson 18 Activity Guide)			●	
	Category Headings and Animal Cards (1 set per student pair)			●	
	Plant Investigation (1 per group): one radish plant grown in direct sunlight, one radish plant grown in dark, ruler				●
	Science Logbook (Lesson 19 Activity Guide)				●

		Lesson 16	Lesson 17	Lesson 18	Lesson 19
Teacher	Monarch Butterfly Range Map (Lesson 16 Resource A)	●			
	North America Climate Zone Map (Lesson 16 Resource B)	●			
	Using the Journey North Website (Lesson 16 Resource C)	●			
	Monarch Migration Map (Lesson 16 Resource E)	●			
	Prepared migration wall labels	●			
	<i>A Butterfly Is Patient</i> by Dianna Hutts Aston and Sylvia Long (2015)	●			
	Caterpillar and Butterfly in Snow Photographs (Lesson 17 Resource A)		●		
	Monarch Butterfly Life Cycle (Lesson 17 Resource C)		●		
	Butterfly Life Cycle Stations: coral hairstreak life cycle, Baltimore checkerspot life cycle, black swallowtail life cycle, mourning cloak life cycle		●		
	Forest Environment Photograph (Lesson 18 Resource A)			●	
	Anchor chart			●	●
	Anchor model			●	
	Radish Plant Preparation: 1 packet of radish seeds, 2 9-ounce cups (per group), 2 cups of soil (per group), water				●
	Birch Forest in Summer and Winter Photographs (Lesson 19 Resource B)				●

		Lesson 16	Lesson 17	Lesson 18	Lesson 19
Preparation	Prepare flipbook maps (see Lesson 16 Resource D).	●			
	Prepare migration wall labels (see Lesson 16 Resource F).	●			
	Cue butterfly video from Lesson 14 and “Masses of Monarchs arriving at Cerro Pelon!” (Rosenblatt 2017) video: http://phdsci.link/1219 and http://phdsci.link/1224 .	●			
	Prepare Butterfly Life Cycle Cards (see Lesson 17 Resource B).		●		
	Prepare Butterfly Life Cycle Stations (see Lesson 17 Resource D).		●		
	Cue “Egg to Butterfly: The Life of a Monarch” (Belchamber 2018) video: http://phdsci.link/1225 .		●		
	Prepare Category Headings and Animal Cards (Lesson 18 Resource B).			●	
	6–7 Days Before: Prepare radish plants for plant investigation (see Lesson 19 Resource A).				●

Lesson 19

Objective: Investigate plants to determine that they are also affected by seasonal changes.

Launch 5 minutes

Display the photographs of a birch forest in summer and winter side by side (Lesson 19 Resource B).  Ask students to think about the strategies animals use to survive seasonal changes as they consider how plants might survive these same changes.



► What in this environment is different in the winter compared with the summer?

- *It looks really cold in the winter because there is snow and ice.*
- *A lot of the plants are probably dead in winter.*
- *The plants on the ground are covered in snow during the winter.*
- *The trees don't look like they have any leaves on them during the winter.*

Agenda

Launch (5 minutes)

Learn (35 minutes)

- Investigate Seasonal Changes in Plants (10 minutes)
- Observe Plants (10 minutes)
- Analyze Plant Observations (10 minutes)
- Revise Anchor Chart (5 minutes)

Land (5 minutes)



Teacher Note

As an alternative to showing the birch forest photographs, consider having students watch the first 2 minutes of this BBC video that uses time-lapse photography to demonstrate the dramatic changes plants experience through the seasons: <http://phdsci.link/1231> (Attenborough 1995) (2E).

- ▶ **Based on your past experiences with plants, how do you think they respond to seasonal changes?**
 - *The grass around my house gets really dry and brown during the summer if it's really hot.*
 - *The leaves on trees turn red, yellow, and brown during the fall.*
 - *I don't usually see flowers in the winter.*
 - *Lots of flowers bloom in the spring when it starts to get warm again.*

- ▶ **Do you think the plants in these photographs might use strategies to survive seasonal changes similar to the strategies animals use? Why or why not?**
 - *I think they must use different strategies because plants can't move to leave an area.*
 - *The plants would have to stay in the area, but I don't think trees can hibernate like bears.*
 - *I know there are trees that are really big and old. So, I don't think trees die every year even when they lose their leaves.*

Invite students to think about how they can find out what strategies plants use to survive seasonal changes.

Learn 35 minutes

Investigate Seasonal Changes in Plants 10 minutes

Ask students to think again about the differences they notice between the photographs of the birch forest in summer and winter.

- ▶ **How would you describe the changes that happen as the seasons change from summer to fall and then to winter?**
 - *The temperature changes from summer to winter. It starts to get colder in the fall, and winter is the coldest season.*
 - *Sometimes there are changes in the amount of precipitation.*

- *It seems like summer has more sunshine than winter.*
- *The precipitation in summer is rain, but the precipitation in winter is sometimes snow.*

Ask students to Think–Pair–Share about how they could simulate some of the seasonal changes they described to test how plants respond. 🐛

Sample student responses:

- *We could try to see how different plants respond to cold temperatures. Maybe we could put plants in a freezer or refrigerator.*
- *We could cover a plant with snow and see what happens.*
- *Since there isn't as much sunlight in the winter, maybe we could see what happens to a plant if it is left in the dark.*

Highlight student responses that mention the amount of light a plant receives. 📖 Explain to students that they will observe plants grown in different light conditions to investigate one example of a seasonal change that can affect plants. 📖



Safety Note

This investigation poses potential hazards. To minimize the risk, review these safety measures and look for evidence that students are following them (3.1A):

- Students must not place soil or any part of the plants in their eyes or mouths.
- Students must wash their hands immediately after handling the plants.

Observe Plants 10 minutes

Divide students into small groups. Distribute one plant that was grown in direct sunlight (Plant 1) to each group. Explain to students that this plant was grown in light conditions similar to those a plant would typically experience in their location at this time of year.



Extension

If time and materials allow, consider having students plan and carry out their own fair tests to investigate how seasonal changes affect plants.



Teacher Note

If students do not initially propose amount of sunlight as a factor related to seasonal change, ask guiding questions to prompt students to think about what plants need to survive. Then tell students that the amount of sunlight a location receives changes from season to season and that most locations receive less sunlight during the winter than during the summer. At this level, students do not need to understand that seasons are the result of Earth's tilt and caused by the differential intensity of sunlight on different areas of Earth across the year.



Teacher Note

Light was chosen as the variable to test in this investigation because it is difficult to simulate other winter conditions (e.g., temperature variation) in the classroom.

Ask students to make observations about the plant and record them in their Science Logbooks (Lesson 19 Activity Guide). As students make observations, tell them to measure and record the height of Plant 1.   Remind students to measure the height to the nearest half centimeter.

When all students have made observations about Plant 1, distribute a plant that was grown in the dark (Plant 2) to each group. Tell students that this plant was grown for 4 days in the same conditions as Plant 1, but it has been growing in complete darkness for the past few days. Explain that both plants received the same amount of water and were kept at the same temperature.

Ask students to measure the height of Plant 2 and record observations about how the plant looks in their Science Logbooks (Lesson 19 Activity Guide).

Sample student response: 

Plant 1 (light)	Plant 2 (dark)
<ul style="list-style-type: none"> ▪ $3\frac{1}{2}$ cm tall ▪ Bright green ▪ Big leaves ▪ Plant standing up 	<ul style="list-style-type: none"> ▪ 4 cm tall ▪ Yellow color ▪ Small leaves ▪ Plant drooping over

Analyze Plant Observations 10 minutes

After students complete their observations, ask them to review what they noticed and to draw conclusions about the plants by completing a comparison chart in their Science Logbooks (Lesson 19 Activity Guide). Discuss the results of the investigation as a class. Remind students that both plants grew for the same length of time, received the same amount of water, and were kept at the same temperature, but the amount of light each plant received was different.

- ▶ In what ways are Plant 1 and Plant 2 similar?
 - Both plants grew.
 - Both plants have leaves.



Differentiation

If students need additional support with measuring during this activity, demonstrate how to measure the height of the plant by placing the ruler at the soil line and recording the distance to the tallest part of the plant.



Content Area Connection: Mathematics

Students should be familiar with reading length measurements on a ruler and drawing number lines to solve problems. However, students may need extra support in measuring and recording heights to the nearest half centimeter. Consider creating or printing rulers marked with only whole and half centimeters to support this new skill. Some students may also benefit from a reminder that rotating the ruler is similar to using a vertical number line to represent numbers in math.



Teacher Note

Height differences between the plants may be minimal, or the plants grown in the dark may be taller than the plants grown in direct sunlight as the plants used their energy to increase stem length and search for light rather than develop leaves. As needed, emphasize to students that both plants were able to continue growing, and help students focus on other differences between the plants.

► **In what ways are Plant 1 and Plant 2 different?**

- *Plant 2 is half a centimeter taller than Plant 1.*
- *The leaves of the plants are different colors. Plant 1 is green, and Plant 2 is yellow.*
- *Plant 2 is droopy, and Plant 1 is standing tall.*

► **What do your observations help you understand about how this kind of plant might survive seasonal changes?**

- *The plant still grew without light, but it didn't grow as well.*
- *The plant without light looks sick. I think it might die soon.*
- *The plant that got more light looks healthier, but the plant that didn't get light isn't dead.*



Check for Understanding

Students should realize that there are differences in the plants' appearance and these differences relate to the amount of light each plant received.

Evidence

Look for evidence that all students

- clearly articulate the differences between the plants by using both quantitative and qualitative observations and
- express reasonable conclusions about how these plants may survive seasonal changes based on the differences between the plants.

Next Steps

If students have difficulty articulating their observations or making inferences based on their observations, then focus on both the quantitative and qualitative observations students made and help students understand the cause and effect relationship between the amount of light the plants received and their appearance.

After students have analyzed their observations, ask them to consider the cyclical nature of seasons.

► **What do you think would happen if Plant 2 stayed in the dark forever?**

- *It already looks sick, so I think it would die.*
- *I think it would die because plants need light to survive.*

► What do you think would happen if Plant 2 was placed in the light again? 🌱

- *I think it would start to grow again.*
- *I think the plant would become healthy again.*

Summarize for students that Plant 2 would likely die if it was left in the dark forever, but it would probably survive if it was placed back in the light. As needed, help students relate this information to the idea that seasons are cyclical and seasonal changes do not last forever. 📖

Revise Anchor Chart 5 minutes

Invite students to Think–Pair–Share and summarize what they have learned about how some plants survive seasonal changes. Encourage students to justify their thinking with examples from the investigation.

Sample student responses:

- *Plants might just wait until spring to start growing again. Plant 2 wasn't surviving well because it looked yellow and sick, but it was still growing.*
- *Plants have strategies for surviving winter just like animals do.*
- *Plants can survive in the dark like when it is winter.*

Update the anchor chart based on students' responses.



Extension

As an extension, move one of the plants labeled as Plant 2 back into the light for the next 1 to 2 days and invite students to watch what happens to the plant. The plant should start to change from yellow back to green and stand back up. Discuss with students what this information helps them understand about plants' ability to survive changing conditions in an environment.



Teacher Note

This investigation uses radish plants because of their ease of growth, but radish plants are annual plants that complete their life cycle within one year and then die. Students should be able to relate the results of this investigation to perennial plants with longer life cycles that need to survive multiple cycles of seasonal changes. Students do not need to understand the difference between annual and perennial plants at this level.

Sample anchor chart:

Survival
<p>Fossil Evidence</p> <ul style="list-style-type: none">• Fossils provide evidence about the kinds of organisms that once lived and what their environments were like.• Some environments looked very different in the past from the way they look now.• The kinds of organisms that live in an area can change over time. Sometimes organisms live in new areas, and sometimes they no longer live anywhere on Earth.
<p>Suitability to Environment</p> <ul style="list-style-type: none">• A habitat contains everything a particular kind of organism needs to survive. Environments include multiple interconnected habitats.• For any particular environment, some kinds of organisms can survive well, some can survive less well, and some cannot survive at all.• Some animals live in groups that help members survive. Living in groups can help animals get food, defend themselves, and cope with change.
<p>Effects of Environmental Change</p> <ul style="list-style-type: none">• When the conditions of an environment change, some of the plants and animals that live there stay and survive, some move away, and some die.

Land

5 minutes

Ask students to respond to the question in their Science Logbooks (Lesson 19 Activity Guide) with a Quick Write.

- ▶ How does moving a plant from light to dark to light again model seasonal changes in a plant's environment?
 - *The change from light to dark to light is like the change from summer to winter and back to summer.*
 - *Winter is like the dark, and spring and summer have more light. Then it gets darker again when the seasons change back to fall and winter.*

Emphasize for students that environmental changes associated with the seasons are not permanent because the seasons continue to cycle through fall, winter, spring, and summer each year. Different kinds of plants and animals use different strategies to help them survive these short-term environmental changes.

Tell students that not all environmental changes are short-term or reversible. In the next lesson, students will analyze long-term environmental changes as they investigate the Phenomenon Question **How do long-term changes in an environment affect the organisms that live there?**

Optional Homework

Encourage students to work with a family member to conduct their own plant investigation to test one of the other seasonal changes that students described in this lesson. For example, students can take a plant from home and expose it to cold temperatures for a few days by placing it in the refrigerator. Students should report their results to the class when the investigation is complete.