

# Lessons 16–19

# Surviving Seasonal Changes

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## 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
<b>Student</b>	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
<b>Teacher</b>	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
<b>Preparation</b>	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: <a href="http://phdsci.link/1219">http://phdsci.link/1219</a> and <a href="http://phdsci.link/1224">http://phdsci.link/1224</a> .	●			
	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: <a href="http://phdsci.link/1225">http://phdsci.link/1225</a> .		●		
	Prepare Category Headings and Animal Cards (Lesson 18 Resource B).			●	
	<b>6–7 Days Before:</b> Prepare radish plants for plant investigation (see Lesson 19 Resource A).				●

# Lesson 16

**Objective:** Make observations to determine that monarch butterflies migrate in response to seasonal changes in their environment.

## Launch 5 minutes

Replay the video of clustering butterflies from Lesson 14 (<http://phdsci.link/1219>). Reveal to students that the butterflies in the video are a kind of butterfly known as monarch butterflies.

- ▶ **What ideas did we have before about why these butterflies behave this way?**
  - *Scientists think butterflies might group together to protect themselves.*
  - *It might help protect them from predators.*

Play the “Masses of Monarchs arriving at Cerro Pelon!” (Rosenblatt 2017) video (<http://phdsci.link/1224>).

- ▶ **How does this video add to or change what you think about monarch butterflies’ behavior?**
  - *It looks like they are flying somewhere together.*
  - *There are so many of them. I wonder where they are going.*
  - *This makes me think something scared the butterflies and they are flying away.*

Ask students to imagine that they are a scientist studying monarch butterflies.

- ▶ **What questions would you research to better understand the behavior of monarch butterflies?**
  - *Where do monarch butterflies live?*
  - *Do monarch butterflies group together like this all the time?*

## Agenda

Launch (5 minutes)

Learn (35 minutes)

- Analyze Sighting Maps (18 minutes)
- Notice and Wonder about Migration Map (6 minutes)
- Act Out Migration (6 minutes)
- Define Migration (5 minutes)

Land (5 minutes)

- *How long do they stay in a group?*
- *Why are they in a group?*

Draw on student responses that show interest in where monarch butterflies live or where they may travel. Invite students to observe where monarch butterflies live around the world by displaying the monarch butterfly range map (Lesson 16 Resource A).



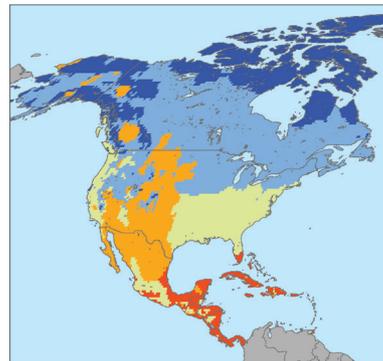
► **What does this map add to our understanding of monarch butterflies?**

- *Monarchs live mostly in North and South America.*
- *Some monarchs can be found in and around Australia.*

Next, display the North America climate zone map (Lesson 16 Resource B).

► **What does the climate zone map tell us about where monarch butterflies are able to live?**

- *It looks like they can live in all the climate zones in the United States.*
- *Different climate zones have different average monthly temperatures, so I think monarch butterflies must be able to live in both hot and cold locations.*



Climate Zones:  
 ■ Tropical ■ Dry/Desert ■ Temperate ■ Cold ■ Polar/Tundra

- *It looks like monarch butterflies can live even in really dry places like those in the dry/desert climate zone.*
- ▶ **What information do we still need to understand the monarch behavior we saw in the videos?**
  - *We don't know if monarchs live in those places all the time.*
  - *We don't know how many monarch butterflies live in each area or whether they always live in groups.*
  - *The maps don't tell us if monarch butterflies move around.*

Inform students that many people are interested in the same information that the class is trying to find out. Tell students that they will have a chance to explore more about where monarch butterflies are found by using data collected by people throughout North America.

## Learn 35 minutes

### Analyze Sighting Maps 18 minutes

Show students the Journey North website (<http://phdsci.link/1226>) (Annenberg Learner 1997–2019). Explain that people throughout North America go to the website to report sightings of monarch butterflies and that scientists and interested citizens can use the compiled data to learn more about these insects. 🦋

Use the Journey North website to show students adult monarch sighting data for spring 2017: <http://phdsci.link/1227>. Orient students to the data in the table by explaining that the columns show the date of each sighting, the location of the sighting, and the number of adult monarch butterflies sighted.

Remind students that it is sometimes helpful to use a visual to represent a large amount of data. Use the Journey North website to show students the adult monarch sighting map for spring 2017: <http://phdsci.link/1228>. Explain that the map represents data for January through July 2017. 🗺️ Select the Play button in the control panel and allow the map to play through once. Then demonstrate how to manipulate the map manually by moving the slider in the control panel to different months.



### Spotlight on Knowledge and Skills

If time allows, highlight this as an example of the nature of science. In this example, citizens and scientists across North America work together to gather data the scientific community can use.



### Teacher Note

While the map is identified as a spring map, it also includes data for months in winter and summer. As needed, remind students of the months in each season.

As data for each month displays, point out additional sightings or sightings that no longer appear on the map. Review the key with students, and clarify that each color corresponds to a different month.

Tell students they will use the monarch sighting map to observe where monarchs are in the United States during each month of the year by creating flipbooks. Each page of their flipbooks will show one month of data. The flipbooks will allow students to more easily examine data one month at a time.

Distribute 12 precut flipbook maps (Lesson 16 Resource D) to each student.  Ask students to sequence the flipbook maps in order of the months, starting with January. Students should then divide their flipbook maps into two stacks so that the January through July flipbook maps are separate from the August through December flipbook maps. Students will analyze the data on the January through July flipbook maps and the August through December flipbook maps separately before putting all the flipbook maps together to analyze data for the entire year.

Explain to students that they will watch the monarch sighting map progress again from January through July. Tell students that as each month is displayed, they should look at the flipbook map that shows that month's data and compare the data with the displayed Journey North map. As students compare the data, they should use a colored pencil or marker to color over or circle the dots that represent monarch sightings on their flipbook map.  Encourage students to use a different color for each month. Students can use colors like the ones on the displayed Journey North map if those colors are available.

When students are ready, manually drag the slider along the scroll bar one month at a time. Pause for each month to allow students to compare the data on the Journey North map with the data on their flipbook map for that month and color over or circle the data points. Help students understand that they should ignore data points for previous months on the Journey North map as it populates over time. For example, when looking at data for March, students should ignore data points for January and February.

Pause after students finish their July flipbook maps. Ask students to restack their January through July flipbook maps one on top of the other in order of the months. Then tell students to hold one side of their stack of January through July flipbook maps tightly with their fingers to create a flipbook.  Show students how to use their flipbooks by flipping through the pages on the opposite side with their thumb. Explain that this flipbook is a way for students to visualize what happens in monarch movement from January through July. After students use their flipbooks, ask them to record what they



### Teacher Note

If time allows, consider allowing students to create their own flipbook maps by printing the blank maps in Lesson 16 Resource D and asking students to draw dots or lines to represent where monarchs were sighted each month. If students make their own flipbook maps, consider using the Journey North website to access data from the previous year instead of using 2017 data. Instructions for using the website are in Lesson 16 Resource C.

If having students create their own flipbook maps, consider splitting up the work by allowing half of the class to work on maps for January through July while the other half works simultaneously on maps for August through December. Students can then pair up to compare maps, make observations, and create flipbooks for an entire year.



### Differentiation

Consider allowing students who struggle with fine motor skills to draw lines to indicate regions where monarchs are found each month instead of coloring over or circling individual data points.



### Teacher Note

Alternatively, students can create their flipbooks by binding their flipbook maps along one side with glue or staples.

notice in their Science Logbooks (Lesson 16 Activity Guide). Then ask for volunteers to share their ideas with the class. 

► **What patterns do you notice for January through July?**

- *More monarchs go to places like New York as the temperatures increase during the summer.*
- *Monarchs leave warmer places in the summer and go north.*
- *There are way more monarch sightings in the spring and summer than during the winter.*

Tell students they will now complete the same activity for August through December. Use the Journey North website to show students the adult monarch sighting map for fall 2017: <http://phdsci.link/1229>. Remind students of the key, and help them notice the color associated with each date range. Manually drag the slider along the scroll bar approximately one month at a time.  Pause for each month to allow students to compare data and color or circle the data points on that month's flipbook map.

After students complete their flipbook maps for August through December, have them use the flipbook maps to create a flipbook to visualize what happens in monarch movement during these months. Tell students to record what they notice in their Science Logbooks (Lesson 16 Activity Guide), and ask for volunteers to share their ideas with the class.

► **What patterns do you notice for August through December?**

- *The monarchs move south to warmer places like Florida in November and December.*
- *The monarchs leave cold places like New York as it gets closer to winter.*
- *There are not as many monarch sightings as it gets colder.*

Finally, allow students to put all 12 of their flipbook maps together to create a single flipbook for January through December. Ask students to observe the movement of the monarch butterflies for all 12 months to make additional observations. 

► **What do you think about the movement of monarch butterflies now?**

- *It looks like monarchs fly up and back down again in different months.*
- *I think monarch butterflies leave in the winter months and come back when it's spring or summer.*
- *I think monarch butterflies fly north in the summer and south in the winter.*



### Teacher Note

Encourage students to use cardinal directions as they describe the movement of monarch butterflies. If students need support, consider displaying a compass.



### Teacher Note

The sightings for the fall map are not shown by month but are instead in 13-day increments. The 2017 flipbook maps (Lesson 16 Resource D) show data for each individual month. To help students compare the data on their flipbook maps with the data on the Journey North map, display approximately one month at a time by choosing the date closest to the end of each month (e.g., show data through 8/29 when students observe their August flipbook maps, and show data after 11/21 when students observe their December flipbooks maps). Because some colors on the Journey North key are for a range of dates that span more than one month, help students notice new data points that populate when moving from one month to the next.

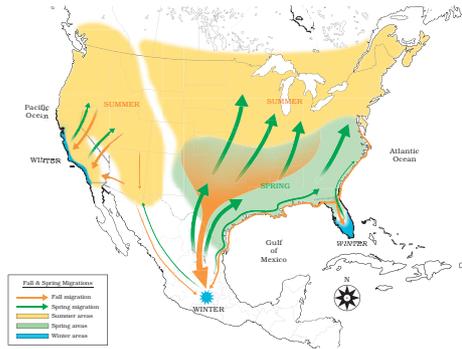


### Extension

Consider using additional Journey North maps to have students create a flipbook that includes data for multiple years. As students flip through maps representing multiple years, the seasonal cycles and migration patterns will become more visible. Instructions for using the Journey North website are in Lesson 16 Resource C.

## Notice and Wonder about Migration Map 6 minutes

Display the monarch migration map (Lesson 16 Resource E). Ask students to record what they notice and wonder about the map in their Science Logbooks (Lesson 16 Activity Guide).



Sample student responses:

I Notice	I Wonder
<ul style="list-style-type: none"> <li>▪ There is a fall and a spring migration.</li> <li>▪ The monarchs move south during the fall and north during the spring.</li> <li>▪ This map looks like our flipbooks except it has seasons.</li> </ul>	<ul style="list-style-type: none"> <li>▪ What do the colors mean?</li> <li>▪ Do monarchs move south to stay warm?</li> <li>▪ Why do monarchs live in a larger area during the summer?</li> </ul>

Tell students that to help make sense of this complex map, they will record where monarch butterflies move season by season in their Science Logbooks (Lesson 16 Activity Guide). Students should work in pairs or small groups to analyze the map more closely by season. Circulate to support students who need help interpreting what each part of the map represents.

Sample student responses:

Spring	Summer
<ul style="list-style-type: none"> <li>▪ The monarchs start to move north.</li> <li>▪ The monarchs are in a larger area than during the winter.</li> </ul>	<ul style="list-style-type: none"> <li>▪ The monarchs are in a lot of places in the summer.</li> <li>▪ The monarchs are in northern areas where they aren't found at any other time of year.</li> </ul>
Fall	Winter
<ul style="list-style-type: none"> <li>▪ The monarchs move out of the middle of the United States and go south.</li> <li>▪ Some monarchs start moving toward the west coast of the United States.</li> </ul>	<ul style="list-style-type: none"> <li>▪ The monarchs go to California, Florida, and Mexico.</li> <li>▪ The monarchs are only in a few, really small areas.</li> </ul>

## Act Out Migration 6 minutes

After students have had time to consider what happens each season during monarch migration, post one of the migration wall labels (Lesson 16 Resource F)—North, East, South, West—on each wall of the room.  Invite students to pretend they are monarch butterflies in the summer, preparing to move to a new area. Ask students to move silently to the labeled wall where they believe they should start. After students move, call out a change in seasons, and allow students to move silently again. After each move, ask for a few student volunteers to share why they chose their location. Provide students the opportunity to change locations if they think they chose the wrong one. Move through all the seasons at least once, and repeat a few times if time allows.



### Teacher Note

When placing the wall labels, help students realize that these labels represent the cardinal directions. Ensure that all students understand that the orientation of the room mimics the migration map they just viewed.



### Check for Understanding

Students should realize that monarch butterflies move to different locations throughout the year and start to connect this movement to the idea of seasonal change.

#### Evidence

Look for evidence that all students

- correctly identify the location of monarch butterflies during each season and
- realize that monarch butterflies move to new locations as the seasons change.

#### Next Steps

If students need support connecting specific movements of monarch butterflies to each season, consider using the monarch migration map (Lesson 16 Resource E) to walk through the movements season by season as a class.

## Define Migration 5 minutes

After students have acted out the monarchs' migration movements, read page 23 ("A butterfly is magical") from *A Butterfly Is Patient* (Aston and Long 2015).

### ► What do you think the book means when it says that the butterflies are waiting for spring?

- *Maybe they need plants to grow, and that doesn't happen until spring.*
- *Maybe they can't be where it is cold, so they wait for it be warmer in the spring.*

Confirm that monarch butterflies stay in a few locations in the south to wait for spring. In the spring, they return to areas in the north and prepare to reproduce.

### ► How would you describe the monarch butterflies' movements through all four seasons?

- *The monarch butterflies go south to warmer places during the winter. They go north during the spring and summer. Then they start moving south again during the fall.*
- *The monarchs go from being in a lot of places during the summer to a smaller area in the fall. They move into an even smaller area in the winter before they spread out again in the spring.*

Highlight student responses that mention monarch butterflies moving to warmer places in the fall and winter. Tell students that the movement of animals from one region or environment to another, usually according to the seasons, is called **migration**. 



### English Language Development

The term *migration* is used repeatedly in this module. Introduce this term explicitly. Sharing the Spanish cognate *migración* may be useful.

## Land 5 minutes

Direct students to discuss with a partner how they think migration may help monarch butterflies survive before asking for volunteers to share with the class.

*Sample student responses:*

- *I think the monarchs' food disappears during the winter.*
- *I don't think butterflies are suited to living in cold weather.*
- *Maybe another animal tries to eat them during the fall and winter.*

Highlight student responses that mention seasonal changes in the environment. Ask students to think about seasonal changes more deeply as they discuss the following question with a partner before sharing their ideas with the class.

- ▶ **What about the seasons do you think causes monarch butterflies to migrate?** 
- *The temperature is different between summer and winter. Maybe the monarchs know when the seasons will change.*
- *We learned that there can be different amounts of precipitation in different seasons. Maybe monarch butterflies need a certain amount of water to survive in an environment.*



### Teacher Note

Note that students may think that the same individual butterflies migrate back and forth seasonally. Prevent this misconception by explaining that seasonal migration occurs over several generations of butterflies. However, this is not the case for all animals that migrate. For more information on monarch generations, view this diagram on the Journey North website: <http://phdsoci.link/1232> (Annenberg Learner 1997–2019) (2E).



### Differentiation

Some students may benefit from additional scaffolding to help them clarify the relationship between seasonal changes and monarch butterfly migration. Consider providing sentence frames such as the following (3F).

- I think \_\_\_\_\_ causes monarch butterflies to \_\_\_\_\_.
- I think changes in the seasons cause monarch butterflies to \_\_\_\_\_ because \_\_\_\_\_.
- Monarch butterflies migrate because \_\_\_\_\_ changes.

Confirm that monarch butterflies migrate due to seasonal changes in their environment. These seasonal changes affect the conditions of the environment, which can make the environment less suitable for the butterflies. Therefore, monarch butterflies migrate to a more suitable environment until the conditions change back.

► **What new questions do you have about butterfly migration?**

- *Do all butterflies migrate?*
- *Do butterflies return to the exact same place they started?*
- *How do butterflies know where to go?*
- *Did the butterfly that formed the fossil migrate?*

Tell students that they will learn about strategies other butterflies use to survive seasonal changes in their environment in the next lesson as they continue to investigate the Phenomenon Question

**How do organisms survive seasonal changes?**

## Optional Homework

Encourage students to sign up for Journey North or another sighting project with their family to participate in registering sightings of monarch butterflies or other animals.