

# Module Overview

## ESSENTIAL QUESTION

*How do butterflies survive over time in a changing environment?*

## Introduction

*Extinction is the rule. Survival is the exception.*

—Carl Sagan and Ann Druyan (1985) 1997

Throughout the module, students study butterfly survival, the anchor phenomenon, and build an answer to the Essential Question: **How do butterflies survive over time in a changing environment?** As they learn about each new concept, students revisit and refine a model to represent how butterflies survive in their environment over time. At the end of the module, students use their knowledge of fossil evidence, suitability, and changing environments to explain the anchor phenomenon and apply these concepts in new contexts. Through these experiences, students begin to develop an enduring understanding that organisms have characteristics that help them survive over time in changing environments.

Lessons 1 through 8 address the Concept 1 Focus Question: **What do fossils reveal about the past?** Students observe photographs of fossils to learn about the kinds of organisms that lived long ago and the nature of their environments. Lesson 1 introduces students to the text *A Butterfly Is Patient* (Aston and Long 2015), which provides additional background knowledge as students draw and describe butterflies and the environments in which butterflies live. Students then develop an initial class anchor model to show how butterflies survive in their environments. In Lesson 2, students observe a butterfly fossil and create a timeline to better understand how long butterflies have survived on Earth. Reflecting on the anchor phenomenon, students organize their questions

on a driving question board. Students revisit the driving question board and the anchor model throughout the module to build a coherent understanding of butterfly survival. Engaging in these practices allows students to take an active role in the educational process and gives teachers insight into students' background knowledge and current understanding of how butterflies survive over time. In Lesson 3, students continue to observe the butterfly fossil and compare it with a clay model fossil. Students also create their own clay model fossils to understand how fossils form and what they reveal about the organisms that formed them. In Lessons 4 and 5, students observe fossils found in their own region to describe the past environment. Students then compare the past environment with the present-day environment to reveal how their region has changed over time. In Lessons 6 through 8, students learn about the Florissant Fossil Beds National Monument, where the butterfly fossil they observed was found. Students study other fossils found near the butterfly fossil so they can describe the past environment of the Florissant area. They also examine organisms that live in the Florissant area today to understand that the kinds of organisms that live in an area can change over time.

Lessons 9 through 15 address the Concept 2 Focus Question: **How do organisms get what they need to survive?** Students make observations to notice that organisms have characteristics that help them survive and that these characteristics affect their suitability to different environments. In Lesson 9, students observe caterpillars in an artificial habitat to understand that a habitat contains everything a particular kind of organism needs to survive. Students connect this understanding to their previous learning in the module to realize that habitats are part of a larger environment and that habitats within an environment are interconnected. In Lesson 10, students observe radish plants and caterpillars to identify their characteristics and analyze how these characteristics help the organisms survive. They then apply this understanding to analyze the characteristics of several other organisms. In Lessons 11 and 12, students use the text *Amos & Boris* (Steig 2009) as they learn how an organism's characteristics determine its suitability

to a particular environment. With this understanding, students observe that for any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. In Lessons 13 through 15, students investigate and model animal group behaviors. They first model penguin behavior, noticing that penguins huddle in groups to stay warm. They continue to model and research animal groups to learn about other benefits of living in a group. This analysis leads students to understand that living in groups can help animals get food, defend themselves, and cope with change, all of which can help individual members of the group survive.

Lessons 16 through 21 address the Concept 3 Focus Question: **What happens to organisms when the environment changes?** In these lessons, students explore how changes in an environment affect the organisms that live there. In Lesson 16, students create flipbooks and act out migration to learn how monarch butterflies move from one region to another each year in response to seasonal changes. Lesson 17 introduces students to the butterfly life cycle, and they use their understanding of the life cycle to explore how other butterflies survive seasonal changes. In Lesson 18, students study how other animals respond to seasonal changes and consider how changes in an environment affect the suitability of animals to that environment. This study helps students understand that when an environment changes, some animals that live there stay and survive, some move away, and some die. In Lesson 19, students consider how seasonal changes affect plants by comparing a radish plant grown in direct sunlight with a radish plant grown in the dark. This leads students to realize that plants also have strategies to survive seasonal changes. In Lesson 20, students create a model to analyze how the construction of a parking lot could cause a long-term change in an environment. Students see that this change would affect the organisms that live in the environment and that some organisms would stay and survive, some would move in or out, and some would die. In Lesson 21, students evaluate proposed solutions to reduce the impact of building a parking lot on cardinals that live in the environment by comparing the merits of each solution.



In Lessons 22 through 25, students apply their understanding of survival, suitability, and changing environments in an engineering challenge, further building on their understanding of the Essential Question: **How do butterflies survive over time in a changing environment?** In Lesson 22, students learn about threats to monarch butterflies that are causing their numbers to decrease. In Lessons 23 through 25, students design a solution to help save monarch butterflies and write a proposal letter explaining the merits of their solution.

Students participate in a Socratic Seminar on how butterflies survive in a changing environment over time in Lesson 26, revisiting the module questions and synthesizing their understanding. In Lesson 27, students reflect on their study and apply their conceptual understandings in an End-of-Module Assessment. Finally, the class debriefs the End-of-Module Assessment in Lesson 28, so the teacher and students can revisit concepts that need further explanation and clarify misconceptions.

# Module Map

## Anchor Phenomenon: Butterfly Survival

*Essential Question: How do butterflies survive over time in a changing environment?*

Organisms have characteristics that help them survive over time in changing environments.

## Concept 1: Fossil Evidence

*Focus Question: What do fossils reveal about the past?*

Fossils provide evidence of the kinds of organisms that lived long ago and the nature of their environments.

Phenomenon	Student Learning	Texas Essential Knowledge and Skills for Science	English Language Proficiency Standards
Butterfly Survival <i>Phenomenon Question: How long have butterflies survived on Earth?</i>	Butterflies have survived on Earth for millions of years. <ul style="list-style-type: none"> <li>Lesson 1: Develop a class anchor model to show how butterflies survive in their environment.</li> <li>Lesson 2: Create a relative timeline to understand how long butterflies have survived on Earth.</li> </ul>	3.3A 3.3B 3.3C 3.9A	3J 4A 4C



Phenomenon	Student Learning	Texas Essential Knowledge and Skills for Science	English Language Proficiency Standards
Butterfly Fossils <i>Phenomenon Question: What can we learn by studying fossils?</i>	Fossils provide information about the organisms that formed them. <ul style="list-style-type: none"> <li>Lesson 3: Analyze and create clay fossil models to understand how fossils form.</li> </ul>	3.2B 3.3A 3.3B 3.3C 3.4	3E 5F
Regional Fossils <i>Phenomenon Question: What can fossils reveal about our region?</i>	Fossils can provide evidence of changes in an environment over time. <ul style="list-style-type: none"> <li>Lesson 4: Observe regional fossils to learn about the past environment of a region.</li> <li>Lesson 5: Compare the past environment with the present-day environment to learn that environments can change over time.</li> </ul>	3.3A 3.3B 3.3C 3.4 3.9A 3.9C	2E 5F
Fossil Evidence <i>Phenomenon Question: What do fossils found near the butterfly fossil reveal about the Florissant area?</i>	Fossils provide evidence of the nature of organisms and environments from long ago. <ul style="list-style-type: none"> <li>Lesson 6: Observe fossils to learn about the past environment of the Florissant area.</li> <li>Lesson 7: Observe organisms that live in the Florissant area today to understand that the environment has changed over time.</li> <li>Lesson 8: Compare the past environment of the Florissant area with the present-day environment to explain how the environment has changed over time.</li> </ul>	3.2D 3.2F 3.3A 3.2D 3.3B 3.3C 3.4 3.9A 3.9C 3.10A	3E 4A 4C



**Concept 2: Suitability to Environment**

*Focus Question: How do organisms get what they need to survive?*

For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. Some animals form groups that help members survive.

Phenomenon	Student Learning	Texas Essential Knowledge and Skills for Science	English Language Proficiency Standards
Suitability <i>Phenomenon Question: Why do plants and animals live where they do?</i>	Organisms are suited to survive in particular environments because of their characteristics. <ul style="list-style-type: none"> <li>▪ Lesson 9: Describe how a habitat is a system in which all components depend on one another.</li> <li>▪ Lesson 10: Identify an organism’s characteristics and explain how these characteristics help the organism survive.</li> <li>▪ Lesson 11: Describe and analyze an organism’s suitability to a particular environment.</li> <li>▪ Lesson 12: Evaluate an organism’s ability to survive in a particular environment based on the organism’s characteristics.</li> </ul>	3.2A 3.2B 3.2C 3.3A 3.3B 3.4 3.9A 3.9B 3.9C 3.10A 3.10B	3E 3G 5B
Animal Groups <i>Phenomenon Question: Why do some animals live in groups?</i>	Patterns in behavior reveal that living in groups helps animals survive. <ul style="list-style-type: none"> <li>▪ Lesson 13: Use evidence from models to explain that animals can benefit from living in a group.</li> <li>▪ Lesson 14: Obtain, evaluate, and communicate information about why different animals live in groups.</li> <li>▪ Lesson 15: Apply prior knowledge of systems to understand how animal groups cope with change.</li> </ul>	3.2A 3.2B 3.2C 3.2D 3.2F 3.3A 3.3B 3.4 3.9A 3.9C 3.10A	2F 3E 4D



**Concept 3: Effects of Environmental Change**

*Focus Question: What happens to organisms when the environment changes?*

When an environment changes, the kinds of organisms that live there may change. Some organisms may stay and survive, some may move in or out, and some may die.

Phenomenon	Student Learning	Texas Essential Knowledge and Skills for Science	English Language Proficiency Standards
Surviving Seasonal Changes <i>Phenomenon Question: How do organisms survive seasonal changes?</i>	Seasonal changes affect the suitability of organisms to their environment, which may cause some organisms to survive less well than others. <ul style="list-style-type: none"> <li>Lesson 16: Make observations to determine that monarch butterflies migrate in response to seasonal changes in their environment.</li> <li>Lesson 17: Investigate how other butterflies survive seasonal changes.</li> <li>Lesson 18: Describe how seasonal changes affect the suitability of animals to their environment.</li> <li>Lesson 19: Investigate plants to determine that they are also affected by seasonal changes.</li> </ul>	3.2A 3.2B 3.2C 3.2D 3.2F 3.3A 3.3B 3.4 3.9A 3.9C 3.10A 3.10B	2E 3F 4C
Long-Term Changes in an Environment <i>Phenomenon Question: How do long-term changes in an environment affect the organisms that live there?</i>	When an environment experiences a long-term change, some organisms will stay and survive, some will move away, some will die, and other organisms will move to the changed environment. <ul style="list-style-type: none"> <li>Lesson 20: Analyze the effects of a long-term change in an environment on the organisms that live there.</li> <li>Lesson 21: Evaluate potential solutions to help organisms survive after a long-term change in an environment.</li> </ul>	3.2C 3.3A 3.3B 3.4 3.9A 3.9C	1A 5F

**Application of Concepts**

Task	Student Learning	Texas Essential Knowledge and Skills for Science	English Language Proficiency Standards
<p>Engineering Challenge</p> <p><i>Phenomenon Question: How can we help monarchs survive in a changing environment?</i></p>	<p>Humans can change an environment to make it more suitable for an organism.</p> <ul style="list-style-type: none"> <li>▪ Lessons 22–25: Apply the engineering design process to help monarchs survive in a changing environment.</li> </ul>	<p>3.2A 3.2C 3.2D 3.2F 3.3A 3.3B 3.3C 3.4 3.9A 3.9B 3.9C 3.10A</p>	<p>1C 2I 4F</p>
<p>End-of-Module Socratic Seminar, Assessment, and Debrief</p> <p><i>Essential Question: How do butterflies survive over time in a changing environment?</i></p>	<p>Organisms have characteristics that help them survive over time in changing environments.</p> <ul style="list-style-type: none"> <li>▪ Lesson 26: Explain how organisms survive over time in changing environments. (Socratic Seminar)</li> <li>▪ Lesson 27: Explain how organisms survive over time in changing environments. (End-of-Module Assessment)</li> <li>▪ Lesson 28: Explain how organisms survive over time in changing environments. (End-of-Module Assessment Debrief)</li> </ul>	<p>3.2A 3.4 3.9A 3.9C 3.10A 3.10B</p>	<p>2F 3F</p>



# Focus Standards\*

## Texas Essential Knowledge and Skills for Science

- 3.1 Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and environmentally appropriate practices. The student is expected to
- 3.1A *demonstrate safe practices as described in Texas Education Agency–approved safety standards during classroom and outdoor investigations using safety equipment as appropriate, including safety goggles or chemical splash goggles, as appropriate, and gloves; and*
  - 3.1B *make informed choices in the use and conservation of natural resources by recycling or reusing materials such as paper, aluminum cans, and plastics.*
- 3.2 Scientific investigation and reasoning. The student uses scientific practices during laboratory and outdoor investigations. The student is expected to
- 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;*
  - 3.2B *collect and record data by observing and measuring using the metric system and recognize differences between observed and measured data;*
  - 3.2C *construct maps, graphic organizers, simple tables, charts, and bar graphs using tools and current technology to organize, examine, and evaluate measured data;*
- 3.2D *analyze and interpret patterns in data to construct reasonable explanations based on evidence from investigations; and*
- 3.2F *communicate valid conclusions supported by data in writing, by drawing pictures, and through verbal discussion.*
- 3.3 Scientific investigation and reasoning. The student knows that information, critical thinking, scientific problem solving, and the contributions of scientists are used in making decisions. The student is expected to
- 3.3A *analyze, evaluate, and critique scientific explanations by using evidence, logical reasoning, and experimental and observational testing;*
  - 3.3B *represent the natural world using models such as volcanoes or the Sun, Earth, and Moon system and identify their limitations, including size, properties, and materials; and*
  - 3.3C *connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.*
- 3.4 Scientific investigation and reasoning. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to
- 3.4 *collect, record, and analyze information using tools, including cameras, computers, hand lenses, metric rulers, Celsius thermometers, wind vanes, rain gauges, pan balances,*

\*The bold text identifies standards that students should master in this module. The italicized text identifies standards that students will develop knowledge of in this module and should master in later modules. Some italicized standards are part of the assessments in this module, but they will be assessed throughout the year.

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.*

- 3.9 Organisms and environments. The student knows and can describe patterns, cycles, systems, and relationships within the environments. The student is expected to
- 3.9A **observe and describe the physical characteristics of environments and how they support populations and communities of plants and animals within an ecosystem;**
  - 3.9B **identify and describe the flow of energy in a food chain and predict how changes in a food chain affect the**

**ecosystem** such as removal of frogs from a pond or bees from a field; and

- 3.9C **describe environmental changes such as floods and droughts where some organisms thrive and others perish or move to new locations.**
- 3.10 Organisms and environments. The student knows that organisms undergo similar life processes and have structures that help them survive within their environments. The student is expected to
- 3.10A **explore how structures and functions of plants and animals allow them to survive in a particular environment;** and
  - 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.

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## Building Content Knowledge

Throughout this module, students build on their understanding of the effects of environmental change caused by flooding and droughts (3.9C) from the Weather and Climate module. Students begin Survival and Change by recording initial ideas about the characteristics of the environment of a butterfly (3.9A). They work to develop an anchor model that represents a butterfly's environment (3.3B). Students ask questions about a butterfly fossil that help drive their learning throughout the module.

Throughout Concept 1, students explore fossils to find evidence of changes in an environment over time (3.9A, 3.9C). Students begin by creating, analyzing, and measuring clay fossil models to learn how fossils form (3.2B, 3.3B). They learn about the past environment in their region by observing and analyzing regional fossils and comparing them to present-day organisms to learn that environments can change over time (3.9A, 3.9C). Students then observe fossils from the Florissant area

of Colorado and compare them to organisms that live in the Florissant area today. They use their observations of the organisms, past and present, and their structures to determine what the environment was like in the past (3.10A) and explain how the environment has changed over time (3.9A, 3.9C).

In Concept 2, students learn that organisms are suited to survive in particular environments because of their characteristics. They observe a caterpillar's environment and develop the understanding that a habitat contains everything an organism needs to survive (3.9A, 3.10A). In their analysis of the caterpillar habitat, students describe the effects of environmental changes on the habitat, on the caterpillar, and on the plants the caterpillar eats (3.9B, 3.9C). Students are also introduced to the life cycle of the butterfly (3.10B). Students then identify characteristics of various organisms and explain how these characteristics help the organisms survive (3.10A). Students use the text *Amos & Boris* (Steig 2009)

as they describe and analyze an organism's suitability to a particular environment, then evaluate the ability of other organisms to survive in a particular environment based on the characteristics of each organism. Students continue to investigate how organisms live in their environment as they use evidence from models (3.3B) and analyze patterns in animal behavior to explain that living in groups helps animals survive.

The focus of Concept 3 is the effects of environmental change on organisms. Students explore how seasonal changes in an environment affect organisms that live there and their ability to survive. Students make observations and determine that monarch butterflies migrate in response to seasonal changes in their environment. Through their investigations, students further explore the life cycle of various butterflies (3.10B) and reflect on the strategies they use at different life cycle stages to survive seasonal changes. Students have an opportunity to compare the life cycle of butterflies and plants that they have been observing over a week's time (3.10B). Students' exploration of organisms in a forest ecosystem reveal that when environmental conditions change, some animals are suited to stay and survive, some move away, and some die

(3.9A, 3.9C). Students then investigate the effects of seasonal changes on plants and learn about strategies plants use to survive. Students revisit the forest ecosystem as they analyze the effects of a long-term change, such as land development by humans, on the various kinds of organisms that live there (3.9C). Students then evaluate potential solutions to help organisms survive after a long-term change in an environment and apply their learning in a Conceptual Checkpoint, where they explore the effects of a volcanic eruption on the organisms that live in the area around a volcano (3.9C).

In an Engineering Challenge, students use their understanding of butterfly survival needs and the engineering design process to design a solution to help monarch butterflies survive in a changing environment, as they learn that humans can change an environment to make it more suitable for an organism (3.2A, 3.9A, 3.9B, 3.9C).

Students reflect on their learning throughout the module about survival and change and apply their understanding of survival and change to a new context in the End-of-Module Assessment.

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## Key Terms

In this module, students learn the following terms through investigations, models, explanations, class discussions, and other experiences.

- Artificial
- Butterfly
- Characteristic
- Cope
- Environment
- Extinct
- Fossil
- Habitat
- Migration
- Organism
- Paleontologist
- Suitable
- System



# Advanced Materials Preparation

Several activities in this module require advanced preparation. See the lesson resources for more details on material preparation and instructions.

Lesson Set	Time in Advance	Investigation	Description
3	1 day	Compare Fossil with Clay Fossil Model	Prepare clay fossil models.
9–12	2–3 weeks	Determine Needs of Caterpillars in an Artificial Habitat	Select, prepare for, and order live animals.
9–12	5–7 days	Analyze Characteristics of Caterpillars and Plants	Prepare radish plants.
13–15	1 day	Model Other Group Behaviors	Collect leaves.
16–19	6–7 days	Observe Plants	Prepare radish plants.

## Safety Considerations

The safety and well-being of students are of utmost importance in all classrooms, and educators must act responsibly and prudently to safeguard students. Science investigations frequently include activities, demonstrations, and experiments that require extra attention regarding safety measures. Educators must do their best to ensure a safe classroom environment.

The hands-on, minds-on activities of this module involve the observation of live plants and animals. In addition to safety notes included in lessons, important safety measures to implement include the following:

- Teachers must explain to and review safety expectations with students before each activity.**
- Students must listen carefully to and follow all teacher instructions.** Instructions may be verbal, on classroom postings, or written in the Science Logbook or other handouts.
- Students must demonstrate appropriate classroom behavior (e.g., no running, jumping, pushing) during science investigations.** Students must handle all supplies and equipment carefully and respectfully.

4. **Debris must be cleaned up immediately.** During investigations, items can fall to the floor even when everyone is careful. Immediate removal of debris from the floor is essential to help prevent slips and falls.
5. **Students must never place any materials in their mouth during a science investigation.**
6. **Put away all food and drinks during science investigations.** Food and drinks can be easily contaminated by investigation materials. Additionally, spilled food or drinks can disrupt investigations.

7. **Monitor student activity on the internet.** If students are permitted access to the internet for science research purposes, their activity must be monitored to ensure that it conforms with school and district policies.

More information on safety in the elementary science classroom appears in the Implementation Guide. Teachers should always follow their school's or district's health and safety guidelines. For additional information on safety in the science classroom, consult the Texas Education Agency–approved safety standards (3.1A).

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## Additional Reading for Teachers

*A World of Butterflies* by Brian Cassie

*Florissant Butterflies: A Guide to the Fossil and Present-day Species of Central Colorado* by Thomas C. Emmel, Marc C. Minno, Boyce A. Drummond