Squirrels - Unit Documents

Learning Set 1

My Notes Tab

Learning Set Driving Question: What do squirrels need to survive?

Lesson Abridged Comments:

Learning Set Description: (ML-PBL to create)

1. **L1.1** Equity focus lesson: Students are introduced to the driving question; and discuss what they think they will learn in the unit. They share what they have experienced in their own lives and family stories, about what they know about squirrels, animals similar to squirrels, and dinosaurs and fossils.
2. **L1.2** In lesson 2, students are introduced to the DQ, they watch movies of prehistoric times, and the teacher solicits background knowledge. Students ask and organize questions on stickys, and do a quick write / picture about the DQ.
3. **L1.3** In lesson 3, students watch the movie again. The class goes outside to look for organisms similar to those in the movie, and lists what they saw environment worksheet #1 . They compare photos of animals in the video to those outside and as scientists figure out if animals and plants; and squirrels and the Laolestes were the same or different.
4. **L1.4** In lesson 4, students engage in fieldwork to observe and collect data about how the squirrel survives outside. They share their observations and organize their data. investigation worksheet #2
5. **L1.5** In lesson 5, students use their observations from the field notes to create models explaining how squirrels are meeting their basic needs in their environment.
6. **L1.6** In lesson 6, the students ask questions about the squirrels and how they survive and survival in the winter, life cycle and growth, and finding food and escaping from predators. Students engage in texts to answer the questions and "research in teams."
7. **L1.7** In lesson 7, the teacher shares one student model with group, and practices giving feedback and suggestions for revision. Then students in pairs, give each other advice for revisions, students share and revise model --and go back to the Driving Question and the teacher with the student's help, writes down big ideas that the students learned.

Phenomenon: Squirrels can survive outside.

Learning Performance: Students will observe squirrels and develop and revise a model of how a squirrel meets its needs and survives in the environment (system and system models, cause and effect).

Figuring Out Statement/ DCI

In this learning set students are figuring out how a squirrel survives outside. They become familiar with the squirrel as an object of study but something that they see everyday. They observe squirrels outside, and ask questions and read "research" about how a squirrel survives. Then they make and revise models of the squirrel surviving.

Practice Statement

Students are gathering data (observing, and engaging in texts) to develop initial models of how the squirrel survives.

Practice Elements from NGSS

Obtaining, Evaluating, and Communicating Information: Communicate scientific and/or technical information orally and/or in written formats.

Asking Questions and Defining Problems: Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.

Developing and Using Models: Develop and/or use models to describe and/or predict phenomena.

Planning and Carrying Out Investigations: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence.

Crosscutting Concepts

Systems and System Models: A system can be described in terms of its components and their interactions.

Cause and Effect/Mechanism and Prediction: Cause and effect relationships are routinely identified, tested, and used to explain change.

Squirrels Learning Set 1– Embedded Language Supports

Lesson 1:

- Funds of Knowledge
- Home language supports
- Brainstorming in pairs
- Metacognitive reflection
- Explicit support for engaging in practice of obtaining information
- Discourse moves from World-class Instructional Design and Assessment (WIDA)

Lesson 2:

- Employment of multiple domains
- Multiple modalities
- Explicit support for asking questions (e.g., grouping types of questions, interactive support for seeking clarification)
- Use of photos for supporting comprehensible input
- Discourse moves from WIDA

Lesson 3:

- Employment of multiple domains
- Demand for different modalities
- Explicit support for the practices (asking for clarification)
- Use of photos to support comprehensible input
- Negotiation of meaning in small groups with pictures for support
- Discourse moves from WIDA

Lesson 4:

- Multimodality - acting out ideas
- Explicit support for engaging in practice of recording and discussing observations
- Opportunity for negotiation of meaning with small group
- Discourse moves from WIDA

Lesson 5:

- Authentic negotiation of meaning - using models to support language
- Explicit support for engaging in practice of modeling to explain
- Discourse moves from WIDA

Lesson 6:

- Use of multiple domains
- Visual supports
- Explicit support for engaging in developing questions
- Discourse moves from WIDA

Lesson 7:

- Models support listening and speaking about science ideas
- Negotiation of meaning with partner
- Support for describing "Big Ideas"
- Specific guidance in metacognition
- Discourse moves from WIDA

Learning Set Driving Question
LS1: What do squirrels need to survive?

L1.1 Family Interviews

Lesson Snapshot

Learning Set Driving Question
LS1: What do squirrels need to survive?

Lesson Driving Question
L1.1: What does your family know about squirrels, prehistoric organisms, and fossils?

Lesson Overview

1. Introduction: Introduce the unit Driving Question (DQ). Remind students about the homework they were given before this unit started.
2. Presentations: Students and family members present their interviews about experiences with squirrels, prehistoric organisms, and fossils.
   After each presentation, students come up with a statement about squirrels, prehistoric organisms, or fossils based on what was presented. Post these statements, along with the names of the students who made them, in a prominent place as evidence.
3. Wrap Up: Students write or draw in their science notebooks, what they learned from the presenters. Students may add a question to the classroom Driving Question Board (DQB), displayed prominently in the classroom, or to the online DQB.

Objectives

Learning Performance
Students will obtain, evaluate, and communicate information from family stories about how squirrels and prehistoric organisms interact with their environment (through the lenses of *cause and effect* and *systems and system models*).

Equity Learning Performance - Funds of Knowledge
We can leverage our families' cultural and linguistic knowledge and histories for learning and doing science.

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all. (met in LS 4-6)

Co-developed by the Multiple Literacies in Project-based Learning Project at Michigan State University and the University of Michigan 2018–2019

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** we can use knowledge from each other's families and cultures to explain, wonder about, and as evidence in our exploration of phenomena. **Look Fors** 1. In the presentations, **look for** students asking questions of other students to make sense of the knowledge they bring (that may be different from their own). 2. In the students' questions, **look for** questions about interactions (*systems*) and about how some events seem to *cause* other events. **Evidence Statement** Students' active listening and questions show that they are learning to respect cultural and familial experiences and stories and to regard these as important for understanding how science is constructed within a scientific community. Students learn that their experiences and cultures are sources of important information when learning science.	***Embedded Language Supports*** • Funds of Knowledge • Home language supports • Brainstorming in pairs • Metacognitive reflection • Explicit support for engaging in practice of obtaining information • Discourse moves from World-class Instructional Design and Assessment (WIDA)

Teacher Preparation	Materials
• Pass out the interview homework 1 week before starting the unit and explain the interview to the class. • Prepare the statement defining ***evidence*** on a sentence strip: "***What you see, or what others have seen, that backs up what you say.***" • Go over the homework to get an idea of who will present and what they are prepared to present. • Set up a classroom DQB in a prominent place. Record student questions and statements of evidence OR use the Learning Set 1 Driving Question Slides. • Make a copy of the DQ slides for your own use so you can add student claims and questions. • Gather as many trade books about squirrels as you can; some ideas are in	***Teacher Materials*** • Driving Question Board (DQB) • Learning Set 1 Driving Question Slides • Lesson 1.1 Driving Question • Optional: Classroom Library Connections ***Student Materials*** • Interview homework that has been turned in (assigned 1 week before beginning this lesson) • Science notebooks

Classroom Library Connections.	

Lesson Segments	Estimated Time
Introduction	15 min
Presentations	30 min
Wrap Up	15 min
This 50-minute lesson could be split up into many mini sharing sessions: Assign homework home and then allow students to share throughout the unit during, for example, morning meeting or other times of the school day.	**Total Time:** 60 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and DQ, "*What does your family know about squirrels, prehistoric organisms, and fossils?*"** 1. Read the DQ: ***"What does your family know about squirrels, prehistoric organisms, and fossils?"*** Remind students about the homework that was assigned the week before. Ask students if they had good discussions with their family members. 2. Have a student read the class definition of *evidence*, "***What you see, or what others have seen, that backs up what you say."*** Discuss this definition. Ask if students' family members saw or recalled something important about squirrels or prehistoric organisms and if it would fit the definition of *evidence*. **Suggested Prompt:** "*Your science-related ideas and evidence can come from experiences you and your family have had. Today we will gather scientific evidence from the experiences with squirrels, prehistoric organisms, and fossils that families shared with us.*"	**15 min**

2	**Presentations: Students and families share their knowledge and experiences with squirrels** 1. Write down the order of presentations. Students can either present with their family members or by themselves, reading from their homework sheet. 2. After each presentation, have students brainstorm in pairs to reflect on the information presented. The presenter or student chooses the statement that best represents what was shared with the class. Record this statement on the [Lesson 1.1 Driving Question slide]() under the heading "Evidence." Include the name of the student who made the statement. **Discourse Move - Make ideas public**  **Suggested Prompt:** *"This claim is a scientific idea. Ideas in science can come from wondering about and explaining natural events and how they relate to other events. Where did the idea come from? Can ideas come from activities we do in class, books we read, and scientists? Can ideas come from wondering about and explaining events that we experience in our communities with our families, or from events our family members have experienced?"*	**30 min**
3	**Wrap Up: Wrap up and use questions for reflection in science notebooks** 1. When all students and/or their families have presented, highlight ideas having to do with *cause and effect* and *systems*, explicitly pointing out the use of these lenses. 2. Have students free write or draw quietly in their science notebooks, reflecting on what they learned. Press students to use the lenses of *cause and effect* and *systems*. • ***Prompt (option 1):*** "What is something new that you learned from listening to your classmates' presentations?" • ***Prompt (option 2):*** "Free write or draw about what you learned." 3. At this time, students can ask the presenters any questions.	**15 min**

1.1 Before-unit Homework

Family Interview Homework

Name _____________________ Who I talked with ______________________

Our class will be starting a new science unit in which we will learn about adaptation. We will engage with the question, "***Why do I see so many squirrels but I can't find any stegosauruses***?" This unit will investigate the structure and behavior of squirrels and how they interact with the environment around them. We will learn how the squirrel-like organisms in the Jurassic period (when stegosaurus was still around) adapted to changes in the environment. The class will benefit from sharing our cultural and family knowledge and experiences about squirrels, fossils, and dinosaurs.

Discuss the following questions together at home. Take notes on the back of this paper or draw a picture to remember what you talked about. Come to class ready to share what you talked about.

1. Is there a cool "squirrel story" that your family likes to tell or has experienced together?
2. If you are from a different part of the United States or the world, do you know of a squirrel that is different from the squirrels we see by our school? Can you describe the differences or similarities?
3. If you or your family is from a different part of the United States or the world, was there an animal that was like the squirrel because it seemed to be everywhere?
4. Do you have any experiences or stories to tell about dinosaurs or fossils?

We would love to have you come in as a guest speaker and share your experience with the class!

Grade 3 Unit 1
Why do I see so many squirrels but I can't find any stegosauruses?
Classroom Library Connections

The table below provides a list of trade book connections to the *Multiple Literacies in Project-based Learning* Grade 3 Unit 1: *Why do I see so many squirrels but I can't find any stegosauruses?* One book is necessary for teaching the unit and is included on the materials list. The other books on the list also relate to student learning in the unit. You could use these books, or others that you are familiar with, as supplemental resources to allow your students to further explore ideas introduced in the unit.

In addition to providing ideas for building your own classroom library, you could take this list to your local public or school library to gather these titles or to ask the library media specialist for similar titles and additional recommendations. You could choose to provide some of these titles as options for students' independent or self-selected reading time, or as read-alouds during English Language Arts instruction.

Dinosaurs
Allosaurus (Little Paleontologist) by Sally Lee, published by Smithsonian Iguanodon (Little Paleontologist) by Sally Lee, published by Smithsonian National Geographic Kids Everything Dinosaurs: Chomp on Tons of Earthshaking Facts and Fun, published by National Geographic National Geographic Kids Ultimate Dinopedia: The Most Complete Dinosaur Reference Ever, published by National Geographic National Geographic Little Kids First Big Book of Dinosaurs, published by National Geographic Little Kids First Big Books Stegosaurus (Little Paleontologist) by A. L. Wegwerth, published by Smithsonian
Fossils
Curious About Fossils by Kate Waters, published by Smithsonian DK Eyewitness Books: Fossil** by Paul Taylor, published by DK Children Fossils (True Books) by Ann O. Squire, published by Scholastic How Does a Bone Become a Fossil? (How Does It Happen?) by Melissa Stewart, published by Capstone Global Library Fossil Detective (Nature Club) by Susan Pope, published by Eagle Books

Fossils Tell of Long Ago (Let's-Read-and-Find-Out Science 2) by Aliki, published by HarperCollins Publishers
Fossil Hunters, Paleontologists, and Others Who Studied Dinosaurs
Mary Anning and The Sea Dragon by Jeannine Atkins, Michael Dooling (Illustrator), published by CreateSpace Independent Publishing Platform Paleontology: The Study of Prehistoric Life (True Books: Earth Science) by Susan Heinrichs Gray, published by Scholastic Rare Treasure: Mary Anning and Her Remarkable Discoveries by Don Brown, published by Houghton Mifflin Harcourt Stone Girl Bone Girl: The Story of Mary Anning of Lyme Regis* by Laurence Anholt, Sheila Moxley (Illustrator), published by Frances Lincoln Children's Books The Dinosaurs of Waterhouse Hawkins (Caldecott Honor Book) by Barbara Kerley, Brian Selznick (Illustrator), published by Scholastic You Can Be a Paleontologist!: Discovering Dinosaurs with Dr. Scott By Scott D. Sampson, published by National Geographic
Organisms We See Today (Animals and Plants)
National Geographic Little Kids First Big Book of Animals by Catherine D. Hughes, published by National Geographic National Geographic Little Kids First Big Book of Birds by Catherine D. Hughes, published by National Geographic National Geographic Little Kids First Big Book of Bugs by Catherine D. Hughes, published by National Geographic Ultimate Bugopedia: The Most Complete Bug Reference Ever by Darlyne Murawski and Nancy Honovich, published by National Geographic Ultimate Explorer Field Guide: Insects: Find Adventure! Go Outside! Have Fun! Be a Backyard Insect Inspector by Libby Romero, published by National Geographic Ultimate Explorer Field Guide: Reptiles and Amphibians: Find Adventure! Go Outside! Have Fun! Be a Backyard Ranger and Amphibian Adventurer by Catherine Herbert Howell, published by National Geographic Ultimate Explorer Field Guide: Trees by Patricia Daniels, published by National Geographic
Prehistoric Mammals

Prehistoric Mammals by Kathleen Weidner Zoehfeld, Franco Tempesta (Illustrator), published by National Geographic
Squirrels
Squirrel (City Safari) by Isabel Thomas, published by Capstone Publishers Squirrels and Their Nests (Animal Homes) *** by Martha E. Rustad, published by Capstone Press Squirrels (Animals in My Backyard) *** by Jordan McGill, published by AV^2 by Weigl Squirrels (Blastoff! Readers: Backyard Wildlife) *** by Derek Zobel, published by Blastoff Readers Squirrels (In My Backyard) by Lindsy J. O'Brien, published by Creative Education Welcome to the World of Squirrels (Welcome to the World Series) *** by Diane Swanson, published by Walrus Books Gray Squirrels (Blastoff! Readers: North American Animals, Level 3) by Christina Leaf, published by Bellwether Media Rabbits, Squirrels and Chipmunks: Take-Along Guide (Take Along Guides) by Mel Boring, Linda Garrow (Illustrator), published by NorthWord Press
Time Periods
Ancient Earth Journal: The Early Cretaceous: Notes, Drawings, and Observations from Prehistory by Juan Carlos Alonso and Gregory S. Paul, published by Walter Foster Jr. Ancient Earth Journal: The Late Jurassic: Notes, Drawings, and Observations from Prehistory by Juan Carlos Alonso and Gregory S. Paul, published by Walter Foster Jr. The Nature Timeline Wallbook: Unfold the Story of Nature—from the Dawn of Life to the Present Day! (What on Earth? Timeline) by Christopher Lloyd, Andy Forshaw (Illustrator), published by What on Earth Publishing When Fish Got Feet, When Bugs Were Big, and When Dinos Dawned: A Cartoon Prehistory of Life on Earth by Hannah Bonner (Author), published by National Geographic Kids
Grade 3 Teacher-recommended Fictional Stories (Narrative Text - Fantasy)
Gooseberry Park by Cynthia Rylant, Arthur Howard (Illustrator), published by Houghton Mifflin Harcourt Flora and Ulysses: The Illuminated Adventures by Kate DiCamillo and K.G. Campbell, published by Candlewick

** Included in unit materials list.*
*** Previously included on unit materials list; no longer included because of its expense. Highly recommended resource for use in the fossil sorting lessons.*
**** Previously included on unit materials list; not available in sufficient quantities.*

Learning Set Driving Question
LS1: What do squirrels need to survive?

L1.2 Background Knowledge

Lesson Snapshot
Learning Set Driving Question LS1: What do squirrels need to survive? **Lesson Driving Question** L1.2 What do we already know about squirrels today and in the past? **Lesson Overview** 1. Introduction: Remind students of the unit DQ. Show the video of the stegosaurus, the early Eutherian mammal, Juramaia, and animals and plants from prehistoric times. 2. Group Discussion: Solicit background knowledge. Students discuss the organisms they saw in the video. 3. Wrap Up: Quick, independent free write or draw—initial response to DQ. Explain that the class will return to the DQ often, and add that before scientists research the past, they must observe and gather information about the present. So for the next few lessons, students will observe and learn about squirrels.

Objectives
Learning Performance Students will ask questions about organisms in their environment and how the organisms may have changed over time (through the lenses of *cause and effect* and *systems and system models*). **Building Toward PEs** **3-LS4-1** Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. **3-LS4-3** Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all. (met in LS 4-6)

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** some organisms they see today are the same as, and some are different from organisms that lived in the past. **Look Fors** **Look for** students building on each other's ideas	***Embedded Language Supports*** • Employment of multiple domains • Multiple modalities • Explicit support for asking questions (e.g., grouping types of questions, interactive support for seeking clarification)

about *cause and effect* and *systems and system models* by making connections and adding to each other's ideas. **Evidence Statement** The questions students ask bring together background knowledge, the DQ, and ideas brought up in the discussion; the questions show some thinking about present and past, *cause and effect*, and the idea that there are *systems* of organisms that have parts that work together.	• Use of photos for supporting comprehensible input • Discourse moves from WIDA

Teacher Preparation	Materials
Preparation • View Prehistoric video once to make sure it works. • Note: The video refers to Laolestes (early Eutherian mammal) • For shared class reflection, have a Padlet site ready if you are familiar with it (or use another shared document). • *Learn Padlet Tutorial* video • Teacher's Guide to Using Padlet in Class written instructions ***Background Information*** More about • Eutheria (Placental Mammals) • Family Sciuridae (Squirrels) • Family Stegosauridae	***Teacher Materials*** • Driving Question Board (DQB) • Learning Set 1 Driving Question Slides • Lesson 1.2 Driving Question • Free write • Video: Prehistoric video (https://www.youtube.com/watch?v=ASxQKIUf6x8) ***Student Materials*** • Science notebooks or Padlet

Lesson Segments	Estimated Time
Introduction	10 min
Group Discussion	25 min
Wrap Up	15 min
	Total Time: 50 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Introduce phenomenon and DQ, "*What do we know already about squirrels today and in the past?*"** 1. Ask some students to re-read what they wrote in their science notebooks from L1.1. 2. Have a student read the Learning Set 1 Driving Question Slide and the Lesson 1.2 Driving Question: ***"What do we know already about squirrels today and in the past?"*** Students *turn-and-talk* about the DQs and share out.	**10 min**
2	**Group Discussion: Introduce phenomenon and solicit ideas** 1. Show the Prehistoric video. 2. Repeat the unit DQ, "***Why do I see so many squirrels but I can't find any stegosauruses?"*** Ask students to describe the video first, and solicit the idea that some plants and animals looked similar to organisms they see today. Then ask the reasons for this similarity (*systems* and *cause and effect relationships*) and support discussion, asking students to add their own ideas. Students will have a lot to say, and some of the ideas will be unrelated to the unit DQ, which is OK, because you want to know what kids know right now. (You may show the video twice.) **Discourse Move - Help a student clarify his/her thinking**  **Suggested Prompt:** When a confusing idea is presented, check for clarification: "*What did you mean by...exactly? Can you clarify? Can you say that in a different way to make sure we all understand*?" 3. Hand out sticky notes or sentence strips or share the Padlet link with students. Students should write their questions on the sticky notes, sentence strips, or Padlet. Add questions directly to the Lesson 1.2 Driving Question slide as students read them. 4. Gather ideas about how you could organize students' questions into categories. Have students think about and describe possible categories.	**25 min**
3	**Wrap Up: Wrap up and use questions for reflection in science notebooks** 1. Students have 10 minutes to write or draw (free write) their initial response to the lesson DQ. 2. Students share out what they wrote or drew.	**15 min**

Free Write: Why do I see so many squirrels but I can't find any stegosauruses?

Think about the Driving Question and our field work today. What questions do you have?

Learning Set Driving Question
LS1: What do squirrels need to survive?

L1.3 Comparing Today with the Jurassic Period

Lesson Snapshot
Learning Set Driving Question LS1: What do squirrels need to survive? **Lesson Driving Question** L1.3 Do any organisms today look like those from the Jurassic period? **Lesson Overview** 1. Introduction: Remind students of the learning set DQ. Show the Prehistoric video again. 2. Field Investigation: Students go outside and look for organisms that they saw in the video. 3. Data Analysis: Students look at photo stills from the video and compare those pictures with what they saw outside. Ask if the prehistoric plants and animals are the same or different from those that can be seen today. 4. Wrap Up: Students record reflections in their science notebooks. They choose one "pair" of plants or animals to write about and draw.

Objectives
Learning Performance Students will ask questions about organisms in their environment and how the organisms may have changed over time (through the lenses of *cause and effect* and *systems and system models*). **Building Toward PEs** **3-LS4-1** Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. **3-LS4-3** Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all. (met in LS 4-6)

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** some plants and animals (today) are similar to those in the Jurassic period, some are different, and some no longer exist (aren't around anymore). **Look Fors** **Look for** students thinking about each others'	***Embedded Language Supports*** • Employment of multiple domains • Demand for different modalities • Explicit support for the practices (asking for clarification) • Use of photos to support comprehensible input

questions that have to do with *cause and effect* of the organisms changing over time. **Evidence Statement** Student reflections should compare differences and similarities between the two plants or animals in *at least* one way (e.g., structure, environment, interaction with other organisms).	• Negotiation of meaning in small groups with pictures for support • Discourse moves from WIDA

Teacher Preparation	Materials
• Split up students into groups of two or three. • Decide how many students are needed in a group to compare photos. Make the required number of copies of materials.	***Teacher Materials*** • Driving Question Board (DQB) • Lesson 1.3 Driving Question • Video: Prehistoric video (https://www.youtube.com/watch?v=ASxQKIUf6x8) • Environment worksheet- Jurassic Organism Search • Clipboards (one for each group of students) • Photos of plants and animals from Prehistoric video ***Student Materials*** • Science notebooks

Lesson Segments	Estimated Time
Introduction	10 min
Field Investigation	20 min
Data Analysis	10 min
Wrap Up	10 min
	Total Time: 50 min

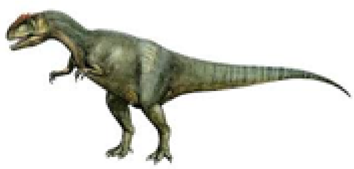
Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Introduce phenomenon and DQ, "*Do any organisms today look like those from the Jurassic period?*"** 1. Have a student read and reflect on the Lesson 1.3 Driving Question: ***"Do any organisms today look like those from the Jurassic period?"*** 2. Then tell students to look carefully at the plants and animals in the video. 3. Show the Prehistoric video from L1.2. You may need to show it more than once. List the plants and animals in the video. 4. Ask if some of the plants and animals in the video can be found outside (today) and how to find out. **Discourse Move - Help a student clarify his/her thinking**  Engaging in the phenomenon presents an opportunity to develop shared language and clarify thinking. When a student presents an idea but the language is unclear, ask others for help stating the idea, and then ask the student, "Is that right?" and "Is that what you were trying to explain to us?"	**10 min**
2	**Field Investigation: Investigate to find plants and animals similar to those from the video** 1. Students go outside with clipboards or science notebooks, writing the names of and drawing any organisms they find (today) that they also saw in the video (and considering organisms that they did not see in the video). Remind students that all organisms can be recorded at this time, including insects, plants, and animals.	**20 min**
3	**Data Analysis: Compare photos from the video with organisms found from field work** 1. In their groups or with partners, have students look at photos from the video and "match" them to the plants and animals they saw outside. 2. Student groups share out their "matches" to the class, explaining why they think animals today seem the same as, or different from, animals from the Jurassic period.	**10 min**

4	**Wrap Up: Wrap up and use questions for reflection in science notebooks** 1. Have students explain, using writing and/or drawing, why they placed some of the organisms in pairs. Ask them to describe why they think the present organism is similar to one that lived in the Jurassic period. Or you may ask why two organisms seem different from each other. Students consider the lesson DQ with new evidence. Record new questions on the DQB or on the Lesson 1.3 Driving Question slide and ask, "Did we answer any of these earlier questions?" **Suggested Prompt:** *"Choose two of the organisms that you paired together. How is the modern organism similar to the Jurassic organism? How are they different?"* 2. Have students, in pairs, use the discussion and data analysis to come up with new questions.	**10 min**

1.3 Jurassic Organism Search

Name____Date________

Environment Worksheet: Jurassic Organism Search

Organism	Observation
Stegosaurus  Stegosaurus/Nobu Tamura/CC BY-SA 3.0	
Allosaurus  Allosaurus/Nobu Tamura/CC BY-SA 3.0	
Conifer Tree 	
Fern 	
Juramaia or Eutheria or Laolestes  Juramaia/Nobu Tamura/CC BY-SA 3.0	

1.3 Photos from video

Photo Stills from The Science Channel's "Mammals vs. Dinos" Prehistoric Video

Learning Set Driving Question
LS1: What do squirrels need to survive?

L1.4 Squirrel Survival Needs

Lesson Snapshot

Learning Set Driving Question
LS1: What do squirrels need to survive?

Lesson Driving Question
L1.4: What can we observe about squirrels and how they survive outside?

Lesson Overview

1. Introduction: Introduce the lesson DQ. Ask students what they think they will see outside and review statements from L1.1 family interviews.
2. Field Investigation: Students go outside and take notes for evidence of squirrels surviving outside.
3. Data Analysis and Large Group Discussion: Students discuss findings and categorize information.
4. Wrap Up: Add questions and answers to the DQB. Students act out a survival activity they saw a squirrel engage in and their partners guess the activity.

Objectives

Learning Performance
Students will make observations about squirrels in their environment and how they survive (through the lenses of *cause and effect* and *systems and system models*).

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all. (met in LS 4-6)

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** the squirrel is surviving outside, and everything it needs to survive is available outside. Students are starting to think about the parts that make up *systems* and how they *affect survival*. **Look Fors** 1. **Look for** students asking for evidence to	***Embedded Language Supports*** • Multimodality - acting out ideas • Explicit support for engaging in practice of recording and discussing observations • Opportunity for negotiation of meaning with small group • Discourse moves from WIDA

back up claims about *relationships* and *causes.* 2. **Look for** students using evidence to back up their own claims about *relationships* and *causes* (i.e., thinking about a pet or other animal). 3. **Look for** students listening to and building on ideas presented by peers. **Evidence Statement** Students' observations serve as evidence for their points in the discussion and build on what other students observed. Their shared discussions show that they are beginning to take a *systems* approach to thinking about a familiar phenomenon.	

Teacher Preparation	Materials
• Review evidence collected from students' families (from L1.1). • Look for an area near your school where a lot of squirrels live or forage. ○ If there are no squirrels anywhere, you can use this video. • Select a video seasons or foraging and eating	***Teacher Materials*** • Driving Question Board (DQB) • Lesson 1.4 Driving Question • Investigation Worksheet- Mammalogist Field Work • Sticky notes/sentence strips/Padlet • Binoculars • Statements from L1.1 • Make a claim slide ***Student Materials*** • Science notebooks • Clipboards

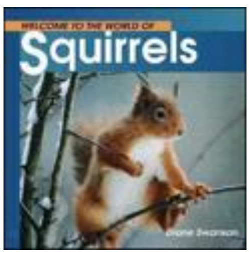
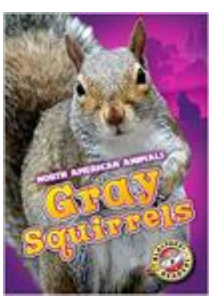
Lesson Segments	Estimated Time
Introduction	10 min
Field Investigation	20 min
Data Analysis and Large Group Discussion	10 min
Wrap Up	10 min
	Total Time: 50 min

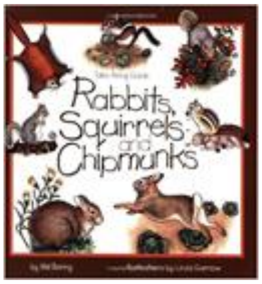
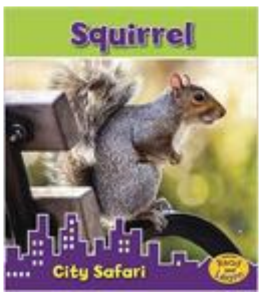
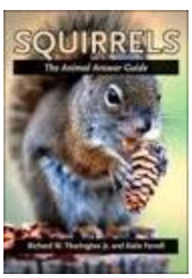
Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Introduce phenomenon and DQ, "*What can we observe about squirrels and how they survive outside?*"** 1. Read the Lesson 1.4 Driving Question, ***"What can we observe about squirrels and how they survive outside?,"*** to the class. Ask students to predict what they'll see squirrels doing outside, and review families' statements from L1.1, if any apply. 2. Solicit ideas of some natural materials we might see squirrels using. Ask if any of the materials help squirrels survive. 3. Develop a "NEEDS for Survival" list for the DQB. Help students generate a list of needs that all organisms must meet to survive. • You may need to help students with the word *organism* and help them understand that the term includes plants and animals. • When a student suggests something an organism needs, press for evidence and reasoning. • The list you generate can be have fewer items than suggested below or have more items (e.g., sleep, communication). **<u>NEEDS for Survival</u> (example list):** Warmth, food (nutrients), water, reproduction, safety, air, sensing the environment, growth	**10 min**
2	**Field Investigation: Investigate what squirrels do to survive outside** 1. Students go outside in pairs and look for evidence of squirrel survival behavior. When you see a squirrel, ask students to describe what need the squirrel is meeting, and press for evidence and reasoning.	**20 min**

3	**Data Analysis and Large Group Discussion: Record and analyze information; discuss** 1. Write or have students write their observations on sticky notes, sentence strips, or the DQB. 2. Support students in categorizing the evidence they collected into similar groups based on the **NEEDS for Survival list, on the DQB.** 3. Help students use the observations to make a claim about how one of their observations might relate to survival. **Discourse Move - Help students apply their thinking to others' ideas**  Students need support attending to each other's ideas. Include prompts so that they become responsible as listeners. **Suggested Prompt:** *"What was the squirrel doing? Can you show us by acting it out? Why was the squirrel doing that? Was it meeting one of its needs? Which one? How was it meeting one of its needs? Why do you think the squirrel might have been running up the tree? How did running up the tree help it to meet that need? Who can explain their understanding of this idea? Does it make sense? Can you add to it?"*	**10 min**
4	**Wrap Up: Wrap up and use questions for reflection in science notebooks** 1. As a class, look over the Lesson 1.4 Driving Question to see if any new questions come up or any prior questions can be answered. 2. Ask volunteers to act out one way squirrels survive. The other students guess.	**10 min**

1.4 Squirrel Trade Books

Squirrel Books for Students at Varying Reading Levels

	***SQUIRRELS*** (Animals in My Backyard) by Jordan McGill July 15, 2011; Grade Level: 1–2
	***Squirrels and Their Nests*** (Animal Homes) by Martha E. Rustad September 1, 2004; Grade Level: K–1
	***Welcome to the World of Squirrels*** (Welcome to the World Series) by Diane Swanson January 1, 2001; Grade Level: Preschool and Up
	***Squirrels*** (Blastoff! Readers: Backyard Wildlife, Level 1) by Derek Zobel August 8, 2010; Grade Level: Preschool–2
	***Gray Squirrels*** (Blastoff! Readers: North American Animals, Level 3) by Christina Leaf January 1, 2014; Grade Level: 1–2

	[***Rabbits, Squirrels and Chipmunks: Take-Along Guide***]() (Take Along Guides) by Mel Boring, Linda Garrow (Illustrator) October 1, 1996; Grade Level: 2–5
	***Squirrels*** (In My Backyard) by Lindsey J. O'Brien March 7, 2017; Grade Level: 1–3
	***Squirrel*** (City Safari) by Isabel Thomas January 1, 2014; Grade Level: 1 and Up
	**Teacher Resource** ***Squirrels: The Animal Answer Guide*** (The Animal Answer Guides: Q&A for the Curious Naturalist) by Richard W. Thorington, Jr. and Katie E. Ferrell, August 28, 2006

1.4 Investigation Sheet- Mammalogist Field Work

Investigation Worksheet: Mammalogist Field Work

Name_______________________________________ Date________________

Time/Place	Describe the squirrel (body color, tail color, size, markings)	What is the squirrel doing?	What is the squirrel using in the environment to do that?
1.			
2.			

3.			
Time/Place	**Describe the squirrel (body color, tail color, size, markings)**	**What is the squirrel doing?**	**What is the squirrel using in the environment to do that?**
4.			
5.			

6.			

Learning Set Driving Question
LS1: What do squirrels need to survive?

L1.5 Modeling Squirrel Survival

Lesson Snapshot
Learning Set Driving Question LS1: What do squirrels need to survive? **Lesson Driving Question** L1.5: How can I make a model to explain how a squirrel survives outside? **Lesson Overview** 1. Introduction: Introduce the lesson DQ. Review evidence from the observations from L1.4. 2. Making and Explaining Models (Writing to Explain): Explain that a model is a picture that can be used to describe an event in nature. Students independently make a model to show how a squirrel meets one of its needs outside. Students write a survival story that explains their model (writing to explain). 3. Wrap Up: Add questions and respond to questions on the Lesson 1.5 Driving Question.

Objectives
Learning Performance Students will create an initial model to show squirrels in their environment and to explain how squirrels survive (through the lenses of *cause and effect* and *systems and system models*). **Building Toward PEs** **3-LS4-1** Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. **3-LS4-3** Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all. (met in LS 4-6)

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** the squirrel interacts with its environment to survive and that survival has to do with interacting parts in a *system*, including *causes and effects*. **Look Fors** 1. **Look for** students describing connections between squirrels, the environment, and	***Embedded Language Supports*** • Authentic negotiation of meaning - using models to support language • Explicit support for engaging in practice of modeling to explain • Discourse moves from WIDA

survival using the lens of *cause and effect* or *systems and system models*. 2. **Look for** students identifying *parts of a system* and using words that describe the "bigger picture" of the *system* that includes some components while excluding others (as a boundary). **Evidence Statement** Models should show connections between needs and interactions with the environment. Survival stories explain the models.	

Teacher Preparation	Materials
• Be ready to review the evidence from the observations from L1.4. • Be ready to review the definition for *evidence* from L1.1.	***Teacher Materials*** • Driving Question Board (DQB) • Lesson 1.5 Driving Question • Sticky notes/sentence strips/Padlet ***Student Materials*** • Science notebooks

Lesson Segments	Estimated Time
Introduction	15 min
Making and Explaining Models (Writing to Explain)	25 min
Wrap Up	10 min
	Total Time: 50 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Introduce phenomenon and DQ, *"How can I make a model to explain how a squirrel survives outside?*** 1. Read the Lesson 1.5 Driving Question, ***"How can I make a model to explain how a squirrel survives outside?,"*** to the class. Review evidence from the observations from L1.4. 2. Explain that a model is a picture that can be used to describe an event in nature. Models show how parts of the event (*system*) interact with one another. In this case, students will make a model that explains how squirrels survive in their environment. 3. Students will focus on one need that squirrels meet outside. Review the list of needs for survival from L1.4. **NEEDS for Survival (example list):** Warmth, food (nutrients), water, reproduction, safety, air, sensing the environment, growth • Discuss *cause and effect.* Write "cause and effect" and draw an arrow from "cause" to "effect." • Ask students what happens if a need is met. Give an example and say, " There are a lot of acorns for a squirrel and its family. If squirrels are happy and have bellies full of acorns, what is the *cause* of their happiness? The acorns. And the *effect* is that they are happy!" • Give one more example of *cause and effect* based on a squirrel's behavior (i.e., what **need** caused a squirrel to run away fast?). • Say, "We will keep talking about *cause and effect."* 4. Ask for some ideas about how students might show a squirrel's behavior and needs, a connection between the behavior and needs, and how interaction with the environment helps squirrels survive (How do the needs or parts of the event (*system*) interact with each other?). **Discourse Move - Help a student clarify his/her thinking**  Ask clarifying questions about interactions. **Suggested Prompt:** "*How does the behavior/item in the environment help squirrels survive? How are you connecting this idea to meeting a need for survival, and how could you show that connection in your model?"*	**15 min**

2	**Making and Explaining Models (Writing to Explain): Construct models of survival stories and write survival story** 1. After gathering students' ideas about showing how squirrels survive in their environment, let students know that they can use words, pictures, and symbols (arrows, lines, etc.) in their models. Remind them that they must show how a squirrel's needs and different parts its environment interact with each other. 2. Remind students that they can only show things for which they have evidence. Review the definition of *evidence*: ***"What you see, or what others have seen, that backs up what you say."*** 3. Ask whether something that clearly doesn't belong in the model (such as a cell phone) should be included. When a student explains why the object doesn't belong in the model, explain that the survival story describes a *system* of parts (e.g., tree and squirrel) that work together, and the cell phone isn't part of that system. 4. Write, on the DQB, the definition of *system*: parts that work together. Ask students about two parts in the model that work together. Ask, "How would we show that these two parts work together?" 5. Send students to independently (or with a partner) construct their own models in their science notebooks. 6. Have students write, on another page of their science notebooks, the survival story that explains their model. Everything in their story must be shown in the model.	**25 min**
3	**Wrap Up: Wrap up and use questions for reflection in science notebooks** 1. Have some students share their models. As they do, have the class work together to *tell the story* of the squirrel survival. Ask students whose models were shared, "Is that what you were trying to say?" 2. As a class, look over the Lesson 1.5 Driving Question to see if students have any new answers to the question.	**10 min**

Learning Set Driving Question
LS1: What do squirrels need to survive?

L1.6 Squirrel Survival Research

Lesson Snapshot

Learning Set Driving Question
LS1: What do squirrels need to survive?

Lesson Driving Question
L1.6: How does a squirrel survive as it grows up, escapes from predators, and lives through the winter?

Lesson Overview
Note: This is a 2-day lesson

1. Introduction: Ask students how some animals survive in the winter. Have students *turn-and-talk* and share. Introduce the lesson DQ.
2. Asking Questions: On sticky notes, students ask questions about each of these different survival situations: surviving in winter, growing up, finding food, and escaping from predators. Present the questions for the class to decide the topic each question belongs to.
3. Shared/Partner Reading: Students do a shared/partner reading about these topics in research teams.
4. Sharing Information: Research teams decide the form their sharing will take (explain, model, act out), and each research team then shares.
5. Wrap Up: Add students' questions and answers to the DQB.

Objectives

Learning Performance
Students will ask questions, engage in texts, and communicate information about squirrels in their environment and how squirrels survive (through the lenses of *cause and effect* and *systems and system models*).

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all. (met in LS 4-6)

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** squirrels have	***Embedded Language Supports*** • Use of multiple domains

strategies that help them survive in difficult situations. **Look Fors** 1. **Look for** students using other students' reasoning to identify the category of each question and using evidence from the text to address questions about survival. 2. **Look for** students exploring the relationship between survival and interaction in the ecosystem and using *cause and effect* and *systems thinking.* **Evidence Statement** The questions students come up with will be about squirrels. The questions and information students share with the group will be obtained from texts and media. The questions may be about *cause and effect relationships* between squirrels' needs for survival and interactions with their ecosystem.	• Visual supports • Explicit support for engaging in developing questions • Discourse moves from WIDA

Teacher Preparation	Materials
• Pre-arrange partners or triads (research teams). • Have enough texts printed, or accessible on computers, for shared partner, or independent reading. • You may decide to read some of the texts as a whole class.	***Teacher Materials*** • Driving Question Board (DQB) • Lesson 1.6 Driving Question • Chart paper for writing questions • Sticky notes • Videos: life cycle, life cycle 2, predator and prey, predator and prey 2, seasons, foraging and eating • Photograph from predator and prey video • Student research sheet - Needs for Survival • Sentence strips for sorting questions ***Student Materials*** • L1.4 Squirrel Trade Books • The Squirrel's Survival chart • Science notebooks and/or research paper **Readings** • What do squirrels eat? • How do squirrels survive winter? • How do squirrels change as they grow? • What eats squirrels, and how do squirrels protect themselves? • Note: You can find digital versions of all the readings in WeRead, where they can be read aloud to students using text-to-speech.

Lesson Segments	Estimated Time
Introduction	10 min
Asking Questions About Survival	40 min
Shared/Partner Reading	25 min
Sharing Information	15 min
Wrap Up	10 min
Portions or all of this 100-minute lesson could be integrated into the Literacy Block.	**Total Time:** 100 min Two 50-minute lessons

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Introduce phenomenon and DQ: *"How does a squirrel survive as it grows up, escapes from predators, and lives through the winter?"*** 1. Review one student's model of the survival story. Tell students that squirrels have to survive some challenging times. Ask students to *turn-and-talk* about what might make it hard for squirrels to survive outside. 2. Highlight ideas that make use of *cause and effect* or *systems thinking* (relationships between organisms and other abiotic factors in the environment). Say, "I hear a *systems* or *cause and effect* idea. Can anyone explain how the idea uses *cause and effect?*" 3. Introduce the Lesson 1.6 Driving Question: ***"How does a squirrel survive as it grows up, escapes from predators, and lives through the winter?"*** Students *turn-and-talk* about what they think they will be figuring out today.	**10 min**

<table>
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Asking Questions: Students ask questions about survival

1. Write down (or use this slide) the three topics for today:
    - Life Cycle: How does the squirrel change as it grows?
    - Predator and Prey: Who eats the squirrel? What does the squirrel eat?
    - Seasons: How does the squirrel survive in different seasons?

2. Students watch squirrel life cycle videos. Afterward they discuss what they notice about how squirrels survive.
   Videos/Images:
    - life cycle,
    - life cycle 2,
    - predator and prey,
    - predator and prey 2,
    - seasons,
    - foraging and eating
    - Photograph from predator and prey

3. Have students work with a partner to generate three questions about survival and write each on a sticky note. They can think of additional questions about survival, as long as they have to do with squirrels. Collect the questions.

4. On chart paper or The Squirrel's Survival chart, write the categories “Seasons,” “Finding Food,” “Escaping from Predators,” “Growing Up,” and “Other.” One by one, read the questions students wrote and have the class decide, with reasoning, under which category the questions should be placed.

Discourse Move - Help students listen carefully and think about one another’s ideas

Suggested Prompt: “Which category does your question go under? Can you explain why you think that question goes under that category? Who can repeat what ______ just said? Does it make sense to you? How does it make sense?”
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<td>40 min</td>
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3	**Shared/Partner Reading: Work in research teams to answer research questions** 1. Assign groups of two or three as research teams to select one of the questions and answer it using the following texts: What do squirrels eat?, How do squirrels survive winter?, How do squirrels change as they grow?, What eats squirrels, and how do squirrels protect themselves?, and/or trade books about squirrels. Students should pick a question on a sticky note and take it to their desks. Then they should use a sticky note of a different color to answer the question and attach it to the student research sheet - Needs for Survival. Students should try to use information from the text to answer their question. They may select a trade book if they cannot locate the information they need in the text provided. 2. Before having students work in their groups, demonstrate for the class the process of collaborating on a question about squirrels (e.g., "What do squirrels eat and how do they find food?"). Then, briefly preview the trade books and other shared-reading texts. Preview each title and cover of the trade books and the titles of the shared reading texts. Ask students which books they think would best help them answer their question about what squirrels eat, based on the titles (e.g., the shared reading text *What do squirrels eat?*). You may also want to demonstrate for students how to use a table of contents in the trade books or flip through the pages of a book to try to answer their question. 3. Students research and answer questions with their research teams. **Options for supporting students' independent, partner, or small group reading:** • Consider using mixed-performance groups, in which one student reads the text aloud for the group, as other group members follow along. • You may choose to read the text aloud to groups while they follow along. • You can find digital versions of all texts in WeRead, where they can be read aloud to students. Students can listen to these texts individually with headphones or aloud in small groups. To use text-to-speech in WeRead, students should highlight the word, paragraph, or page they want to hear, then click on the green speaker at the top right of the screen.	**25 min**

4	**Sharing Information** 1. Ask groups to share out the question they researched and the information they found in the texts that helped them answer their question (they become the “experts” in this area). As students share, ask how they could use this new information to add to their models of the squirrel survival story. Press students to look for connections between organisms and the environment in the model.	**15 min**
5	**Wrap Up: Wrap up and use questions for reflection in science notebooks** 1. Students have 10 minutes to write and draw in their science notebooks. • ***Prompt (option 1):*** “What is something new that you learned about squirrels today?” • ***Prompt (option 2):*** “Free write or draw about what you have learned.” 2. As a class, look over the questions and consider how many questions were answered and how many remain. 3. Return to the Lesson 1.6 Driving Question, the Unit Driving Question, and the DQB (slides 3, 4, 5, 6, and 9). Think about the questions that are being addressed, and discuss how they are being answered (how did the students come up with different ways to answer the questions). If students ask more questions, write them on the DQB.	**10 min**

1.6 Squirrel Photo

Squirrel Photo (“Predator and Prey” Video)

“Squirrel Posing” by Peter Trimming is licensed under CC BY 2.0

1.6 Research Question

Squirrel Needs for Survival

1. Scientific Question:

What I found out:

2. Scientific Question:

What I found out:

What eats squirrels, and how do squirrels protect themselves?

Have you ever seen a squirrel climb up a tree and hide in the branches? Why do you think the squirrel did this?

You may have seen this when you looked for squirrels around your school. If you did, the squirrel may have been trying to escape a predator. Eastern gray squirrels have many predators. Some animals that eat squirrels are foxes, bobcats, and house cats.

"Squirrel in Hiding" by Ivy Dawned is licensed under CC BY-NC-SA 2.0

Squirrel hiding

Larger mammals, like wolves and coyotes, also hunt squirrels. They use their size and strength to chase down their prey.

"Coyote Look" by ForestWander is licensed under CC BY-SA 3.0

Coyote

Some birds, like hawks and owls, that have sharp beaks and talons, also eat squirrels. Squirrels must be fast to escape these predators. Luckily, squirrels are good tree climbers. Squirrels can jump and dodge to keep from being eaten!

US Fish and Wildlife Services, Keenan Adams

Red-tailed hawk

Squirrels have many predators, but they also have skills that help them escape.

When you went outside to look for squirrels around your school, did you see any squirrels trying to protect themselves?

What have you learned about what eats squirrels and how squirrels protect themselves?

1.6 What do squirrels eat (text)

What do squirrels eat?

When you looked for squirrels around your school, did you see them gathering or eating food? If so, what did you see them eating?

You have probably seen squirrels carrying or chewing nuts. But squirrels eat other things too. Eastern gray squirrels are **omnivores** (OM-nuh-vores). Omnivores eat both plants and animals. Squirrels live near trees that grow nuts and seeds, their favorite foods. They especially like foods that can be stored through winter, like acorns, walnuts, and pine nuts.

"Eastern gray squirrel eating a nut" by Diliff is licensed under CC BY-SA 3.0

Squirrel eating a nut

Squirrels also eat flowers and buds from tree branches. During the winter, squirrels can get into barns and eat corn and wheat.

"Wheat close-up" by Bluemoos is licensed under CC BY-SA 3.0

Wheat

During the summer, young squirrels eat insects to help them grow. Adult squirrels sometimes eat insects as well. They also eat mushrooms, eggs, and even frogs!

"Squirrel eating a mushroom" by Andrew Russell is licensed under CC BY 2.0

Squirrel eating a mushroom

Squirrels eat many different kinds of food.

How does what you have learned help you understand how squirrels survive in their environment?

1.6 How do squirrels survive winter (text - no boxes)

How do squirrels survive the winter?

Have you ever noticed squirrels digging in the ground? What do you think they were doing?

Squirrels dig to bury acorns and other nuts. They also dig to uncover those acorns and nuts. Squirrels bury nuts in the fall. They uncover them in the winter.

"Sciurus carolinensis" by Son of Groucho is licensed under CC BY 2.0

Squirrel digging in the ground

How do you think burying acorns helps squirrels survive during cold winter months?

The way squirrels bury and uncover nuts is called **scatter hoarding.** They hide their food in different places. The hiding places are scattered all over an area. The squirrels hoard, or collect, thousands of nuts to bury. They need enough nuts to last all winter.


"Eastern gray squirrel" by KirinX is licensed under CC BY-SA 2.5
Eastern gray squirrel with acorn

In the winter, squirrels search for their hidden food. To find the food, they use memory and smell. Sometimes they find food that other squirrels buried! Squirrels eat snow for water in the winter.

Another way that squirrels get ready for winter is by gaining weight. In the fall, squirrels eat a lot so they can put extra fat on their bodies. Their bodies can use this fat when they cannot find food.


"Grey squirrel in snow" by George Chriss is licensed under CC BY-SA 3.0
Gray squirrel in the snow

Squirrels survive in the winter because they have food or fat. They also do things to stay warm. Like people, squirrels shiver. The shivering moves their bodies. Squirrels also use their tails to keep warm. They wrap their tails around their bodies like blankets. Squirrels also stay close together in their dens or nests to stay warm.

What have you noticed and learned about how squirrels survive during cold winter months?

How do squirrels change as they grow?

When squirrels are born, they have no fur and they cannot see. Baby squirrels cannot see because their eyelids are sealed shut. Look at the picture. How do you think a baby squirrel can survive and grow?

"Pup" by Travis Witt is licensed under CC BY-SA 3.0

Baby squirrel

When trees lose their leaves, you may see nests in the branches. You might think that these nests were made by birds. But many nests are made by squirrels. Baby squirrels are born in these nests. They depend on their mothers to protect them. And their mothers feed them. Like all mammals, baby squirrels drink their mother's milk.

Co-developed by the Multiple Literacies in Project-based Learning Project at Michigan State University and the University of Michigan 2018–2019

“Squirrel nest in white oak” by NatureServe is licensed under CC BY-NC 2.0

Squirrel drey, or nest

After 9 months, squirrels are fully grown. They will soon be ready to start their own families. First, they have to build a home. Squirrels have two kinds of homes. One is a den. The other is a drey.

A **den** is a hole in a tree. The den is lined with leaves and grass. A **drey** is like a large bird’s nest. The drey is made of leaves and twigs. It is built high in a tree.

How do squirrel homes help squirrels survive?

When you went outside to look for squirrels, did you see a den or a drey?

What did it look like?

Learning Set Driving Question
LS1: What do squirrels need to survive?

L1.7 Revising Survival Models

Lesson Snapshot

Learning Set Driving Question
LS1: What do squirrels need to survive?

Lesson Driving Question
L1.7: What can we learn from each other by sharing and revising our models?

Lesson Overview
1. Introduction: Introduce the lesson DQ. Discuss what *revise* means. Ask, "Why would someone want to revise something. Why do scientists revise?"
2. Whole Group Revisions: Demonstrate to the class how revising models works, using a student's model.
3. Partner Revisions: Students share their models with a partner. They give each other feedback and suggestions. They revise their models. Students share out the suggestions they received from their partners, their revisions, and the reasoning behind the revisions.
4. Learning Set Wrap Up - "Big Ideas" and "Take Aways": Review the Learning Set and collaboratively discuss and write down "Big Ideas" or "take aways."

Objectives

Learning Performance
Students will review and revise a model, explaining how interactions between squirrels' needs and the environment allow them to survive (through the lenses of *cause and effect* and *systems and system models*).

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all. (met in LS 4-6)

Figuring Out Statement, Look Fors, and Evidence Statements	Universal Supports
Figuring Out 1. **Students are figuring out that** new evidence adds to their understanding of the phenomenon and that their models can be improved based on feedback from	***Embedded Language Supports*** • Models support listening and speaking about science ideas • Negotiation of meaning with partner • Support for describing "Big Ideas"

one another. 2. **Students are figuring out that** the interactions often have a *cause and effect* relationship and that the *systems they are studying* about the life cycle are *part of a larger system* that relates to a squirrel's survival. **Look Fors** 1. **Look for** students thoughtfully considering the suggestions made by others for revising their survival story models and incorporating suggestions or disagreeing with them based on reasoning and evidence. 2. **Look for** students thinking about *systems* and *cause and effect* with respect to a squirrel's survival. **Evidence Statement** 1. Students' suggestions for revisions will incorporate some data from the observations and written materials. 2. Students' responses to the suggestions include evidence and reasoning. 3. The model will (creatively) use the lens of *systems and system models* to show *cause and effect*.	• Specific guidance in metacognition • Discourse moves from WIDA

Teacher Preparation	Materials
• Pre-teach giving suggestions for those who may need it. • Pre-teach listening to suggestions for those who may need it. • Select a model to share and analyze; choose one from a student who will respond well to the whole group analysis and suggestions for revision.	***Teacher Materials*** • Driving Question Board (DQB) • Lesson 1.7 Driving Question • An overhead projector, Elmo (document camera), or some other way to share models with the class ***Student Materials*** • Science notebooks with models of survival from L1.5

Lesson Segments	Estimated Time
Introduction	10 min
Whole Group Revisions	15 min
Partner Revisions	15 min

Learning Set Wrap Up - “Big Ideas” and “Take Aways”	10 min
	Total Time: 50 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Introduce phenomenon and DQ, *"What can we learn from each other by sharing and revising our models?"*** 1. Ask students to read out loud together the Lesson 1.7 Driving Question: ***"What can we learn from each other by sharing and revising our models?"*** Ask two students to share what they think they will be figuring out in this lesson. 2. Explain that each student will give and receive revision suggestions for how to improve the model they constructed in L1.5. **Suggested Prompt:** "*Scientists are always thinking about their own thinking and changing their thinking based on new evidence. Scientists talk to one another about what they are thinking. They often ask other scientists to help them revise their models. Today we are going to do exactly what scientists do and share and revise models*."	**10 min**
2	**Whole Group Revisions: Provide feedback on models** 1. Show the class the student model you selected. Explain that this model is an example of one way to describe how squirrels survive in their environment. Emphasize that each person has a different way to tell the story and show ideas and that each person uses different evidence to connect to the needs for survival. 2. Ask multiple students to use the model to tell a part of that student's story. Ask students to point to the part of the model to which they are referring. 3. Ask students to think about one thing they might change based on evidence, a different connection between needs and survival, or the reading from L1.4. Have students do a *turn-and-talk* to share their ideas. Select volunteers to share what they would change or add to the model. 4. Ask the student whose model is being projected to respond to the suggestions. **Suggested Prompts:** "*Which change would you make and why? Which suggested change might you choose not to make and why?"* 5. Emphasize to students that *they* get to choose what to revise because it is their model and they choose the story they want to tell (explain) with their model. But they must have a reason for their decision.	**15 min**

3	**Partner Revisions: Give and receive suggestions for revision**
	1. Students work on reading their partners' models and telling the story, checking with partners that they got the story (explanation) right.
	2. Each student suggests one revision to their partner's model. They must write
	    a. What the suggestion is and
	    b. Why they made that suggestion.
	3. Partners read the suggestions. They respond to the suggestions, saying
	    a. "Yes, I will make the revision," or "No, I do not accept the suggestion".
	    b. Why or why not.
	4. Students revise their models.
	5. Share Out: Have some students share what they revised.
	
	Discourse Move - Make ideas public
	
	Have students share their reasoning
	
	Suggested Prompt: "*Scientists use evidence to make revisions. How did the suggestion make this student's survival story more based on evidence, or in other words, more scientific? How did the student show that organisms and the parts of the environment are connected? How did the student show the effect of having or not having the need met?"*
		15 min

4	**Learning Set Wrap Up: Students come up with a "Big Idea" or "take away" about the Learning Set** 1. Read the lesson DQs from each lesson in the Learning Set. 2. Ask students to first talk to a partner and then share out what they think could be a "Big Idea" of the Learning Set. (Possible Big Idea: ***"Squirrels can survive in their environment because they can meet all their needs."***) 3. When students have come up with their "Big Idea" (claim), have them write it on the DQB or in the oval in the middle of the slide. Additionally, add the same statement to this slide.	**10 min**

Learning Set 2

LS_2 My Notes Tab

Learning Set # 2
Learning Set Driving Question: How is the squirrel's structure unique and important?

Lesson Abridged Comments:

Learning Set Description:

1. **L2.1:** In lesson 1, students try to break apart pine cones and acorns and think about the structure of the squirrel's teeth and jaw. Then they make a claim about the structure of the jaw and how it helps the animals eat the food available to them in their environment.
2. **L2.2: SEL focus lesson:** Students watch a squirrel balancing and then the students design and carry out an investigation plan to try to balance on a rope, an analogy for a branch, and land on a new "branch". They analyze at the squirrel's structure and compare these structures to those of a marmot. The students watch a video of the marmot "balancing". They make a claim that the structure of the squirrel allows it to balance and meet its needs for survival.
3. **L2.3: Math: Jumping contest:** Students make predictions about how far a squirrel can jump and then they participate in a jumping contest. They graph the different jumps and compare their jumps to those of a squirrel.
4. **L2.4: Math continued: Jumping contest:** Students look at the videos of a squirrel jumping and talk about why its is important for the squirrel to be able to jump really far. They think about what it is about the structure of the squirrel that help it jumps so far.
5. **L2.5:** Students engage with text about the squirrel's ankles and how the structure helps it to survive. They observe videos of the squirrel climbing upside down. The students add to their models of squirrel survival to include structures and how they also are important for the squirrel to meet its needs.

Phenomenon: Grey Squirrels look a certain way that makes them recognizable as grey squirrels; they survive where they live; and they look different from marmots. :-)

Learning Performance: *Students will* develop claims and a model using mathematical reasoning that the squirrel's structures *are* related to its survival in its environment. (through the lens of structure and function, patterns, and cause and effect) .

Figuring Out Statement/ DCI
Students are figuring out that the structures of a squirrel are perfectly adapted for the life of a squirrel and are different from those of humans. They figure out that these structures are important to keep in mind when considering how an animal survives, or does not survive, in its environment.

Practice Statement
Throughout this learning set the students are engaging in investigations, including one with text and one with math and measurement to develop claims that will ultimately become a model.

Practice Elements from NGSS
Planning and Carrying Out Investigations: Plan and conduct an investigation collaboratively to produce

data to serve as the basis for evidence.

Constructing Explanations and Designing Solutions: Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.

Using Mathematics and Computational Thinking: Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.

Developing and Using Models: Develop a model using an analogy, example, or abstract representation to describe a scientific principle.

Obtaining, Evaluating, and Communicating Information: Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.

Crosscutting Concepts
Cause and Effect: Cause and effect relationships are routinely identified, tested, and used to explain change.

Structure and Function: Substructures have shapes and parts that serve functions.

Patterns: Patterns can be used as evidence to support an explanation.

Squirrels Learning Set 2– Embedded Language Supports

Lesson 1

- Negotiation of meaning through authentic peer dialogue
- Support language of meaning through realia, videos, and action
- Explicit support in developing claims

Lesson 2

- Negotiation of meaning through authentic peer dialogue
- Support language of meaning through realia, videos, and action
- Explicit support in developing claims
- Discourse moves from WIDA

Lesson 3

- Negotiation of meaning through authentic peer dialogue
- Support language of meaning through graphs, charts, videos, and action
- Explicit support in using data to develop claims
- Discourse moves from WIDA

Lesson 4

- Negotiation of meaning through authentic peer dialogue
- Support language of meaning through videos and action
- Explicit support in using data to develop claims
- Discourse moves from WIDA

Lesson 5

- Opportunity for multiple language domains
- Multimodality
- Discourse moves from WIDA

Learning Set Driving Question
LS2: How is the squirrel's structure unique and important?

L2.1 Squirrel Structures - Teeth

Lesson Snapshot
Learning Set Driving Question LS2: How is the squirrel's structure unique and important? **Lesson Driving Question** LS2.1: How does a squirrel use its teeth to survive outside? **Lesson Overview** 1. Introduction: Introduce the unit DQ. Ask students to think about what they can predict about each animal by looking at its structures. *Turn-and-talk* and share out. 2. Investigation: Students watch and describe a video of a squirrel eating nuts and pinecones. Students try to break apart pinecones and acorns, then look at squirrel skulls to think about the structure of a squirrel's teeth and jaw. 3. Large Group Discussion: Students make claims about the structure of teeth and how it helps animals eat the food available to them in their environment. 4. Wrap Up: Add questions and answers to the DQB. The class creates a shared claim.

Objectives
Learning Performance Students will develop claims that a squirrel's structures are related to its survival in its environment and that a person can tell what an animal ate by looking at its teeth and jaw (through the lens of *structure and function*). **Building Toward PEs** **3-LS3-1** Analyze and interpret data to provide evidence that plants and animals have **traits** inherited from parents and that variation of these traits exists in a group of similar organisms. (met in Birds) **3-LS4-1** Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. (in L4.4) **3-LS4-3** Construct an argument with evidence that in a particular habitat, some organisms survive well, some less well, and some cannot survive at all. (in L3.6)

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** their teeth and a squirrel's teeth are different because they need to do different things and that it is possible to look at	***Embedded Language Supports*** • Negotiation of meaning through authentic peer dialogue

bones and learn something about the animal and how it survives. **Look Fors** 1. **Look for** students building on connections between the structures and environment of squirrels. 2. **Look for** students building on connections between the nuts that squirrels eat and the structure of their skulls and teeth. **Evidence Statement** Student's claim uses data from the investigation and the skull as evidence. The claim indicates that there is a relationship between the structure of teeth and jaw bones and the food an organism eats. In a separate claim, students make the opposite connection that because there is a relationship between structure and function, one could make a guess about what an organism ate by looking at bones and teeth.	• Support language of meaning through realia, videos, and action • Explicit support in developing claims • Discourse moves from WIDA

Teacher Preparation	Materials
• Make sure the nuts are washed, although students won't actually be putting the nuts in their mouths. • Check for allergies**.** Often peanut allergies do not indicate tree-nut allergies. • ***Background Material*** ○ Reading about Eutheria (a mammalian clade) for teachers.	***Teacher Materials*** • Driving Question Board (DQB) • Learning Set 2 Driving Question Slides • Videos: Squirrel eating pinecone, Squirrel eating nuts, Squirrel eating acorn, Marmot video ***Student Materials*** • Skeletal and Body Diagrams of Eastern Gray Squirrels and Marmots including skulls and skeletons • Pinecones, acorns (enough for all in class to have one or two) • Science notebooks

Lesson Segments	Estimated Time
Introduction	10 min
Investigation	10 min
Large Group Discussion	15 min
Wrap Up	15 min
	Total Time: 50 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Introduce phenomenon and DQ, *"How does a squirrel use its teeth to survive outside?"*** 1. Read the lesson DQ with the class. Ask students if they can figure out something about an animal based on its teeth structure. Have them think about their own teeth and describe their structure. Do students use their front teeth to chew different foods than they do their back teeth? *Turn-and-talk* and share out.	**10 min**
2	**Investigation: Investigate how squirrels eat** 1. Ask students what they know about how squirrels eat. Show the pinecones and acorns and help students understand that the seeds are protected by outer layers. 2. Watch the videos of squirrels eating and ask students to describe what they observe in the videos. Ask, "Are the squirrels eating the whole pinecone and acorn? How do you think they get the seed out from the protected layer." 3. Say, "Seeds have special structures to protect them, and animals have special structures too. We can figure out how a squirrel's teeth structure helps it to open nuts and pinecones." 4. Distribute the pinecones and acorns and ask students to try to break them apart, like squirrels do, but with their hands. They can't use any tools. They should not eat the pinecones and acorns, but if that happens these are non-toxic. As students break the pinecones apart, they should think about what structures they have and what structures they would need to eat like squirrels.	**10 min**

3	**Large Group Discussion: Students discuss what structures help squirrels find and eat food** 1. Show the [Skeletal and Body Diagrams of Eastern Gray Squirrels and Marmots including skulls and skeletons]() on the whiteboard, then pass around the skull. As the skull goes around the circle, help students describe and analyze the structures. Have some students share out. **Discourse Move - Help students deepen their reasoning**  **Possible Questions**: "*Can you describe the skull and teeth? Are they different from yours? How do you think the shape, or structure, of the teeth helps squirrels open nuts and peel the outside scales off a pinecone to get the seeds? Look at the way a squirrel's jaw opens, and think about how you broke into the nuts with your hands. How might the structure of the jaw be important?*	**15 min**

4	**Wrap Up: Use questions for reflection in science notebooks** 1. Help the class make claims on the Learning Set 2 Driving Question Slides - Claims about how the structure of teeth helps squirrels meet their needs for survival; press for evidence and reasoning. • **Example:** "*I think a squirrel's hard teeth help it survive. I see that the teeth look like a chisel, and I know from experience that pointy, hard things break hard things like nuts. How would breaking the hard nut shell help squirrels meet their needs for survival? Squirrels eat nuts as food for survival*." 2. Display and describe the pictures of the marmot and the eastern gray squirrel. *Note that the marmot teeth are smaller and rounded while the squirrel's front teeth are chiseled and sharper:* Skeletal and Body Diagrams of Eastern Gray Squirrels and Marmot including skulls and skeletons. 3. Tell students that the marmot is a kind of squirrel in the same family as the ones we see in our community: the eastern gray squirrel (the squirrel whose skull we have), the red squirrel, and the fox and flying squirrels (if applicable). The marmot lives very high in the mountain tundra. 4. Play the video of the eastern gray squirrel eating nuts and/or pinecones again, then play the video of the marmot eating for comparison: Marmot video. **Suggested Prompt:** *"Let's watch what a marmot eats. Think about whether its teeth are different from the eastern gray squirrel's teeth. Would you expect the structure of the marmot's teeth to be different if it eats mostly grass? Why?"* 5. With students' help, write a definition for *structure* and place it on the DQB: Learning Set 2 Driving Question Slides - Definition of Structure. 6. Allow students to review the questions for the DQB on the Learning Set 2 Driving Question Slides and/or offer a new question.	**15 min**

LS2, LS3, LS4 Skulls, pictures, body diagrams of Marmot and Eastern Grey Squirrel

Skeletal and Body Diagrams of Eastern Gray Squirrels and Marmots

"Gray Squirrel Skull" by Wolfiedude101

Squirrel Skulls

Other Squirrel Skull Images

"Murmeltierschädel" by Lokilech is licensed under CC BY-SA 3.0

Marmot Skull -- (teeth rounded and shorter)

NPS, Walter Kaesler

Marmot on Rock

Photo by DAVID ILIFF. License: CC BY-SA 3.0

Squirrel Eating a Nut

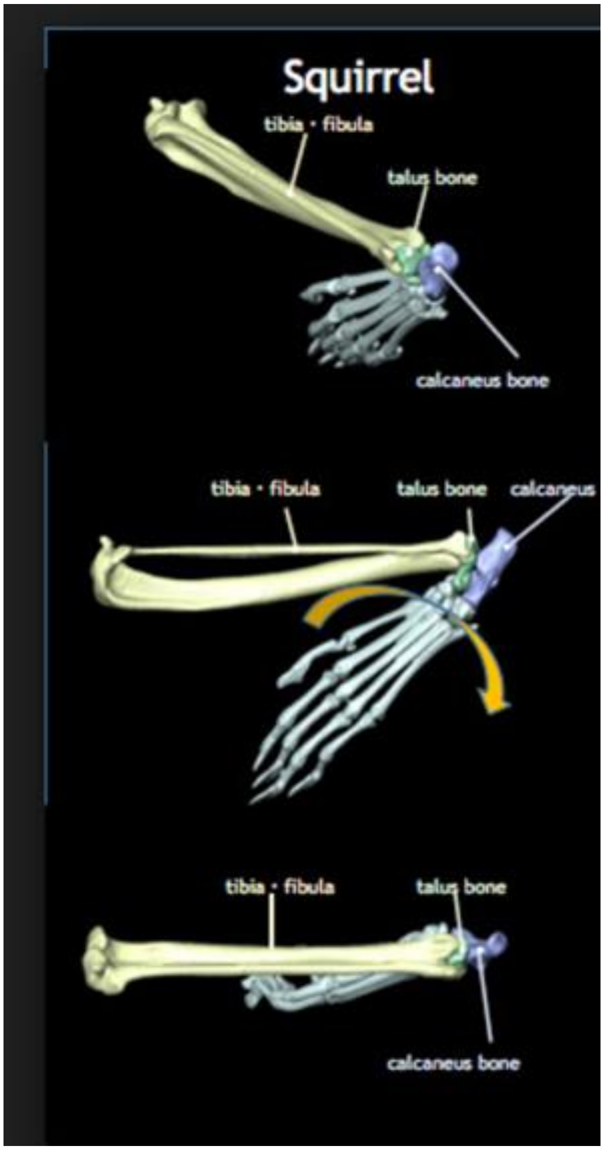
“Serious Squirrel” by Ed Sweeney is licensed under CC BY 2.0

© Copyright Peter Trimming, CC BY

Squirrels Jumping

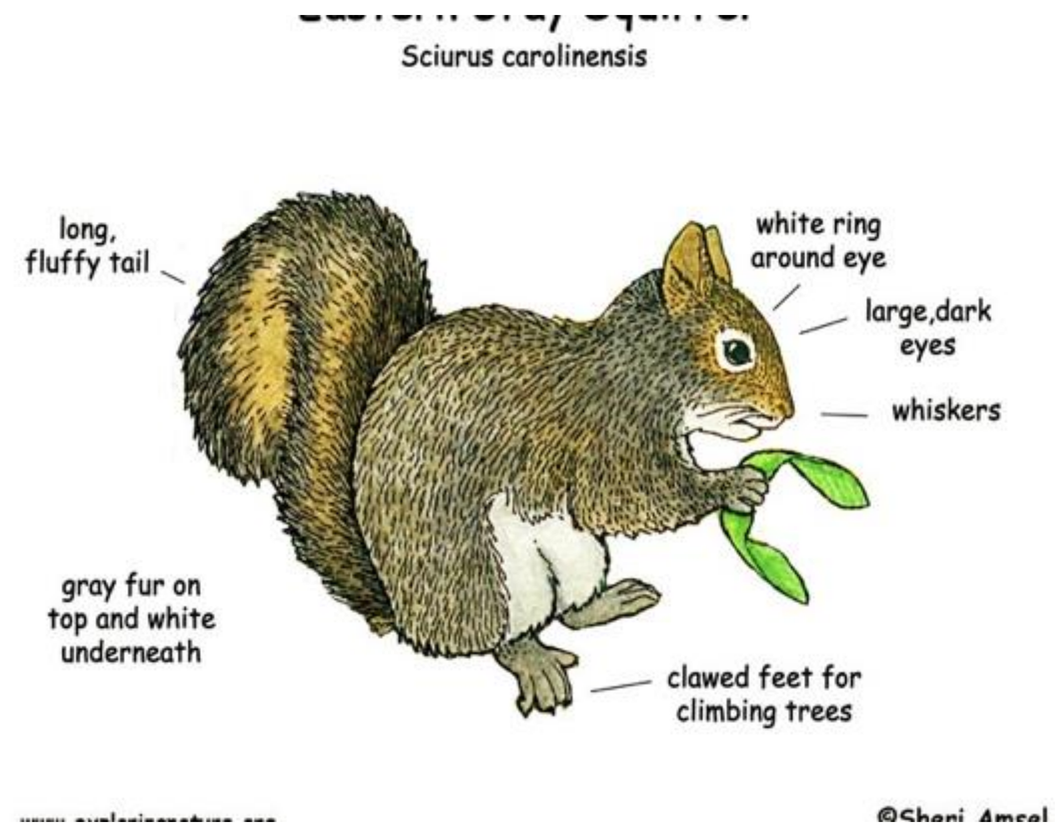
“Yellow-Bellied Marmot” by Inklein is licensed under CC BY-SA 3.0

Marmot Sitting on Rock

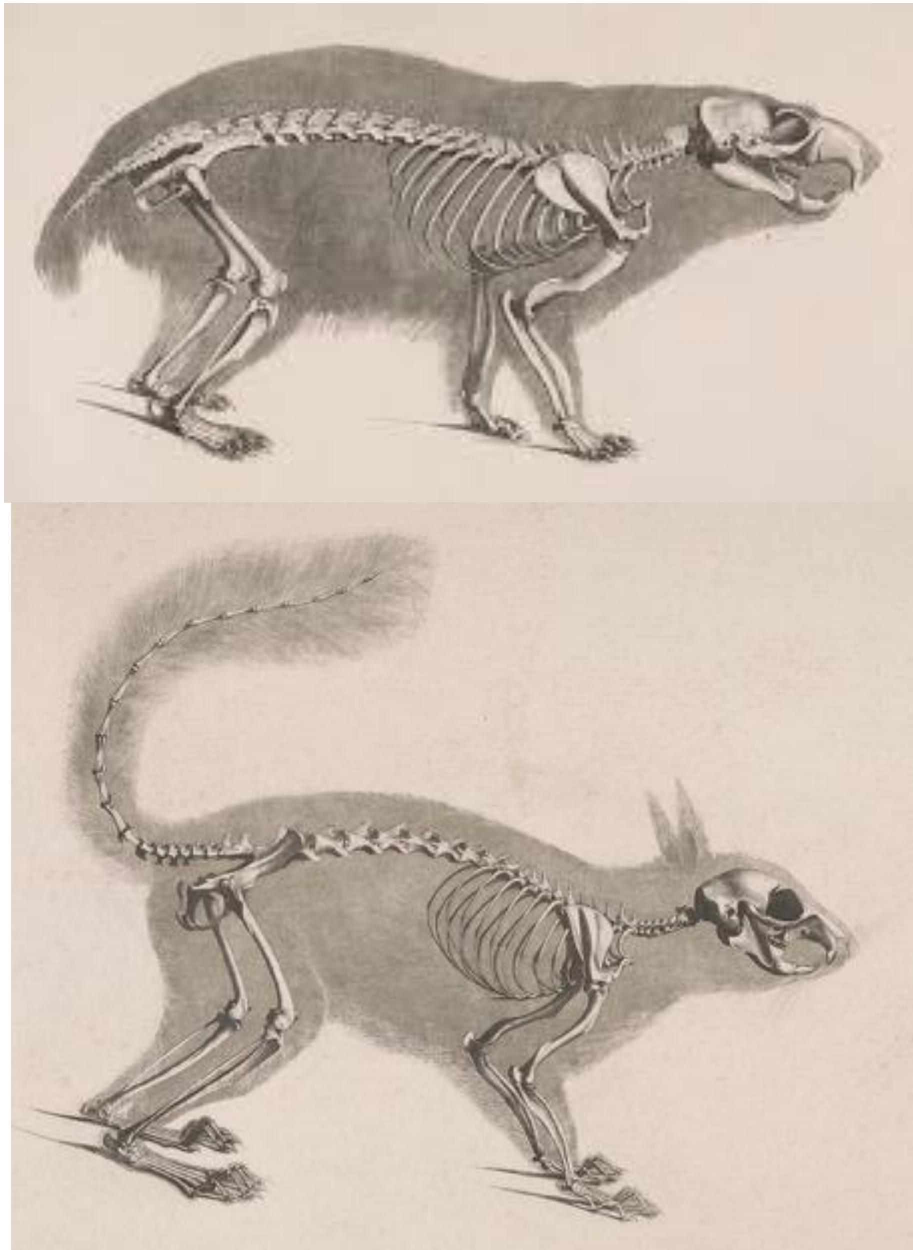


["Mammals' Locomotion" by Naomi Wada, PhD. VMD.]()

"Compression Springs" by Renard is licensed under CC BY-SA 3.0


Sciurus carolinensis
long, fluffy tail
white ring around eye
large,dark eyes
whiskers
gray fur on top and white underneath
clawed feet for climbing trees


Marmota flaviventris
covered in hair
Lighter patch on the nose, between their eyes
small ears
golden on their shoulders and belly.
8-inch tail
sharp claws for digging
darker fur on their backs is frost-tipped



Marmot (top) and Eastern Grey Squirrel (bottom) Body and Skeletons

Learning Set Driving Question
LS2: How is the squirrel's structure unique and important?

L2.2 Squirrels Balancing

Lesson Snapshot

Learning Set Driving Question
LS2: How is the squirrel's structure unique and important?

Lesson Driving Question
L2.2: How does a squirrel balance?
SEL Focus: How can we challenge ourselves?

Lesson Overview

1. Introduction: Watch the balancing video and introduce the lesson DQ and the challenge.
2. Planning and Investigation: Introduce students to another use for models, to test their ideas. Students develop a plan for how they will balance on and walk across a rope (pool noodle). As students test out their plans, plan "checkers" make sure they follow the plan.
3. Analyzing Data and Discussion: Students observe and analyze a squirrel's skeletal structure—tail, body low to the ground, and lightweight body—and compare it with a marmot's skeletal structure. They watch a video of a marmot "balancing." Students make claims with evidence about the need for balance, the squirrel's structure, and how the structure helps the eastern gray squirrel meet its needs for survival.
4. Wrap Up: Students analyze the marmot video, as well as a photo, body, and skeleton of a marmot, and discuss if the marmot needs to balance and how they know.

Objectives

Learning Performance
Students will develop claims with evidence that a squirrel's structures are related to its survival in its environment and that a person can tell the behaviors of an organism by looking at its skeleton (through the lenses of *structure and function, patterns,* and *cause and effect*).

SEL Learning Goal
Identity development during challenges: We can learn to be comfortable with uncertainty and take on the challenge of collaborating with others and finding new ways of engaging with content.

Building Toward PEs
3-LS3-1 Analyze and interpret data to provide evidence that plants and animals have **traits** inherited from parents and that variation of these traits exists in a group of similar organisms. (met in Birds)
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. (in L3.6)
3-LS4-3 Construct an argument with evidence that in a particular habitat, some organisms survive well, some less well, and some cannot survive at all. (in L3.6)

Math Standards
Measurement and Data - Represent and Interpret Data

CCSS.MATH.CONTENT.**3.MD.B.4** Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. **Math Competency Statements** I can generate data by measuring lengths to the half and fourth of an inch/cm.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out 1. **Students are figuring out that** squirrels have special structures that allow them to balance and that they need to balance to survive. Students also make a claim that a person could tell that an animal needed to balance by looking at its skeleton. 2. **(SEL) Students are figuring out that** they are comfortable with taking risks, making mistakes, and trying out new ideas. **Look Fors** 1. **Look for** students basing claims (Learning Set 2 Driving Question Slides - Claim About Structures) on *structure and function* and *cause and effect* and using evidence from the skeleton and body structure. 2. **(SEL)** Throughout the lesson, **look for** students trying new challenges and risking making mistakes. **Evidence Statement** The claim will include evidence from the investigation of balancing and a connection to the skeleton. The second claim is the reverse—that the skeleton gives clues to how an organism might have needed to balance. (SEL) Students will try more than one time.	***Embedded Language Supports*** • Negotiation of meaning through authentic peer dialogue • Support language of meaning through realia, videos, and action • Explicit support in developing claims • Discourse moves from WIDA

Teacher Preparation	Materials
• Have the videos ready. • Decide in advance if there will be rules for balancing (shoes/no shoes, etc.). • Read about squirrels and balancing. • Read about the hoary marmot (resides in the Rocky Mountains).	***Teacher Materials*** • Driving Question Board (DQB) • Learning Set 2 Driving Question Slides • Videos: Squirrel relaxing on telephone wire, Squirrel on obstacle course, Squirrel on phone line; Squirrel jumping, Marmot mother and baby walking on rocks

	• Object or weights of 10 pounds, and an object that weighs just over 1 pound for demonstration • Measuring tape/yardstick or meter stick • Pillow for landing ***Student Materials*** • 2 strands of thick rope (or pool noodles) • Science notebooks • Skeletal and Body Diagrams of Eastern Gray Squirrels and Marmots including skulls and skeletons

Lesson Segments	Estimated Time
Introduction	10 min
Planning and Investigation	25 min
Analyzing Data and Discussion	15 min
Wrap Up	10 min
	Total Time: 60 min

<table>
<tr><th>Part</th><th>Lesson Steps</th><th>Estimated Time / Materials</th></tr>
<tr><td>1</td><td>Introduction: Introduce phenomenon and DQ, “How does a squirrel balance?”

1. Have a student read the Learning Set 2 Driving Question. Remind students that they will still explore squirrel survival, but now they will look at the structures of animals’ bones and bodies to examine how that helps them to survive where they live outside. Have a student read the Lesson 2.2 Driving Question: “How does a squirrel balance?” Discuss in turn-and-talk: “How could we find out how squirrels balance?”

2. Review the student definition of structure from L2.1. Have one student read it to the class. Turn-and-talk: “Will structures be important in this lesson, too?” Have students share what their partners said.

3. Ask students if they’ve ever seen a squirrel jump or balance. Watch videos of a squirrel balancing and jumping: Squirrel relaxing on telephone wire; Squirrel on obstacle course; Squirrel on phone line; Squirrel jumping.

4. Ask students to review the purpose of the survival model they drew in LS 1. “What were they trying to communicate? Why did they make it?” Tell students that they will use a different type of model today. Present the challenge: Students will try to balance on a piece of rope (or pool noodle) while walking from one end to the other. Then they will jump from the end of the rope to a pillow and “land.” Ask students to brainstorm what they think the rope and the yardstick stand for. They will use this physical model to test their ideas about squirrels’ structures and how they help squirrels balance.
• Let students know that they will have more than one chance to try their plan (attempt). Tell them there is no one “right way” to plan and encourage them to try something new.

5. Write down the Lesson 2.1 Driving Question: “How does a squirrel balance?” Have students do a turn-and-talk about what they think they will figure out today. Have two students share what their partners said. Add questions to the DQB.</td><td>10 min</td></tr>
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2	**Planning and Investigation: Describe the challenge for balancing and conducting the investigation** 1. Students design an investigation of themselves, humans, balancing on thick ropes (pool noodles) and jumping and landing. They must make a careful plan, because the class will check their plan for accuracy as they attempt to balance. 2. Students may use a yardstick for balance to stretch behind them like a squirrel’s tail, crouch down low, go sideways, crawl, etc. 3. Students draw plans of themselves balancing on the rope and jumping and landing. 4. After 5–10 minutes, students explain their plans to the class, one by one. Then, they try and balance on the rope as outlined in their plans. 5. Students compare how they balanced and jumped to how squirrels balance (i.e., squirrels flip their tails back and forth, stay low to the ground, are light). This might be a good time to rewatch one of the videos from the introduction. Ask students how the physical model of balancing on the rope as if on a tree branch helps them understand a squirrel’s structure. 6. If there is time, allow students to “correct”their plans and try again (make adjustments so the plan matches what the students do in the trial).	**25 min**

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Analyzing Data and Discussion: Compare a squirrel and a marmot and how they may, or may not, need to balance to survive

Show a picture of a marmot and its environment. Compare the marmot to the eastern gray squirrel. Ask, “How are the structures the same or different?”
Skeletal and Body Diagrams of Eastern Gray Squirrels and Marmots including skulls and skeletons
Write down the measurements of a hoary marmot and an eastern gray squirrel, and demonstrate with objects and tape measure how much these two animals weigh and how long they are. If there is time, students can work in small groups to measure the length of the two animals. Pass around the objects to students.
In North America,

Adult hoary marmots weigh 10 pounds (4.5 kilograms) or more and may exceed 30 inches (76 centimeters) in total length.
Adult eastern gray squirrels can weigh up to about 1 ⅓ pounds (600 grams or 20 ounces) and they are 18 to 20 inches (46 to 51 centimeters) long (including the tail).

Ask students to use evidence to predict if the marmot needs to balance for survival. They should do this in groups of three, then share out in a large group. Help students make sense of one another’s ideas.

Suggested Questions: “How can you use the marmot’s structure and body to make a prediction about the marmot’s needs for survival?” “Could the marmot have different ways of meeting its needs for survival than the eastern grey squirrel? How could this be?”
Watch the video of a marmot to check and discuss claims: Marmot mother and baby walking on rocks.

Discourse Move - Help students listen carefully and think about one another’s ideas


Suggested Prompt: “What is a difference that your friends noticed about the marmot’s structure compared with the squirrel’s? How do they think this structure helps or doesn’t help the marmot balance and jump in trees? Does their idea make sense to you?”
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<td>15 min</td>
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4	**Wrap Up: Wrap up and use questions for reflection in science notebooks** 1. As a large group, construct an explanation about the need to balance, the structure of squirrels, and how this structure helps them meet their needs for survival. Once a claim is agreed upon, write it on the DQB slides. 2. If there is time, look over the Learning Set 2 Driving Question Board Slides; decide if any questions have been answered.	**10 min**

Learning Set Driving Question
LS2: How is the squirrel's structure unique and important?

L2.3 Squirrels Jumping, Part 1

Lesson Snapshot
Learning Set Driving Question LS2: How is the squirrel's structure unique and important? **Lesson Driving Question** LS2.3: How does a squirrel jump so far? **Math:** How does a line plot help me understand how squirrels jump? **Lesson Overview** 1. Introduction: Review the unit DQ, introduce the lesson DQ, and watch and describe a video. Students make predictions about whether squirrels or humans can jump farther and why. 2. Investigation: Students jump and take measurements. 3. Data Analysis - Mathematical Thinking: Students graph their data. 4. Group Discussion: Discuss the data. Students make claims linking the specialized structures of squirrels and the need to jump far to meet their needs for survival. 5. Wrap Up: Five minutes of free writing or drawing on a proposed question.

Objectives
Learning Performance Students will use mathematical thinking to support claims that a squirrel's structures are related to its survival in its environment and that a scientist can tell that an organism might have lived in trees by looking at its skeleton (through the lens of *structure and function*). **Math Standards** **Measurement and Data -** Represent and Interpret Data CCSS.MATH.CONTENT.**3.MD.B.4** Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. **Math Competency Statements** I can generate data by measuring lengths to the half and fourth of an inch. I can represent measurement data in halves and fourths of an inch on a line plot.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out	***Embedded Language Supports***

Students are figuring out that squirrels have body structures that are different from humans and that can help them jump far. **Look Fors** 1. During the investigations, **look for** students using the data from the line plot correctly. 2. In the final writing, **look for** students collaboratively constructing the idea that a squirrel's structure helps it jump, and it must jump to survive. **Evidence Statement** The claim students develop uses evidence (data) from the math investigation and the skeleton and body of a squirrel. Students use their observations from field notes to help them think of reasons why the squirrel's structure would help the squirrel jump far. They must connect the structure of a squirrel's body to its ability to jump. They also may make the connection that the skeleton of a marmot, structured the way it is, means that a marmot is not likely to be able to jump far and that it must not need to jump far to survive.	• Negotiation of meaning through authentic peer dialogue • Support language of meaning through graphs, charts, videos, and action • Explicit support in using data to develop claims • Discourse moves from WIDA

Teacher Preparation	Materials
• Use yardsticks or measuring tape that allow for measurement in inches (measuring tools can be taped to the floor) or have sticky notes available to record jumps and measure the distance afterward. • If you do not have enough time to finish the lesson in one period, continue during the next class period. Another option is to complete some of the lesson during a math period. • ***Background Information*** ○ Reading about hoary marmots for teachers.	***Teacher Materials*** • Driving Question Board (DQB) • Skeletal and Body Diagrams of Eastern Gray Squirrels and Marmots including skulls and skeletons • Video: How to do a standing broad jump • Video: Squirrel jumping • Video: Byron Jones jump ***Student Materials*** • Measuring tools for measuring in inches • Sticky notes for data collection • Graph paper • Student worksheet - The Jumping Contest: Student vs. Squirrel, one per student; each group needs a conversion chart

Lesson Segments	Estimated Time
Introduction	15 min
Investigation	30 min

Data Analysis - Mathematical Thinking	15 min
Group Discussion	20 min
Wrap Up	10 min
This lesson could be integrated into the Math Block.	**Total Time:** 90 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Introduce phenomenon and DQ, *"How does a squirrel jump so far?"*** 1. Review the unit DQ. Explain that together you will analyze a squirrel's body structures and think about survival. You will explain how some structures help squirrels survive in trees. 2. Have a student read the Lesson 2.3 Driving Question, ***"How does a squirrel jump so far?,"*** on the DQB and the claim(s) about structures from L2.2. Discuss in *turn-and-talk:* "Does anyone have a prediction (about an answer to the DQ)?" 3. Show the video of a squirrel jumping; choose a student to narrate. **Suggested Prompt:** "*Now we are going to watch a short video of a squirrel jumping. As you watch, pay attention to where the squirrel jumps from, what its body looks like when jumping, and how it holds on to the branch after jumping."* Ask three volunteers what they notice. 4. Explain that students will jump and find out how their jumps compare with those of a squirrel. 5. Have a few students demonstrate for the class how they would "jump like a squirrel." Students can jump using all four limbs or they can jump using just their feet and legs. After each jump, the teacher or student volunteer(s) measures and records the jump length on chart paper or the chalkboard. 6. Students *turn-and-talk* after each jump to see how the student jumpers used their bodies. What did they do with their legs and arms? Were they standing? How did the rest of their bodies look? Which jump was the longest? Why do students think this was? 7. Prediction**:** *Turn-and-talk* and predict whether a squirrel's body structure is better suited for jumping than a human's body structure. Explain the prediction.	**15 min**

2	**Investigation: Students jump and take measurements** 1. **Prepare for Jumping**: Separate students into pre-arranged groups. Remind them about the tools they will use for measuring. Tell students that now they will try to jump as far as a squirrel. 2. Give each group the jumping instructions in the student worksheet - The Jumping Contest: Student vs. Squirrel and show the video of how to do a standing broad jump. 3. Demonstrate how to place yardsticks/measuring tape on the floor end -to -end. Tape yardsticks/measuring tape down. Place masking tape at the bottom of the first yardstick/measuring tape to mark the starting line. Remind students that tree squirrels, like eastern gray squirrels, can jump horizontally 8 to 10 feet. Show students the yardsticks/measuring tape that measure 9 feet (108 inches) on the floor. (To save time, set up the yardsticks/measuring tape before beginning the lesson if possible.) 4. In groups of three or four, students jump and tally their results on their student worksheet - The Jumping Contest: Student vs. Squirrel. Students may jump three times and record their best jump.	**30 min**
3	**Data Analysis - Mathematical Thinking: Students create a line plot to compare their jumps** **Suggested Prompt:** "*Now that we have each recorded our information, let's see how our jumps compare with those of an average eastern gray squirrel. We will make a line plot of how far each of us jumped.*" Start putting a plot up on the board, or have one already started to save on time. "*My first mark is 2 feet, but we can change our first number to reflect the shortest distance someone jumped*." 1. Support the class in filling in numbers on the line plot. The line plot should have a mark for every inch between 2 feet (or the shortest jump) and the longest jump. (Leave room on the end if possible to go to 9 feet [108 inches] or have an idea of where the 9-foot mark might be.) 2. Once the numbers are all written, have students come up in small groups and place their sticky notes above the numbers on the line plot that match their jumps. Sticky notes that have the same measurement should be stacked one above the other on the line plot. 3. Making plots with partners or a small group: Working with partners, students should review and discuss the information from the class plot, make their own copy of the plot, then answer the questions in Part II of the student worksheet - The Jumping Contest: Student vs. Squirrel.	**15 min**

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Group Discussion: Analyze the data

Once the line plots are finished, bring students together on the rug or at their desks so they can see the information.
Ask, “How do we measure up to the average squirrel?” Review the information students recorded:

What is the minimum (smallest) measurement on the plot?
What is the maximum (largest) measurement on the plot?

Possible Questions for Discussion: Show yardsticks/measuring tape measuring 9 feet. Say, “Now that we see how far we can jump, let’s compare that with squirrels. What is the longest jump on our line plot?”

“If a squirrel jumps between 8 feet and 10 feet, where would the squirrel measurement be on the line plot?” Place the squirrel’s measurement on the line plot.

Have students show how long 9 feet (108 inches) is with yardsticks/measuring tape. Then ask the following:

“About how many more inches would the longest jumper in the class have to jump in order to reach 9 feet?”
“The average eastern gray squirrel head and body length is between 9 and 12 inches long. If a squirrel were 12 inches (or 1 foot) long it could jump 8 to 10 times its body length. If a 3rd grader is 4 feet tall, jumping 8 to 10 times his or her body length means that child could jump between 32 and 40 feet.”
“Can human beings jump as far as squirrels? The current standing long jump record is held by football player Byron Jones. He recorded a jump of 12 feet, 2 ¾ inches (146 ¾ inches) on February 23, 2015.” Here is a video of that jump: Byron Jones jump.

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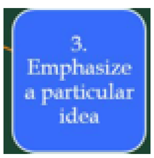
5	**Wrap Up: Wrap up and use questions for reflection in science notebooks** 1. Say, "What is one structure that squirrels have that helps them jump far?" Return to the student definition of *structure* on the Learning Set 2 Driving Question Slides - Definition of Structure. *"Does the definition still make sense? How might you change it?"* 2. **Writing Prompt** (Questions 6 and 7 on the student worksheet - The Jumping Contest: Student vs. Squirrel): **Question 6:** Why does a squirrel need to jump long distances to survive? **Claim:** ______ **Question 7:** What about a squirrel's body and skeletal structure makes the squirrel a better jumper than me? **Claim:** ______ 3. Review the claim about structures and ask if students would like to add anything to it. **Discourse Move - Emphasize a particular idea**  *Help students notice if the ideas they present respond to the question or topic at hand. Press students to discuss ideas that connect a squirrel's needs for survival with the ability to jump, and connect the ability to jump with a squirrel's structure.*	**10 min**

The Jumping Contest: Student vs. Squirrel

Part I. For this contest, follow the directions on the Jump Instructions page, then record your information on sticky notes and below.

1) Jump 1: In inches ______

2) Jump 2: In inches ______

3) Jump 3: In inches ______

4) What is your longest jump? In inches ______

STOP HERE: We will now make a class line plot together.

Part II. Complete the class line plot on your own graph paper, then answer the following questions:

1) What is the **minimum** (shortest distance) jump for our class?

2) What is the **maximum** (longest distance) jump for our class?

3) How does your jump compare with that of the average eastern gray squirrel? Remember, these squirrels can jump an average of 8 to 10 feet. You will need to convert this information to inches using the conversion chart provided. (Choose 8, 9, or 10 feet.)

4) How does the average jump of the eastern gray squirrel compare with the longest jump in our class?

5) Do you think a person could jump as far as a squirrel if he or she were jumping from and to branches on a tree? Why or why not?

STOP HERE: Save questions 6 and 7 for the Wrap Up at the end.

Part III.

6) Why do you think it is important for squirrels to jump long distances to survive? Why would it not be necessary for humans or marmots to have this same skill?

7) Predict: What about a squirrel's body and skeletal structure makes the squirrel a better jumper? (Use words and/or pictures to show your thinking.)

The Jumping Contest: Student vs. Squirrel

Feet and Inches Conversion Chart

Inches	Feet
12 inches	1 foot
24 inches	2 feet
36 inches	3 feet
48 inches	4 feet
60 inches	5 feet
72 inches	6 feet
84 inches	7 feet
96 inches	8 feet
108 inches	9 feet
120 inches	10 feet

Co-developed by the Multiple Literacies in Project-based Learning Project at Michigan State University and the University of Michigan 2018–2019

The Jumping Contest: Student vs. Squirrel

Jump Instructions

1) Students work in pairs or small groups.
2) Each student gets three jumps, using his/her longest jump for the final result.
3) The jumper starts where the masking tape is placed. His/her toes should line up at the bottom of the first yardstick/measuring tape. Students should jump from a standing position.
4) When the jump is finished, the jumper waits for his/her partner to measure the distance to the nearest inch.
5) The jumper records the distance on a sticky note. Partners may help each other record the information accurately.
6) Take turns until all students have their jump lengths recorded. Place the information on your worksheet.

2.4 Squirrels Jumping, Part 2

Learning Set Driving Question
LS2: How is the squirrel's structure unique and important?

L2.4 Squirrels Jumping, Part 2

Lesson Snapshot

Learning Set Driving Question
LS2: How is the squirrel's structure unique and important?

Lesson Driving Question
L2.4: How does a squirrel jump so far?
Math: How does a line plot help me understand how squirrels jump?

Lesson Overview

1. Introduction: Review the unit DQ. Some students will share what they wrote at the end of L2.3.
2. Exploration and Group Discussion: Students will watch a brief video of a squirrel jumping. They discuss jumping notes and answer the question "What could we change about our bodies so that we could jump as far as squirrels?" They consider structures for jumping.
3. Analysis: Students analyze the squirrel skeleton, weight, and jumping ability. Afterward ask, "Do squirrels need to jump for survival?"
    a. Creating Models: Students create a model, in small groups, of squirrel structures for jumping.
    b. Museum Walk: Museum walk of posters.
4. Wrap Up: Add questions and answers and vocabulary to the DQB.

Objectives

Learning Performance
Students will use mathematical thinking to support claims that a squirrel's structures are related to its survival in its environment and that a scientist can tell that an organism might have lived in trees by looking at its skeleton (through the lens of *structure and function*).

Math Standards
Measurement and Data - Represent and Interpret Data
CCSS.MATH.CONTENT.**3.MD.B.4**
Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

Math Competency Statement
I can represent measurement data in halves and fourths of an inch on a line plot.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** squirrels can jump so far because of their skeletal structure, long body and tail, springy back legs, and light bones. **Look Fors** 1. **Look for** students listening to and thinking about one another's ideas. 2. **Look for** students identifying structural characteristics that would enable tree squirrels to jump far. **Evidence Statement** The claims that students develop use evidence from the math investigation and the skeleton and body of the squirrel. Students use their observations from field notes to help them think of reasons why having special structures enables squirrels to jump far and understand that squirrels need this ability to survive.	***Embedded Language Supports*** • Negotiation of meaning through authentic peer dialogue • Support language of meaning through videos and action • Explicit support in using data to develop claims • Discourse moves from WIDA

Teacher Preparation	Materials
• Have the graph from L2.3 available for review. • Have the claim about structures from L2.1–2.3 available so that you can revisit and revise it after this lesson. ***Background Information*** • Reading about hoary marmots • Elephants Can't jump—and Here's Why • Why Can't Elephants Jump? • Mammals' Locomotion	***Teacher Materials*** • Driving Question Board (DQB) • Lesson 2.4 Driving Question • Skeletal and Body Diagrams of Marmots and Eastern Gray Squirrels including skulls and skeletons ***Student Materials*** • Worksheets for students to cut out and label • Poster paper/chart paper for museum walk for small groups • Video: Squirrel jumping

Lesson Segments	Estimated Time
Introduction	10 min
Exploration and Group Discussion	20 min
Analysis	20 min
Wrap Up	10 min

This lesson could be integrated into the Math Block.	**Total Time:** 60 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Introduce phenomenon and DQ, *"How does a squirrel jump so far?"*** 1. Review the Lesson 2.4 Driving Question: ***"How does a squirrel jump so far?"*** Ask students to share with their partners what they figured out in L2.3 and how they used the line plot as evidence to support their claim. 2. Ask for volunteers to read their answers to the questions "*Why does a squirrel need to jump long distances to survive? Why would it not be necessary for a human or a marmot to have this same skill? What about a squirrel's body and skeletal structure makes the squirrel a better jumper than me?"* (Questions 6 and 7 on the student worksheet - The Jumping Contest: Student vs. Squirrel from L2.3). 3. Return to the definition of structure that the class came up with. Ask a volunteer to review it for the class and provide an example of a structure.	**10 min**

2	**Exploration and Group Discussion: Students consider structures for jumping** 1. Tell students that they will watch a short video that shows a squirrel jumping. 2. Show students ***only the first 1 minute and 15 seconds*** of the video. **Suggested Prompt:** *"We saw this video yesterday. Today we will watch it again, and while you watch it, think about how the squirrel's body might help it jump farther than most humans."* 3. Share and Mimic: Jumping observations. Students *turn-and-talk,* make observations, and try to jump like a squirrel. Have students compare jumping with their legs straight with jumping with their legs bent and flexible like a spring and stretching out their arms. 4. Distribute pictures of the skeleton and body of a squirrel from Skeletal and Body Diagrams of Marmots and Eastern Gray Squirrels including skulls and skeletons. **Discourse Move - Help students apply their thinking to others' ideas**  **Suggested Prompts**: Consider other's ideas: *"Think about the structures of squirrels and objects that move through the air. Can you make any connections between the structure of a paper airplane or frisbee and a squirrel? Can you describe the connection? What is similar? How does being able to jump long distances help a squirrel survive?"*	**20 min**

3	**Analysis: Analyze structures for jumping** 1. Distribute poster paper and worksheets for students to cut out and label to pairs or groups of three. 2. Students glue pictures on a large poster and draw arrows identifying areas that are key to helping the animal jump. 3. Students do a museum walk in which they walk around and read one another's diagrams on their tables or desks. Give each student pair a sticky note and let them know that they should put the sticky note (with their initials) on a poster explaining a structure that was different from one on their poster. 4. Students do a quick share out of something they learned or wondered about from a group's diagram.  **Squirrel skeleton**	**20 min**
4	**Wrap Up: Revisit DQB** 1. Students add questions to the Lesson 2.4 Driving Question slide. Review the claims about structures that the class came up with. Ask for suggestions for responses to at least one of the questions on the board. You may select one that students might try to answer based on new evidence.	**10 min**

2.4 Student sheet

Squirrel Structure Analysis

Writing Prompt: Cut out the pictures and, with your partner, draw arrows to the body parts or structures that help tree squirrels jump so far.

When you are finished drawing the arrows, write one to three sentences about what you notice.

"Serious Squirrel" by Ed Sweeney is licensed under CC BY 2.0

Think about a spring, rubber band, frisbee, and paper airplane. Do any of these objects have structures that seem like a squirrel's structure? Explain using words and drawings.

Learning Set Driving Question
LS2: How is the squirrel's structure unique and important?

L2.5 Squirrel Structures

Lesson Snapshot

Learning Set Driving Question
LS2: How is the squirrel's structure unique and important?

Lesson Driving Question
L2.5: How do the squirrel's structures help it meet its needs and survive in its environment?

Lesson Overview

1. Introduction: Review the unit DQ and quickly review key features from the models from L2.4. Introduce the challenge.
2. Research: Students watch a brief video of a squirrel climbing headfirst down a tree.
3. Shared Reading and Discussion: Students read a text, *For Squirrels, It's Headfirst and Down!,* about how the structure of the squirrel helps it climb trees. Students think about other structures.
4. Shared Model: Develop teacher-created model of the squirrel in its environment.
5. Wrap Up: Add questions and answers and vocabulary to the DQB.

Objectives

Learning Performance
Students will develop a model that shows a squirrel's structures *are* related to its survival in its environment and that you can tell things about an animal's environment and behavior by looking at its structure (through the lenses of *structure and function, patterns,* and *cause and effect*).

Building Toward PEs
3-LS3-1 Analyze and interpret data to provide evidence that plants and animals have **traits** inherited from parents and that variation of these traits exists in a group of similar organisms. (met in Birds)
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. (in L3.6)
3-LS4-3 Construct an argument with evidence that in a particular habitat, some organisms survive well, some less well, and some cannot survive at all. (in L3.6)

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out 1. **Students are figuring out that** there is an ankle structure unique to squirrels that helps them survive and that they can tell	***Embedded Language Supports*** • Opportunity for multiple language domains • Multimodality • Discourse moves from WIDA

by a squirrel's bones that it could go down trees head first. 2. **Students are figuring out that** all of a squirrel's structures come together to help it survive in this environment. **Look Fors** 1. **Look for** students drawing connections in their reasoning between the structure of squirrels and the environment and the needs of squirrels. 2. **Look for** explicit thinking about *structure and function* and how they affect survival *(are causes for survival).* **Evidence Statement** The model should depict the relationships between all the components—the squirrel's structure, the environment, and survival of the squirrel. The model should show how the components are related (by arrows, words, and lines, etc.) and can be used to explain the relationships.	

Teacher Preparation	Materials
• Take a few minutes to watch the videos and figure out where to pause them to point out structures or climbing behavior. • Select a nearby tall, un-climbable tree for the students to try (and fail) to climb.	***Teacher Materials*** • Driving Question Board (DQB) • Lesson 2.5 Driving Question • Videos: Squirrel climbing palm tree, Squirrel climbing/jumping, Squirrel climbing down headfirst • Interactive reading guide ***Student Materials*** • Copies of shared reading: *For Squirrels, It's Headfirst and Down!* (find the reading without responses boxes here) ○ WeRead version of shared reading

Lesson Segments	Estimated Time
Introduction	10 min
Research	20 min
Shared Reading and Discussion	20 min
Shared Model	10 min

Wrap Up	10 min
Portions of this lesson could be integrated into the Literacy Block.	**Total Time:** 70 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Introduce phenomenon and DQ, *"How do the squirrel's structures help it meet its needs and survive in its environment?"*** 1. Review the unit DQ. **Suggested Prompt:** *"Earlier we researched some squirrel activities. We saw that our bodies needed to be different to eat and balance on branches and jump far. Today we are going to do another squirrel investigation, and then we will make a shared model of how a squirrel's structures help it eat, balance, jump, and climb."* 2. Have a student read the Lesson 2.5 Driving Question slowly as you write it down: ***"How do the squirrel's structures help it meet its needs and survive in its environment?"*** 3. Consider the word *environment* and help students explain this word. Ask them to think about things that are in the gray squirrel's environment. Let them popcorn (throw out ideas). Repeat (or have a student repeat) the ideas you hear. **Discourse Move - Help students deepen their reasoning** When you hear the word *trees*, solicit ideas from students and press for reasoning.  **Suggested Prompts:** "*Are there some needs that squirrels have that require them to climb up and down trees (building nests, gathering nuts, running away and hiding from predators)? Why do they need to climb up and down trees fast?"*	**10 min**

2	**Research: Consider structures that help animals climb trees** 1. Go outside and stand by the tree(s) selected. **Suggested Prompt:** "*We are going to figure out how our bodies would need to change to climb trees and how a squirrel's structures help it go up and down trees really fast*." 2. Have students, one by one, try to climb a tree. Make sure it is a tree that students would not be able to climb. Say, "*One by one, try to climb a tree that you have seen a squirrel climb*." • **Possible Questions**: Make connections as students try to climb: *"What would help you to climb the tree? What do you need on your fingers to help you? I saw a squirrel do this, and it looked so easy! Could you climb upside down with your head pointing down? Why not?"*	**20 min**

3	**Shared Reading and Discussion: Think about predictions for structures** 1. Watch the videos (squirrel climbing palm tree, squirrel climbing/jumping, squirrel climbing down headfirst) and ask students for their observations about how the squirrel is climbing up and down the tree. If students notice that the squirrel can dig its claws into the tree, climb perpendicular, or swivel its ankles backwards as it is climbing down the tree, emphasize these observations. 2. Introduce the reading about squirrels: *For Squirrels, It's Headfirst and Down!* (WeRead version) Explain that students can use it to consider some of the predictions they made about how squirrels climb down trees. Engage students in an interactive read aloud of the text (see the interactive reading guide). Tell students that you will read aloud and pause periodically to ask about their thinking and discuss ideas in the text, as they follow along using digital or printed copies of the text. **Note:** *You will notice that there are supportive questions followed by boxes in which students may enter written responses, either digitally or on paper. You may choose whether you want students to enter written responses as a quick check of understanding or to use these as discussion prompts to engage students in a whole-group discussion about the ideas in the text.* 3. Discuss evidence from the text that supports the predictions about how the squirrel climbs upside down. **Suggested Prompt**: *"Turn-and-talk to your partner about how a squirrel's unique, or special, ankle structure helps it live its life as a squirrel. Be ready to explain to the whole group how the squirrel gets one of its needs met because of the structure of its ankle. Use evidence to support your response.*	**20 min**

4	**Shared Model: Add to and revise models** 1. Use one of the student's models from L1.5. With the class's help, show how one of the squirrel's structures helps it meet one of its needs. Pick a need that is already shown in the model. Remind students that their models must explain how a squirrel can survive in its environment. 2. Ask students for ideas about how to add to the model to show additional needs of the squirrel and how the squirrel's structures help it survive. Show students how to add to their own models by drawing student's ideas on the projected model. **Suggested Prompts:** *"How could we show in the model how structures and a squirrel's needs are related? Can we tell from the squirrel's structure that it is suited for its environment?"* 3. Ask students to revise or add to their own models from L1.5 to include one structure that helps the squirrel meet one of its needs for survival. Make sure students write what they added to their models and why that structure is important for meeting the need for survival. 4. Ask a few volunteers to share what they added to their model and why.	**10 min**
5	**Wrap Up: Class-generated claim and reflection on LS** 1. As a class, write a claim (use the second box) about how a squirrel's ankles help it survive. Add this claim to other class claims students have made about a squirrel's structures. 2. Return to the DQB and record new questions and the word *environment* with an initial definition. 3. Look over all of the lesson DQs for this learning set. Ask students to come up with the **overall "Big Idea" for this learning set** and write it in the oval in the middle of the slide. Additionally, add the same "Big Idea" to this slide. • Example: Special structures help animals survive. The structures can give clues to how animals meet their needs and survive.	**10 min**

For Squirrels, It's Headfirst and Down!

Red Squirrel Moving Down and Oak Tree by R. Drake is licensed under CC BY-SA 4.0

Red squirrel climbing down an oak tree

Have you ever seen a squirrel climbing down a tree like the one in the photograph?

How does a squirrel's body help it do that?

A squirrel has special features or structures that allow it to climb down trees headfirst. **What do you think those structures are?**

There are four.

"Squirrel dexterity demonstration" by Tomi Tapio is licensed under CC BY 2.0

Squirrel hanging onto the side of a tree

If you think that a squirrel's claws help it to climb, you are right. With its sharp claws, a squirrel can grip the bark of a tree. The strong grip of the front claws allows the squirrel to hold on while it moves its back feet. Then the back feet can hold on while the front feet move.

The claws are attached to strong legs and arms. Those legs and arms are another structure that allow the squirrel to climb down headfirst.

If you think that the tail of a squirrel is important, you are right again. The squirrel's tail helps it keep its balance. A squirrel can move its tail to keep it steady while it's on the ground and while it's climbing up or down.

“Ekorn Squirrel” by Arnstein Rønning is licensed under CC BY-SA 3.0

Squirrel running along a tree branch

To find out about the last feature that helps a squirrel climb down a tree headfirst, look closely at the back feet of the squirrels in these photographs.

U.S. Fish and Wildlife Service, Laura Perlick/Eastern Gray Squirrel by BirdPhotos is licensed under CC BY 3.0

Did you notice that the back feet of the squirrel in the first photograph are pointed back, while the back feet of the squirrel in the second photograph are pointed toward the front?

The squirrel has an amazing anklebone that allows it to rotate its back feet. If you could do what the squirrel can do, you could twist your foot so your toes are where your heels are!

The squirrel’s anklebone can swivel, or turn from side to side. It can rotate, or turn. When the anklebone turns, it can lock in place. This lets the squirrel move freely in many different directions. Because of its special anklebone, the squirrel is able to change its position quickly if it needs to.

To sum up, the squirrel has four structures, or body features, that allow it to climb down a tree headfirst.

Describe something new that you learned about how squirrels can climb headfirst down a tree.

2.5 For Squirrels It_s Head First (text - no boxes)

For Squirrels, It's Headfirst and Down!

Red Squirrel Moving Down and Oak Tree by R. Drake is licensed under CC BY-SA 4.0

Red squirrel climbing down an oak tree

Have you ever seen a squirrel climbing down a tree like the one in the photograph?

How does a squirrel's body help it do that?

A squirrel has special features or structures that allow it to climb down trees headfirst. **What do you think those structures are?**

There are four.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Squirrel hanging onto the side of a tree

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The squirrel has an amazing anklebone that allows it to rotate its back feet. If you could do what the squirrel can do, you could twist your foot so your toes are where your heels are!

The squirrel's anklebone can swivel, or turn from side to side. It can rotate, or turn. When the anklebone turns, it can lock in place. This lets the squirrel move freely in many different directions. Because of its special anklebone, the squirrel is able to change its position quickly if it needs to.

To sum up, the squirrel has four structures, or body features, that allow it to climb down a tree headfirst.

What is something new that you learned about how a squirrel can climb headfirst down a tree?

2.5 Interactive Reading Guide

Student Text	Interactive Prompts/Discussion Questions
For Squirrels, It's Head First and Down!  Red Squirrel Moving Down and Oak Tree by R. Drake is licensed under CC BY-SA 4.0 **Red Squirrel climbing down an oak tree** Have you ever seen a squirrel climbing down a tree like the one in the photograph? How does a squirrel's body help it do that? A squirrel has special features or structures that allow it to climb down trees headfirst. **What do you think those structures are?** There are four.  "Squirrel dexterity demonstration" by Tomi Tapio is licensed under CC BY 2.0 **Squirrel hanging onto the side of a tree**	Read the title aloud and ask students to look closely at the photograph. Use the questions as opportunities to engage students in discussion and to have them reflect on their observations of squirrels outside. You may choose to have students *turn-and-talk* to a partner about these questions and then briefly discuss with the whole class. If using Collabrify tools or printed copies, students may write their predictions to the question "What do you think those structures are?" Challenge students to use the photographs of squirrels to make predictions about the structures, to think about the squirrels they have observed outside, and to think about the squirrels they have observed in videos. Allow students to share their ideas with the class.
If you think that a squirrel's claws help it to climb, you are right. With its sharp claws, a squirrel can grip the bark of a tree. The strong grip of the front claws allows the squirrel to hold on while it moves its back feet. Then the back feet can hold on while the front feet move.	Ask students if they can identify and describe the squirrel's claws in the photograph of the squirrel hanging onto the side of a tree. You may ask students to explain to a partner, in their own words, how the squirrel uses its

	claws to climb up and down trees.
The claws are attached to strong legs and arms. Those legs and arms are another structure that allow the squirrel to climb down headfirst.	**Suggested prompt**: "*How do you think a squirrel's legs and arms help it climb down headfirst?"*
If you think that the tail of a squirrel is important, you are right again. The squirrel's tail helps it keep its balance. A squirrel can move its tail to keep it steady while it's on the ground and while it's climbing up or down.  "Ekorn Squirrel" by Arnstein Rønning is licensed under CC BY-SA 3.0 **Squirrel running along a tree branch**	**Suggested prompt**: "*Look at the squirrel's tail as it runs along the tree branch. What do you notice about the tail in this picture?" (turn-and-talk)* *"Have you observed squirrels balancing with their tails? How does this help them survive?"*
To find out about the last feature that helps a squirrel climb down a tree headfirst, look closely at the back feet of the squirrels in these photographs.   U.S. Fish and Wildlife Service, Laura Perlick/Eastern Gray Squirrel by BirdPhotos is licensed under CC BY 3.0 Did you notice that the back feet of the squirrel in the first photograph are pointed back, while the back feet of the squirrel in the second photograph are pointed toward the front?	Encourage students to compare the information in the text with the two photographs.
The squirrel has an amazing anklebone that allows it to rotate its back feet. If you could do what the squirrel can do, you could twist your foot so your toes are where your heels are!	Challenge students to stand up and try to turn their ankle like the squirrel. They will quickly notice that their anklebones do not work in the same way! **Suggested prompt**: "*How are human anklebones different from squirrel anklebones?"*
The squirrel's anklebone can swivel, or turn from side to side. It can rotate, or turn. When the anklebone turns, it can lock in place. This lets the squirrel move freely in many different directions.	**Suggested prompt**: "*How does a squirrel's anklebone help it survive?"*

Because of its special anklebone, the squirrel is able to change its position quickly if it needs to.	Look back at the text. Say, *"Because of its special anklebone, the squirrel is able to change its position quickly if it needs to. Why might a squirrel need to change its position quickly? Have you ever seen a squirrel do this?"*
To sum up, the squirrel has four structures, or body features, that allow it to climb down a tree headfirst. **What is something new that you learned about how a squirrel can climb headfirst down a tree?**	Challenge students to describe something new that they learned from the information in this text that helps them explain how squirrels survive.

Learning Set 3

LS_3 My Notes Tab

Learning Set # 3

Learning Set 3: What other organisms live in the squirrel's environment, and does the squirrel need them to survive?

Lesson Abridged Comments:

Learning Set Description: (ML-PBL to create)

1. **3.1:** In lesson 1, students are presented with a picture of a squirrel, on chart paper, that shows only a squirrel. Using this poster students decide if the squirrel can survive in an environment with no other organisms in it. The teacher explains to students that they will work in pairs to draw a picture of the organisms and how they interact with a squirrel in its environment (including predators) -- hawk, bacteria, ants, pine tree, grass, etc. Some students share their models or ideas or question to the whole class and explain their thinking. This is the information they use to develop a whole class "Interactions Model" that explains how the squirrel and the organisms around it are interconnected.
2. **3.2**: In lesson 2 partner-read very short information from texts about one of the animals and then act out one structure and how have the students guess what the animal is that they are acting out and how that structure is helping the animal survive. **Go back to the Driving Question and the teacher with the student's help, writes down big ideas that the studen**ts learned.
3. **3.3: Equity focus lesson:** In lesson 3, students use the "Interactions Model" to consider the importance of trees to the squirrel's survival. The class analyzes photos of communities in the same cities and identify a neighborhood in their community that would benefit from more trees. They write an email to an alderperson asking for more trees in that neighborhood.

Phenomenon

Squirrels live in a world with a variety of different organisms, which are part of the environment. They interact with each other to survive.

Learning Performance: *Students will* develop a model to explain how all organisms together form what is known as the environment (habitat) and that many of them are interrelated in complex ways (through the lens of systems and systems models and structure and function).

Figuring Out Statement/ DCI

In this learning set, students are figuring out that an organism's environment (habitat) includes the other organisms that live there. Students learn about the organisms' structures and that these structures are different from those of the squirrel, but enable survival in the same environment. Students model how the squirrel is directly and indirectly dependent on (connected to) these various organisms for survival.

Practice Statement

Students ask questions and then investigate organisms that live in the squirrels' environment and impact the squirrel's survival. Students read and communicate information about other organisms in the squirrels' environment. Last, they will develop a model to explain how all the organisms are connected.

Practice Elements from NGSS

Asking Questions and Defining Problems: Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships

Planning and Carrying Out Investigations: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Engaging in Argument from Evidence: Construct and/or support an argument with evidence, data, and/or a model.

Analyzing and Interpreting Data: Analyze and interpret data to make sense of phenomena, using logical reasoning

Obtaining, Evaluating, and Communicating Information: Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas; communicate scientific and/or technical information orally and/or in written formats

Developing and Using Models: Develop a model using an analogy, example, or abstract representation

Crosscutting Concepts

Systems and System Models: A system can be described in terms of its components and their interactions.

Structure and Function: Substructures have shapes and parts that serve functions.

Squirrels Learning Set 3– Embedded Language Supports

Lesson 1

- Photos to support comprehensive input
- Opportunity for multiple domains
- Authentic demand for negotiation of meaning around data gathered, peer to peer
- Discourse moves from WIDA

Lesson 2

- Charts and photos to support comprehensive input
- Support for mediation of meaning with acting out.
- Opportunity for multiple domains for language learning
- Authentic demand for negotiation of meaning
- Discourse moves from WIDA

Lesson 3

- Charts and photos to support comprehensive input
- Opportunity for multiple domains for language learning
- Using justice as Funds of Knowledge, authentic demand for negotiation of meaning
- Discourse moves from WIDA

Learning Set Driving Question
LS3: What other organisms live in the squirrel's environment, and does the squirrel need them to survive?

L3.1 Other Organisms

Lesson Snapshot

Learning Set Driving Question
L3: What other organisms live in the squirrel's environment, and does the squirrel need them to survive?

Lesson Driving Question
L3.1: What other organisms live in the squirrel's environment (habitat)?

Lesson Overview
1. Introduction: Discuss the lesson DQ. Introduce blank "interactions" model of the squirrel's survival. Discuss as a group, organisms is the squirrel's environment and which the squirrel depends on to survive.
2. Reading Texts: Cards and readings (independent or in pairs).
3. Sharing Data: Students share what they learned about their organisms with the class and how their organisms interact with the squirrel.
4. Wrap Up: Students use a ball toss to share something they and others learned.

Objectives

Learning Performance
Students will engage in reading text about other organisms that are part of the squirrel's environment (**habitat**), including how they all interact and survive and meet their needs in different ways (through the lenses of *systems and systems models* and *structure and function*).

Building Toward PEs
3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.* (met in Birds)
3-LS4-3 Construct an argument with evidence that in a particular **habitat** some organisms can survive well, some less well, and some cannot survive at all.
3-LS4-2 Use evidence to construct an explanation for how the variations in individuals of the same species may provide advantages in survival, finding a mate and reproducing.

Figuring Out, Look For, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** all organisms in the squirrel's environment have adapted various structures to survive in the same environment (habitat) as the squirrel and they all interact directly or indirectly.	***Embedded Language Supports*** • Photos to support comprehensive input • Opportunity for multiple domains • Authentic demand for negotiation of meaning around data gathered, peer to peer • Discourse moves from WIDA

Look Fors 1. **Look for** and support students setting up their reading in a way that allows each person in the group to get the information. 2. **Look for** students building on ideas about how animals are part of an ecological system and that various structures enable each animal to meet different needs in that system. **Evidence Statement** The ideas the students look for in the text will be about the other organisms, how they survive in the same environment as the squirrel relying on different structures, and how the organisms interact with the squirrel.	

Teacher Preparation	Materials
• Copy information sheets for each group to either read as a partner read or independently. ***Background Information*** • Habitat - An organism's **habitat** refers to an ecological or **environmental** area inhabited by a particular species of plants, animals, fungi, etc. It refers to an organism's natural **environment**. The term *environment* refers to the biotic (living) and abiotic (nonliving) factors in the surroundings of a population of organisms. • Teacher reading about categories of organisms. • **Note: Eutheria** is the larger group of placental mammals (dogs, squirrels, etc.). You might contrast eutherian mammals with marsupials (one example is the koala). However, the small squirrel-like eutherian organism from the Jurassic that we refer to throughout the unit is the Juramaia.	***Teacher Materials*** • Driving Question Board (DQB) • Learning Set 3 Driving Question Slides ***Student Materials*** • Science notebooks • Notecards • **Readings:** Structure Function Cards ○ **Note:** You can also find digital versions of all of the readings in WeRead , where they can be read aloud to students. • Picture of squirrel

Lesson Segments	Estimated Time
Introduction	10 min
Reading Texts	15 min

Sharing Data	15 min
Wrap Up	10 min
This 50-minute lesson could be integrated into the Literacy Block.	**Total Time:** 50 min

<table>
<tr><th>Part</th><th>Lesson Steps</th><th>Estimated Time / Materials</th></tr>
<tr><td>1</td><td>Introduction: Introduce phenomenon and DQ, “What other organisms live in the squirrel’s environment (habitat)?”

1. Introduce the DQ. Then show students a blank chart paper with a picture of a squirrel in the center. Ask students if the squirrel could live in an environment with nothing else around? Solicit answers with evidence.

2. Tell students that they will help fill in the chart with other organisms and show how they interact with the squirrel. Students will have to learn a little about the organisms first so they know how each organism is important for the squirrel’s survival.

3. Ask students to turn-and-talk about the organisms they listed that are in the squirrel’s environment.

4. Teacher Notes: Begin to use the term habitat interchangeably with squirrels’ environment.
Remind students that plants are organisms.

Suggested Prompt: Which organisms do you think we can put on this “interactions” model of organisms that the squirrel depends on to survive?</td><td>10 min</td></tr>
</table>

2	**Reading Texts: Research other organisms in pairs or groups** 1. Write the research questions on the board: • What is the name of the organism? • What are its interesting structures? • How does the structure help the organism meet a need? • How is the organism connected (or not connected) to the squirrel. 2. In pairs or small groups, students select an organism (hawk, worm, bacteria, ant, rabbit, coyote, snake, pine tree, spider, oak tree, or salamander) and receive (or access online through WeRead) the Structure Function Cards with information about their organism. 3. Before having students work in their groups, project and preview one of the Structure Function Cards with the class (each text is organized similarly). Ask students what kind of information they can learn from reading the cards and about text features that can help them identify certain types of information (e.g., the bolded headings that preview the different sections, the structures and photographs in the chart). 4. Go to the student definition of structure from LS2 and have students read this definition silently. Remind them of their claim from the last learning set about how the squirrel's structures are important for its survival. Wonder out loud about the structure of the other organisms they are studying and the importance of these structures for their survival too. 5. Using the texts, students read about the organisms and take notes about their structures and how they interact with other organisms in the environment. **Options for supporting students' independent, partner, or small group reading:** • Consider using mixed-performance groups, in which one student reads the text aloud for the group, as other group members follow along. • You may choose to read the text aloud to groups while they follow along. • You can find digital versions of all texts in WeRead, where they can be read aloud to students. Students can listen to these texts individually with headphones or aloud in small groups. To use text-to-speech in WeRead, students should highlight the word, paragraph, or page they want to hear, then click on the green speaker at the top right of the screen. 6. Students draw their organisms on index cards, label the organisms' structures, and write how they think their	**15 min**

		organisms are related to the squirrel's survival (e.g., the red-tailed hawk might be the squirrel's predator; squirrels might eat acorns from the red oak tree; like the squirrel, the cottontail rabbit might be prey for a red-tailed hawk; bacteria are almost everywhere in a squirrel's environment).	

<table>
<tr>
<td>3</td>
<td>Sharing Data: Students share information about their organisms

Groups share with the class their organisms and the interactions the organisms have with the squirrel. Students place pictures of their organisms near the picture of the squirrel on the board. They invite questions and comments. Help students add arrows and text to the pictures to represent interactions.
When all students have shared, ask if they think their interactions poster is a model. Invite several ideas and encourage students to provide reasoning. If necessary, ask for volunteers to share what they know about models (they are used to explain events in science or to test ideas).
Review some organisms that form a relationship that is critical for the squirrel to meet its needs, drawing on Learning Sets 1 and 2. Explain that the relationship is part of a whole system, which is the habitat. Ask for a volunteer to identify another part of the habitat.
Explain to students that scientists use models to describe or study different systems.

</td>
<td>15 min</td>
</tr>
<tr>
<td>4</td>
<td>Wrap Up: Share research findings using ball toss and revisit the DQB

Suggested Prompt: Listen carefully to what each student shares so when the ball is tossed to you, you will be able to repeat what you heard and add your own thinking.

Have students share their research using the ball toss strategy. One student shares something s/he learned today and tosses a ball to another student (who wasn’t expecting the ball). Then that student repeats what the previous student learned, adds what s/he learned, and tosses the ball to someone new. If time allows, repeat the process until all students have shared. In this way everyone must listen to the student who is speaking. Additionally, students are only responsible for repeating the last statement, not multiple statements.
Return to the DQB. Add questions that students still have about interactions with organisms.
Ask students to use this “interactions” model to help them with their questions.

</td>
<td>10 min</td>
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</table>

3.1 Squirrel Photo

Squirrel Drawing for Lesson 3.1

Structure Function Organism Cards

Ants

Where do ants live?

Ants can live almost anywhere on land, except for the coldest places on Earth. All ants need a place to build their nests and take care of their young. Most types of ants build their nests underground. Some ants live in trees. Some very tiny ants build nests inside acorns and other small spaces.

What do ants eat?

Different types of ants eat different kinds of food. Some ants eat sweet nectar in flowers, seeds, fungi, fruit, and food like cookies or hot dogs. Many ants eat small animals or other insects.

What eats ants?

Ants have many predators. Birds, spiders, beetles, other ants, and toads eat ants. Bears eat ants by breaking open their nests and eating the young ants they find inside.

"Weaver ant defense" by PHGCOM is licensed under CC BY-SA 3.0

How do you think ants survive?

How do ants survive?

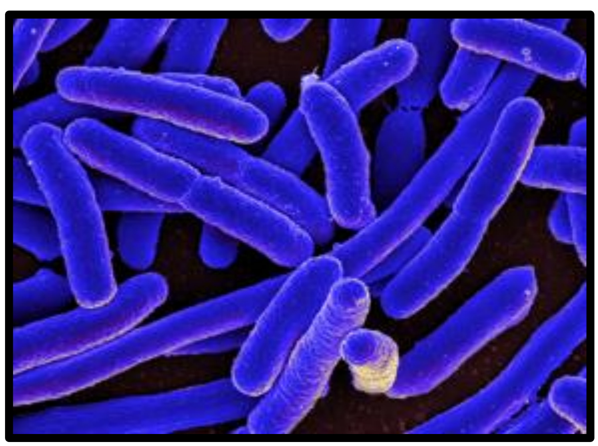
Antenna Ants have two antennae on their heads. They use their antennae to sense information about the world around them. For example, ants' antennae help them find other ants from their nest, enemies, and their way back home.	
Mandible Ants have strong mandibles (jaws) on their heads that they can open and close. They use their mandibles to grab and carry things like food. Mandibles can also cut and bite. Ants can use their mandibles to protect them from predators.	 "Weaver ant defense" by PHGCOM is licensed under CC BY-SA 3.0
Hooked Claw Ants have a claw at the end of each of their six legs. These claws help them climb and hang onto trees and plant stems.	 © Yann Forget / Wikimedia Commons / CC-BY-SA-3.0.
Sting Some ants have stingers. They use their stingers to poison their predators.	 "Paraponera clavata" by Project Phoebus is licensed under CC BY-SA 4.0

Bacteria

Where do bacteria live?
Bacteria live in large groups almost everywhere on Earth. They even live in your body. Some types of bacteria live deep in the ocean. They also live in the frozen ground in Antarctica.

What do bacteria eat?
Different types of bacteria eat different foods. Some bacteria make their own food with light from the sun. Other types of bacteria get food from where they live. The bacteria that live in your body get food from the food that you eat.

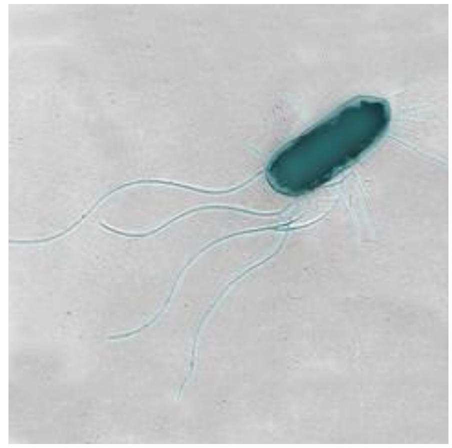
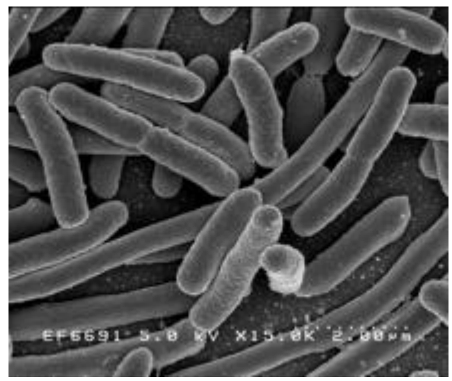
What eats bacteria?
Everyone eats bacteria! They are so small that you need to look in a microscope to see them. Bacteria are everywhere. This means almost everything people and animals eat has bacteria on it.



"E.coli bacteria" by NIAID is licensed under CC BY 2.0

How do you think bacteria survive?

How do bacteria survive?

Flagellum Flagella look like tiny strings. Flagella move back and forth very fast to help bacteria move around. They help bacteria move from one place to another.	 "E.Coli with Flagella" by AJC1 is licensed under CC BY-SA 3.0
Cell Wall Some types of bacteria cells have walls. The cell wall is like a fence around a house. It protects the cell.	

Cottontail Rabbits

Where do cottontail rabbits live?
Cottontail rabbits live in many places. You can find cottontail rabbits in fields, woods, swamps, farms, and on open land. They also live in places with low bushes, vines, and trees.

What do cottontail rabbits eat?
Cottontail rabbits eat different foods at different times of the year. When it is warm outside, they eat grass, clover, vegetables, and wild berries. In the winter, cottontail rabbits eat small twigs and tree bark.

What eats cottontail rabbits?
Cottontail rabbits have many predators. Hawks, owls, coyotes, and foxes are some animals that eat cottontail rabbits. If cottontail rabbits are sick, even squirrels will eat them.

How do you think cottontail rabbits survive?

How do cottontail rabbits survive?

Back Leg Cottontail rabbits have strong back legs. Their back legs are stronger and bigger than their front legs. Cottontail rabbits use their back legs to jump and move fast. They can move as fast as 18 miles an hour to get away from predators.	 "Run Away!" by Eric Sonstroem is licensed under CC BY 2.0
Thick fur that can change color Cottontail rabbits have thick, soft fur. It changes color at different times of the year. In warm summer months, their fur is brown. In cold winter months, their fur is white. Blending in with the land around them helps them hide from predators.	 "Eastern Cottontail" by The High Fin Sperm Whale is licensed under CC BY-SA 3.0
Long Ear Cottontail rabbits have long ears. They can move their long ears in different ways. Cottontail rabbits have very good hearing. This helps them hear predators that come too close.	 "Eastern Cottontail Rabbit" by Jim is licensed under CC BY 2.0
Large Eye Cottontail rabbits have large eyes that can move all the way around. By moving their eyes, cottontail rabbits look at things behind them without turning their heads. This allows them to watch for and see predators that come too close.	

3.1 Coyote

Coyotes

Where do coyotes live?
Coyotes live in many places like fields, forests, swamps, and deserts. Sometimes coyotes live near farms and even in cities.

What do coyotes eat?
Coyotes usually eat small mammals, like squirrels, rabbits, and mice. Sometimes coyotes eat birds, big insects, snakes, fish, and frogs. They also eat fruit and grass.

What eats coyotes?
Coyotes only have a few predators. Their predators are mountain lions and gray wolves.

"Coyote in Alaska" by Jitze is licensed under CC BY 2.0

How do you think coyotes survive?

How do coyotes survive?

Rod in eye Coyotes have rods in their eyes that help them see at night. Other animals have rods in their eyes too, but animals that see well at night have more rods. Coyotes' good sight helps them see while they hunt for food in the dark.	 "Coyote closeup" by Christopher Bruno is licensed under CC BY-SA 3.0
Large, sharp cheek teeth Coyotes have large teeth that are sharp like blades. The sharp edges of these teeth cut food like scissors. This helps coyotes eat small mammals, like squirrels and rabbits.	 "Coyote Yawning" by Gregory Smith is licensed under CC BY-SA 2.0
Long snout Coyotes have long snouts. Coyotes have a very strong sense of smell, much better than humans. This helps them smell nearby prey.	 "Coyote in Yosemite" by Christpher Bruno is licensed under CC BY-SA 3.0
Fur Coyotes have fur that can be a different color based on where they live. For example, coyotes that live in the desert have lighter fur than those that live in the mountains. Their fur helps them blend in with the land around them.	 NPS photo, Sarah Stio

Earthworms

Where do earthworms live?
Earthworms often live in muddy places. You can find them near lakes, streams, and rivers. You can also find earthworms anywhere there is soil.

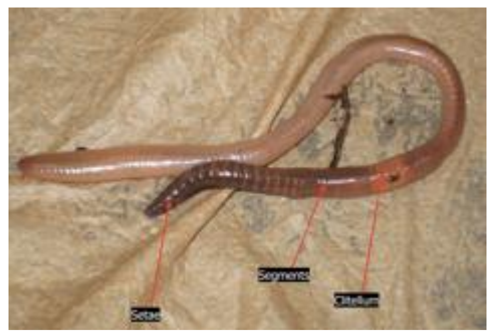
What do earthworms eat?
Earthworms eat anything that is dead or decaying. They are often in compost piles. Compost piles contain dead leaves, plants, or leftover food scraps. As earthworms eat the dead material, they break it down into smaller pieces that farmers can use as soil for their crops.

What eats earthworms?
Earthworms are a popular food choice for birds. Salamanders, foxes, snakes, frogs, and ants also eat earthworms.

"Earthworm" by pfly is licensed under CC BY-SA 2.0

How do you think earthworms survive?

How do earthworms survive?

Mucus on skin Earthworms make slime on their skin, called mucus. The mucus is slick and helps the earthworm move through the soil.	 "Earthworm" by pfly is licensed under CC BY-SA 2.0
Setae [**see**-tee] Earthworms have small, stiff hairs all over their bodies, called setae. These hairs help them move from one place to another.	 "Earthworm segments" by Iceclanl is licensed under CC BY-SA 3.0
Muscle Earthworms have long muscles along their whole bodies. They also have small round muscles that go around each part of their bodies. These muscles help earthworms move forward and turn.	 "Close up of earthworm" by Fir0002 is licensed under CC BY-NC 3.0

3.1 Eastern Garter Snake

Garter Snakes

Where do garter snakes live?
Garter snakes can live in many places. You can find garter snakes near water, such as streams, ponds, and lakes. They also live in woods and fields. If there are places to hide, garter snakes will live in cities.

What do garter snakes eat?
Garter snakes often eat worms, frogs, fish, and other snakes. Sometimes, garter snakes eat small mice or baby birds.

What eats garter snakes?
Garter snakes have many predators. Bullfrogs, fish, snapping turtles, and other snakes eat garter snakes. Some birds eat garter snakes too, like hawks and crows. Other predators are squirrels, foxes, and raccoons.

How do you think garter snakes survive?

How do garter snakes survive?

Skin Garter snakes have three stripes down their body. The stripes help them blend in with the land around them. This helps them hide and escape from predators as they move through the grass.	
Jaw Garter snakes can detach their jaw. This lets them open their mouths very wide so they can eat their prey whole.	 NPS, Sally King
Tongue Like other snakes, garter snakes have a forked tongue. They stick out their tongue to learn about the area around them. They have nostrils that they use to smell, but their tongues also help them smell. Garter snakes flick out their tongues to help them smell nearby prey or predators. They also use their tongue to help them find other garter snakes.	 "Medusa" by Matt Reinbold is licensed under CC BY-SA 2.0

Eastern White Pine Trees

Where do eastern white pine trees grow?
Eastern white pine trees grow in forests and mountains in the northern part of the United States. This means that these trees grow in states like Michigan, Wisconsin, and Minnesota.

What eats eastern white pine trees?
Birds eat the berries that grow on eastern white pine trees. Porcupines, rabbits, and mice also eat the bark of the trees.

How do you think eastern pine trees survive?

How do eastern white pine trees survive?

Bark Bark is the hard outer part of the tree. The bark of eastern white pine trees is a gray-green color and is smooth. The bark helps the tree hold in water.	 Eastern White Pine Bark by Derek Ramsey is licensed under CC BY-SA 4.0
Cone Cones hold eastern white pine tree seeds. When the seeds are ready to be spread around, the cones open. Then, the seeds spread to other places by sticking in bird feathers or on the bottom of people's shoes.	 Pinus strobus cone by Keith Kanoti is licensed under CC BY-SA 4.0
Needle Eastern white pine trees have needles instead of leaves. Their needles are long and covered with wax. The wax keeps water in the needles. Some trees lose their leaves in the fall, but eastern white pine trees keep their needles through the winter.	

3.1 Garden Spider

Garden Spiders

Where do garden spiders live?
Garden spiders live in many places. They often live in gardens and fields near tall flowers and bushes. Garden spiders make their webs in sunny areas with no wind.

What do garden spiders eat?
Garden spiders eat many kinds of insects that get stuck in their webs. Garden spiders often eat flies, beetles, moths, wasps, and grasshoppers.

What eats garden spiders?
Some predators of garden spiders are frogs and lizards. Birds, like red-tailed hawks, turkeys, and robins will also eat garden spiders.

"Yellow garden spider" by Dakota L. is licensed under CC BY-SA 3.0

How do you think garden spiders survive?

How do garden spiders survive?

Fang Garden spiders use fangs to poison their prey. They use the poison to keep their prey from moving.	 "Yellow garden spider" by Dakota L. is licensed under CC BY-SA 3.0
Hair Garden spiders are covered in tiny hairs. These hairs help them feel movement. When a garden spider is standing on a leaf or a web, it can feel very tiny movements. This helps the garden spider catch prey that lands on its web.	
Claw on feet A garden spider is a type of spider called an orb weaver. This means they have three claws on each foot. Garden spiders use their claws to spin webs. Sticky webs help garden spiders catch prey.	 "Yellow garden spider zig zag web" by Deisy Mendoza is licensed under CC BY 3.0
Spinneret Garden spiders use spinnerets on the back of their bodies to make silk. They use the silk to spin sticky webs. Sticky webs help garden spiders catch prey.	 "Female specimen wrapping her prey" by Lucarelli is licensed under CC BY-SA 3.0

3.1 Northern Oak Fern

Northern Oak Fern

Where do northern oak ferns live?
Northern oak ferns can live in many places. They live in cool, damp forests and woods. These ferns grow well in rocky soil hillsides.

What eats northern oak ferns?
Many northern oak ferns have a toxin that keeps most animals away. Sometimes deer and rabbits will eat ferns if they can't find any other food. Some insects will also chew on the leaves.

"Oak Fern" by Homer Price is licensed under CC BY 2.0

How do you think northern oak ferns survive?

How do northern oak ferns survive?

Rhizome A rhizome is the part of a northern oak fern that makes roots. Most plants have roots that grow down, but rhizomes grow out. This helps ferns get more water and food from the soil.	
Spore You may know that many plants grow from seeds, but northern oak ferns grow from spores. You can find spores under the fern's leaves. Spores are very tiny. When they drop off of the fern, the wind can carry them far away. This spreads ferns so that more can grow.	 "Gymnocarpium dryopteris" by Walter Siegmund is licensed under CC BY-SA 3.0
Toxin Many northern oak ferns have a toxin that keeps most animals away. This protect ferns from being eaten.	 "Oak Fern" by Homer Price is licensed under CC BY 2.0

Red Oak Tree

Where do red oak trees grow?

Red Oak trees often grow in forests, by streams, and on hillsides. You can find red oak trees in the eastern and central United States.

What eats red oak trees?

Over 100 types of animals eat acorns from red oak trees! Some animals that eat acorns are squirrels, blue jays, and black bears. Deer also eat the twigs from the branches in the winter.

"Tamme-Lauri Oak" by Abrget47j is licensed under CC BY-SA 3.0

How do you think oak trees survive?

How do red oak trees survive?

Bark Bark is the hard outer part of the tree. The bark of red oak trees is a red-brown color and looks very bumpy. The bark helps keep water in the tree.	 "Querecus alba bark" by Derek Ramsey is licensed under CC BY-SA 2.5
Acorn Acorns are the seeds for red oak trees. Inside each acorn is a small root and stem that can grow into a new oak tree.	 "Quercus rubra acorn" by Jamain is licensed under CC BY-SA 3.0
Root Red oak trees use roots to get water and food from the soil. Red oak trees have a special root, called a tap root. A tap root grows deep under the ground to get water.	 "Exposed Tree Roots by a Creek" by Ryan Somma is licensed under CC BY-SA 2.0

Red-backed Salamander

Where do red-backed salamanders live?

Red-backed salamanders live under leaves, rocks, and logs. You can often find them near water because they must keep their skin wet.

What do red-backed salamanders eat?

Red-backed salamanders eat small insects like ants and flies. They also eat spiders, snails, and earthworms.

What eats red-backed salamanders?

Red-backed salamanders have many predators, like garter snakes, birds, and frogs. They are also food for squirrels and raccoons.

"Northern Red-backed Salamander" by Fyn Kynd is licensed under CC BY 2.0

How do you think red-backed salamanders survive?

Co-developed by the Multiple Literacies in Project-based Learning Project at Michigan State University and the University of Michigan 2018–2019

How do red-backed salamanders survive?

Long, fast, sticky tongue Red-backed salamanders use their tongues to catch prey. They push their tongues out very fast, and their prey sticks to their tongues.	 "Northern Red-backed Salamander" by Fyn Kynd is licensed under CC BY 2.0
Tail that grows back If a red-backed salamander is caught by a predator, it can get away by dropping part of its tail. It can regrow a new tail after it escapes.	 "Redbacked Salamander" by Albert Herring is licensed under CC BY 2.0
Bright stripe on skin Red-backed salamanders have a bright red stripe on their backs. This stripe warns predators to stay away.	 "Western red backed salamander" by John Villella is licensed under CC BY-NC-SA 2.0

Red-tailed Hawk

Where do red-tailed hawks live?
Red-tailed hawks live in many places. They often live in deserts, fields, and forests. They need open areas for hunting and trees for building their nests.

What do red-tailed hawks eat?
Red-tailed hawks often eat rodents, like mice and rats. They also eat rabbits, squirrels, snakes, and other birds.

What eats red-tailed hawks?
Red-tailed hawks do not have many predators. Great-horned owls and crows will try to eat young hawks and eggs that are still in the nest.

U.S. Fish and Wildlife Service, Keenan Adams

How do you think red-tailed hawks survive?

How do red-tailed hawks survive?

Great sight Red-tailed hawks have great eyesight. Their eyes let them see prey from very far away. Red-tailed hawks fly around looking for prey on the ground.	 "Northern Red-tailed Hawk" by Scott Campbell is licensed under CC BY-SA 2.0
Sharp, strong talon Red-tailed hawks have sharp claws, called talons. They use their talons to kill prey and carry it back to their nests.	 "Red tailed hawk talons" by Todd Martin is licensed under CC BY-NC 2.0
Hooked, sharp beak Red-tailed hawks have a very sharp beak that works like a knife and fork. The hooked shape makes it easy to tear apart prey.	 National Park Service, Sally King
Wing Red-tailed hawks hunt for their prey from the sky. They have long wings that help them fly very fast, up to 40 miles an hour. That is faster than most people can ride a bike!	 "Red-tailed Hawk in Flight" by Alan Vernon is licensed under CC BY 2.0

Learning Set Driving Question
LS3: What other organisms live in the squirrel's environment, and does the squirrel need them to survive?

L3.2 Survival - Other Organisms

Lesson Snapshot
Learning Set Driving Question LS3**:** What other organisms live in the squirrel's environment, and does the squirrel need them to survive? **Lesson Driving Question** L3.2: How do other organisms help the squirrel survive? **Lesson Overview - Represents two 50-minute lessons that could be integrated within the Literacy Block** **First Day** 1. Introduction: Introduce the lesson DQ and review the "interactions" model from the previous lesson. 2. Researching as a Class - Reading and Communicating Information from Texts: Students read texts about their animals as a class. 3. Sharing Data: Students discuss the organisms with the class and share structures and how they help the organisms, using a T-Chart. **Second Day** 4. Group Work: Students act out different structures they learned about while others guess the structure (and organism). 5. Wrap Up: Return to the learning set DQ and write down a "Big Idea" in a sentence about what students learned in this learning set.

Objectives
Learning Performance Students will gather information from texts about other organisms that are part of the squirrel's environment (habitat), including how they all interact and survive and meet their needs in different ways (through the lenses of *systems and systems models* and *structure and function*).

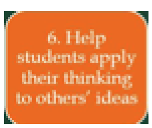
Figuring Out, Look For, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** other organisms have adapted various structures to survive in the same environment (habitat) as the squirrel and they all interact directly or indirectly. **Look Fors** 1. **Look for** and support students setting up their reading in a way that allows each person in the group to get the	***Embedded Language Supports*** • Charts and photos to support comprehensive input • Support for mediation of meaning with acting out. • Opportunity for multiple domains for language learning • Authentic demand for negotiation of meaning • Discourse moves from WIDA

information. 2. **Look for** students building on ideas about how animals are part of an ecological system and various structures enable each animal to meet different needs in that system. **Evidence Statement** Students look for ideas in the text about other organisms, how they survive in the same environment (habitat) as the squirrel while relying on different structures, and how they interact with the squirrel.	

Teacher Preparation	Materials
• Maintain groups from L3.1 • Copy information sheets for students to read with a partner or independently	***Teacher Materials*** • Driving Question Board (DQB) • T-Chart ***Student Materials*** • Science notebooks • “Interactions” model from L3.1 • Structure Function Cards

Lesson Segments	Estimated Time
Introduction	10 min
Researching as a Class - Reading and Communicating Information from Texts	25 min
Sharing Data	25 min
Group Work	30 min
Wrap Up	10 min
These two 50-minute lessons could be integrated into the Literacy Block.	**Total Time:** 100 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and introduce DQ, *"How do other organisms help the squirrel survive?"*** 1. Introduce the lesson DQ and ask volunteers to explain and review the need to complete the "interactions" model from the previous lesson. 2. Ask for some ideas about possible organisms (and their structures) that could be added to the model.	**10 min**
2	**Researching as a Class - Reading and Communicating Information from Texts: Pairs and groups look for and share information on a T-chart** 1. Students are given the Structure Function Cards with information about the same animals from the previous lesson. Students revisit the readings, as needed, then one by one, share with the class the drawings of their organisms (with labeled structures) and how their organisms' structures help them survive. 2. Have students write the different structures (refer to the class definition of structure from Learning Set 2) on a T-Chart labeled **Organism, Structure,** and **How the structure helps the organism**. You may create this T-Chart on the whiteboard or chart paper. 3. Students discuss, as a class, how their organisms are connected to the squirrel. They provide their reasoning and evidence from the text; other students may help them. To support students, place their cards on an overhead projector and help the class look for the evidence that the students found in the text to support their claims.	**25 min**

3	**Sharing Data: Students engage in argument about how they show that the organisms are connected** 1. The class must figure out how to show a connection on the model. For example, if a squirrel is connected to a tree because it needs the tree to live in, then the class should show this connection by drawing an arrow, symbol, or other indication between the squirrel and the tree. 2. If the class wants to explain that the squirrel gets eaten by a hawk, then the class must figure out how to show this connection so it is clearly different from using something for a home (e.g., the squirrel may use the trees to build a den or a nest). 3. Students can argue for an interaction that makes sense to them, and they can also argue for the connection to be drawn a certain way. 4. Ask students to describe the part of the habitat system they had noted during L3.1. Ask a volunteer to try to find another part of the habitat system. 5. Invite some students to show on the model how organisms in that part of the system are related. 6. Discuss whether any students want to change the placement of their organisms in relation to the squirrel. **Discourse Move - Help students apply their thinking to others' ideas**  Help students check their understanding of other students' ideas by stating the idea, then asking for responses to the idea.	**25 min**
4	**Group Work: Structures charades** 1. Put students into pairs or triads to act out one of the organisms, and its structures, they learned about as a class. • Each student in the small group must have a part to play in the charade. • Students may not make any sound effects. • Students may guess the organism and its structures only after they are called on. • Students can use the T-Chart to help them guess. 2. Students guess the organism the small group is acting out. They may also describe how the structures help the organism.	**30 min**

5	**Wrap Up: Review DQB and all material and create a "Big Idea" with the class** 1. Review the DQB and ask questions. 2. Together, as a class, come up with a "Big Idea" or summary of what was learned from the learning set DQ.	**10 min**

Learning Set Driving Question
LS3: What other organisms live in the squirrel’s environment, and does the squirrel need them to survive?

L3.3 Equity - Trees

Lesson Snapshot

Learning Set Driving Question
L3: What other organisms live in the squirrel’s environment, and does the squirrel need them to survive?

Lesson Driving Question
L3.3: Are there a lot more trees in some communities than in others?

Lesson Overview

1. Introduction and Class Discussion: Introduce lesson DQ. Then, have students *turn-and-talk* and share out. Students use their interactions model to talk about the importance of trees to squirrels.
2. Research Data: Students look at photos of various communities in the same city to see if the number of trees in each area is different.
3. Small Group Discussion: Students discuss, in small groups, what areas in their community or city need more trees.
4. Group Work (Optional): Students decide on a community and write an email (individually or as a group) to an alderperson or other representative asking the city to plant more trees or start a tree-planting program.
5. Wrap Up: Students reflect on what they did (and why) and what they hope will happen in their science notebooks.

Objectives

Learning Performance
Students will analyze data from text and media sources about the differences between squirrels’ environment within urban areas and how squirrels may, or may not, meet their needs in different communities (through the lens of *systems and system models*).

Equity Learning Performance - Critical Knowledge
I can explain phenomena using the lens of social justice.

Figuring Out, Look For, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** the work they have done in Learning Set 3 is relevant to their communities. They are figuring out that some communities have more trees, thus can support more organisms and more biodiversity. They are also figuring out that phenomena in the natural	***Embedded Language Supports*** • Charts and photos to support comprehensive input • Opportunity for multiple domains for language learning • Using justice as Funds of Knowledge, authentic demand for negotiation of meaning

world can be observed critically from an equity perspective. **Look Fors** 1. **Look for** students using evidence to support the claim that communities with more trees would have more squirrels. 2. **Look for** students using the idea of a system as it relates to city design and neighborhoods when they discuss equity. **Evidence Statement** The claims students make include that squirrels and trees interact so that more trees would probably mean more squirrels. The claim uses evidence from the "interactions" model, drawing from relationships between organisms in the model and evidence from the text. The claim shows the lens of *systems* and notes city design and neighborhoods as a system.	• Discourse moves from WIDA

Teacher Preparation	Materials
• Before the lesson, identify a city representative (or other local official) to whom the class could write an email. • Make sure you can locate an aerial view of the students' community on Google Maps . • Preview Trees Grow on Money. • ***Background Material****:* ○ You may want to read the short articles that the photos are based on: "Trees Grow on Money: Economist Gets to the Root of Urban Tree Cover"; "More Trees, Please"; "The Troublesome Connection Between City Trees and Income Inequality"; "Income Inequality, as Seen from Space"; "Urban Trees Reveal Income Inequality"	***Teacher Materials*** • "Interactions" models from L3.1 and L3.2 • T-Chart on whiteboard or poster paper • Interactive reading guide ***Student Materials*** • Science notebooks or whiteboards for small groups • Photographs, and/or slideshow • Trees Grow on Money (copies of the text for each student or a copy to project for interactive read aloud)

Lesson Segments	Estimated Time
Introduction and Class Discussion	10 min
Research Data	20 min
Small Group Discussion	10 min
Group Work (Optional)	Optional - 20 min

Wrap Up	10 min
This 50-minute lesson and/or its optional writing task could be integrated into the Literacy Block.	**Total Time:** 50 min + Optional Group Work (20 min)

<table>
<tr><th>Part</th><th>Lesson Steps</th><th>Estimated Time / Materials</th></tr>
<tr><td>1</td><td>Introduction and Class Discussion: Introduce phenomenon and DQ, “Are there a lot more trees in some communities than in others?”

1. Introduce the lesson DQ. Have students turn-and-talk about how they would answer the DQ, “Are there a lot more trees in some communities than in others?”, and have a few students share out their ideas with the class. Write student questions in the space provided on the slide or DQB.
2. Direct students to the “interactions” model and ask them why trees are important to squirrels.
3. Ask if students think there would be more squirrels where there were more trees. Ask for evidence and encourage discussion.
4. Ask a student, “If trees were not part of the system, would the squirrel be able to survive?”</td><td>10 min</td></tr>
<tr><td>2</td><td>Research Data: Analyze data as a whole class

1. Show students photographs and/or a slideshow of different areas of cities.
2. Ask students what they notice. Have them turn-and-talk and share out.
3. Ask students to write on their whiteboards whether they predict that for each city there would be more squirrels in the first or second photograph and an explanation of their reasoning.
4. Students share with a partner and then share out with the class. You can fill out this T-Chart (slide 7) as a class.
5. Ask a student to be an evidence checker, that is, to check that statements include evidence from the photographs to support students’ claims.
6. Read Trees Grow on Money with students as an interactive read aloud. Tell them that, as you read aloud, you will pause to ask questions about their thinking and the ideas in the text. You may also have students turn-and-talk about particular questions to share their thinking with a partner before sharing out with the class.
• See the interactive reading guide for suggested prompts and discussion questions for discussing the ideas in the text as you read aloud with the class.</td><td>20 min</td></tr>
</table>

3	**Small Group Discussion: Students discuss in groups the areas in their community that need more trees (and squirrels)** 1. Students split up into groups of three or four and choose a neighborhood in their city that doesn't have enough trees, or has fewer trees than other areas, using the aerial view on Google Maps. You could print screenshots of Google Maps for different parts of your city, or you may project the map for the whole class and have students *turn-and-talk* about what they notice. 2. Students come back together in a large group and discuss their small groups' findings. Revisit the discussions from the introduction and first activity about whether students think there would be more squirrels in certain areas and whether these were areas where students identified many or few trees. Ask for evidence and encourage discussion. 3. Remind students that in L3.1 and L3.2, they looked at relationships between organisms that are parts of systems. Ask, "*Is it is fair that some cities have fewer trees and fewer squirrels than others?*" Ask for thumbs up, sideways, or down. Ask for one thumb up and one thumb down if students want to explain their thinking.	**10 min**
4	**Group Work (Optional): Write email or plant tree** 1. After discussing what they notice, students choose a neighborhood or area in their city or a nearby city (preferably one where they live) that they will help. 2. Write, as a class, an email to an alderperson or other city representative describing what students learned and requesting that more trees be planted in particular areas. The class can explain the benefits of trees for people's health and well-being, using text-based evidence from Trees Grow on Money. 3. As an alternate or additional connection, you could pursue ways to help students get involved with planting trees in the community, particularly if tree-planting programs already exist in your city.	**Optional - 20 min**

5	**Wrap Up: DQB and students write in their science notebooks** 1. Review the DQB and ask more questions. Are there any students can answer at this time? Fill in those answers. 2. Students write in their science notebooks. **Writing Prompt:** "*The article described some benefits of having more trees in neighborhoods. What do you think are the benefits of having more trees in neighborhoods? What could you do to help your community plant more trees?*" 3. Show students the DQs of all the lessons in this learning set. Ask them to think of a "Big Idea" for the learning set. When they agree on one, write it in the middle oval and add it to this slide for later reflection.	**10 min**

L3.3 Trees Grow on Money (text)

Trees Grow on Money

Researchers find that richer areas in U.S. cities have more trees.

"Tree Lined Street" by Alex Proimos is licensed under CC BY-NC 2.0

Tree-lined city street

Wealthy areas in cities seem to have everything. They have large parks, nice restaurants, theaters, and more trees. Wait, even trees?

A 2015 study found a connection between the number of city trees and income. Income is how much money people make. The study found that people who live in big U.S. cities like Los Angeles, New York, and Washington D.C., are more likely to live in tree-filled areas if they make more money.

Trees have benefits that improve our lives. They make us feel cooler, give shade, and clean the air. Imagine a tree-lined city street versus miles of concrete. Tree-lined streets look nicer and more welcoming. Some studies even found that trees improve people's attitudes and reduce stress. Trees have a big impact on our health!

The researchers predicted that they would find more trees in parts of cities with higher incomes. Their predictions were correct! The researchers found that wealthier areas in large cities had more trees. Less wealthy, or poorer, areas had fewer trees.

Kirsten Schwarz and the other researchers wrote, "Money may not grow on trees, but this study suggests that in a way, trees grow on money."

It is important to know how many trees are available to people in different parts of cities. If all cities knew about patterns in tree cover, they could create programs for tree planting. Tree planting and other projects would help address this problem. In fact, all of the cities in the study started tree-planting programs to increase the number of trees in poorer areas!

Planting and taking care of trees costs money. Researchers predict that this is one of the reasons they found fewer trees in poorer parts of cities. Schwarz said her study is a call for cities “to think about equity when developing tree-planting goals.”

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Bliss, Laura. “The Troublesome Connection Between City Trees and Income Inequality”. City Lab. 9 April 2015.

Bienkowski, Brian. “More money means more trees in US cities”. *Environmental Health News.*

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3.3 Interactive Reading Guide

Interactive Reading Guide- Teacher

Student Text	Interactive Discussion Prompts/Questions
## Trees Grow on Money *Researchers find that richer areas in U.S. cities have more trees.*  **Tree-lined city street**	Introduce the reading by connecting it to the photographs students analyzed of different areas in cities. Read the title of the text aloud and ask students what they think this title means. ***Suggested Prompt:*** *"What do you predict the article will be about?"* Then, read the subtitle, "Researchers find that richer areas in U.S. cities have more trees." Ask students if this provides more "clues" about the meaning of the title or what they will learn in the article. You may also ask students to describe the photograph under the title. ***Suggested Prompt:*** *"Look at the photograph. What do you notice?"* As you continue reading aloud with the class, pause periodically to ask students questions about the meaning of ideas in the text and to clarify any points you think might be confusing for students. Below are suggested prompts and questions.
Wealthy areas in cities seem to have everything. They have large parks, nice restaurants, theaters, and more trees. Wait, even trees?	**After reading this paragraph:** Make a connection to the photograph investigation students just conducted. ***Suggested Prompt:*** *"What did you notice about the number of trees on some of the maps? Were there different amounts of trees in different places?"*
A 2015 study found a connection between the number of city trees and income. Income is how much money people make. The study found that people who live in big U.S. cities like Los Angeles, New York, and Washington D. C., are more likely to live in tree-filled areas if they make more money.	**After reading this paragraph:** Ask students if they can describe, in their own words, the relationship or connection the researchers found in their study between income and number of trees.
Trees have benefits that improve our lives. They make us feel cooler, give shade, and clean the air. Imagine a tree-lined city street versus miles of concrete. Tree-lined streets look nicer and more welcoming. Some studies even found that trees improve people's attitudes and reduce stress. Trees have a big impact on our health!	**After reading this paragraph:** Ask students to *turn-and-talk* about whether they can think of any **other** benefits of having trees in a neighborhood, in addition to the benefits listed in the article. Allow students to share with the class.
The researchers predicted that they would find more trees in parts of cities with higher incomes. Their predictions were correct! The researchers found that wealthier areas in large cities had more trees. Less wealthy, or poorer, areas had fewer trees.	**After reading this paragraph:** Ask students if they have any predictions about *why* there might be more trees in richer or wealthier areas and fewer trees in poorer or less wealthy areas.

Kirsten Schwarz and the other researchers wrote, "Money may not grow on trees, but this study suggests that in a way, trees grow on money."	**During reading this paragraph:** Ask students if they have ever heard the phrase "money doesn't grow on trees." *"Has anyone ever said this to you when you wanted to buy something expensive?"* Allow students to share an example of when someone might use this phrase and discuss what it means. Ask students what the researcher means when she says, "Trees grow on money" (the title of the article). *"What might this mean based on what the researchers found in the study?"*
It is important to know how many trees are available to people in different parts of cities. If all cities knew about patterns in tree cover, they could create programs for tree planting. Tree planting and other projects would help address this problem. In fact, all of the cities in the study started tree-planting programs to increase the number of trees in poorer areas!	**After reading this paragraph:** **Suggested Prompt**: *"What are some solutions to this problem?"*
Planting and taking care of trees costs money. Researchers predict that this is one of the reasons they found fewer trees in poorer parts of cities. Schwarz said her study is a call for cities "to think about equity when developing tree planting-goals."	**After reading this paragraph:** **Suggested Prompt**: *"What does the researcher mean when she says, 'Think about equity when developing tree-planting goals'? What does the word* equity *mean? How could we make the number of trees more 'equitable' in different areas? What would it mean if something were described as 'inequitable'?Do you think the number of trees is 'equitable' in the communities or neighborhoods where we live? Do you think certain areas have more trees than others? When you go outside, do you notice how many trees are around?"*

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Urban Trees Reveal Income Inequality (May 17, 2012) by Tim de Chant, Per Square Mile

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L3.3 Satellite Photographs

High/Low Income City Photos

Content based on "Income inequality seen from space" from Per Square Mile. All images © Google Maps, 2019.

Rio de Janeiro

Zona Sul

Oakland

West Oakland

Piedmont

Chicago

Woodlawn

Hyde Park

Houston

Fourth Ward

River Oaks

Boston

Ball Square, Somerville

West Cambridge

Learning Set 4

LS_4 My Notes Tab

Learning Set # 4

Learning Set Driving Question: How do scientists use evidence from the past and present to find out about the prehistoric organisms?

Lesson Abridged Comments:

Learning Set Description: (ML-PBL to create)

1. **L4.1:** The first lesson includes the video of the stegosaurus -- and then the students engage in discussion of differences and similarities between today and the past (prior knowledge) and the students use math to make a timeline to think about relative time. They find the stegosaurus, Juramaia (an early eutherian mammal), and squirrel on the timeline.
2. **L4.2:** The students observe and describe the prehistoric time period posters and place them in order based on evidence a nd reasoning. They try to figure out which time period would support the stegosaurus and which would support the squirrel. They ask, "Would the squirrel survive in any of these?"
3. **L4.3:** The Students sort actual fossils and describe the organisms (i.e., animals or plants) based on their structures. They identify one of the fossils (e.g., Which one may be trilobite?), identify the time period when the organism lived, and make a claim about the other plants and animals that lived in and what the environment was like during that time period.
4. **L4.4:** The students engage in texts about how fossils give clues about organisms, such as the stegosaurus and the Juramaia. Students make claims about which time period would have best supported the stegosaurus, which would have supported the Juramaia and which, if any, would support the squirrel.
5. **L4.5:** Shared reading - *Animals from Today and Long Ago* - about how fossils give clues about animals that no longer live today (whole class shared reading). The class analyzes pictures of the skeleton from the fossil of the Juramaia and the squirrel and place similarities and differences between the structure of the squirrel and the Juramaia in a Venn Diagram. They argue about the behavioral traits that match the structure (i.e., Did it eat nuts? Did it eat pine cones? Can you tell by the teeth and jaw?). **Go back to the Driving Question. The teacher with the student's help, writes down big ideas that the students learned.**

Phenomenon: Fossils provide evidence of the past.

Learning Performance: Students will analyze data from fossils, and argue from evidence that the environments from a long time ago were comprised of different plant and animal communities and that the climate and geographic features were different from today (through the lens of stability and change, structure and function and scale, proportion and quantity).

Figuring Out Statement/ DCI

In this learning set, the students learn about how scientists use fossils to recreate past environments and communities of plants and animals. Using information about organisms living today and how they interact with each other and meet their needs for survival, like scientists, the students describe the interactions among living and nonliving components of prehistoric environments.

Practice Statement

Students are doing the work of scientists: they are using fossils to give them clues about environments of long ago, analyzing data, using math, constructing explanations, engaging in texts, and arguing from evidence.

Practice Elements from NGSS

Analyzing and Interpreting Data: Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings

Using Mathematics and Computational Thinking: Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.

Constructing Explanations and Designing Solutions: Construct an explanation of observed relationships

Engaging in Argument from Evidence: Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation

Obtaining, Evaluating, and Communicating Information: Obtain and combine information from books and/or other reliable media to explain phenomena

Crosscutting Concepts

Scale, Proportion, and Quantity: Observable phenomena exist from very short to very long time periods.

Stability and Change: Some systems appear stable, but over long periods of time will eventually change.

Structure and Function: Substructures have shapes and parts that serve functions.

Squirrels Learning Set 4– Embedded Language Supports

Lesson 1

- Multiple modalities
- Authentic cross-disciplinary integration
- Use of photos for supporting comprehensible input
- Discourse moves from WIDA

Lesson 1 ALT

- Multiple modalities
- Authentic cross-disciplinary integration
- Use of photos for supporting comprehensible input
- Discourse moves from WIDA

Lesson 2

- Employment of multiple domains for language learning
- Explicit support for analyzing data (e.g., large group description and comparison of the data)
- Use of graphs and photos for supporting comprehensible input
- Discourse moves from WIDA

Lesson 3

- Employment of multiple domains for language learning
- Explicit support for constructing claims (e.g., large group authentic negotiation of meaning)
- Use of realia, diagrams, and photos for supporting comprehensible input
- Discourse moves from WIDA

Lesson 4

- Employment of multiple domains for language learning
- Use of realia, diagrams, and photos for supporting comprehensible input
- Discourse moves from WIDA

Lesson 5

- Employment of multiple domains for language learning
- Opportunity for language of meaning support using models
- Use of realia, diagrams, and photos for supporting comprehensible input
- Discourse moves from WIDA

Learning Set Driving Question
LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms?

L4.1 Using a Timeline

Lesson Snapshot

Learning Set Driving Question
LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms?

Lesson Driving Question
L4.1 Math: How can we use a timeline to think about the past?

Lesson Overview

1. Introduction: View the video and discuss the unit and lesson DQs; relate the DQs to the stegosaurus and the Jurassic period. Set the challenge of creating a timeline.
2. Timeline Investigation: Students create a timeline in years, counting by hundred millions, and add historic events to the timeline.
3. Group Discussion: Guided discovery with the timeline.
4. Wrap Up: Relate the timeline to the unit DQ. Students consider how long the squirrel and squirrel-like organisms have survived and when the stegosaurus lived.

Objectives

Learning Performance
Students will analyze data from the past and use math to make claims about when events occurred relative to each other (through the lenses of *stability and change* and *scale, proportion, and quantity*).

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.

Math Standard: 4th Grade - Numbers and Operations in Base Ten
Place value understanding for multi-digit whole numbers.
CCSS.MATH.CONTENT.**4.NBT.A.2**
Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

Math Competency Statement
I can read and write multi-digit whole numbers using base-ten numerals and number names, and expanded form.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** they can analyze data from the past to make relative claims about when events occurred. **Look Fors** 1. **Look for** students building on one another's ideas about how to sequentially order the photos to indicate an understanding of relative time using standard measurements that communicate *scale, proportion, and quantity*. 2. **Look for** students describing periods of *stability and change*. **Evidence Statement** Students use the math timeline, the photos, and prior knowledge as evidence to describe the relative time during which events took place, using language that indicates the lenses of *stability and change* and *scale, proportion and quantity*.	***Embedded Language Supports*** • Multiple modalities • Authentic cross-disciplinary integration • Use of photos for supporting comprehensible input • Discourse moves from WIDA

Teacher Preparation	Materials
• Consider creating photos of events that have been discussed so far in class (pyramids, inventions, an event from a read aloud, a famous person in history, etc.). If you have a picture of yourself (or another adult whom the students know) as a baby, that would help ground the timeline. We have included certain dates in the recent past, but it is best if students are familiar with some of the events. • Print a copy of the history timeline. You will need to cut each sheet in half because two periods are listed on one sheet. • Plan how to set up the timeline investigation—what area to use (hallway tiles, sidewalk sections, fence sections), where to place each timeline period, etc. • ***Background Information*** ○ BBC Earth timeline: The 25 Biggest Turning Points in Earth's History	***Teacher Materials*** • Driving Question Board (DQB) • Timeline grid number chart • History timeline: Copies of the timeline numbers to be used in Investigation • Small images of events for sequencing (no dates) and teacher key (with dates) • Timeline dates (no images) and timeline dates (with images) • Camera to take a picture of this lesson's timeline • Video: Prehistoric video ***Student Materials*** • History timeline: Copies of the numbers used in the timeline for use in the lesson • Small images of events for sequencing (no dates)

Lesson Segments	Estimated Time
Introduction	10 min
Timeline Investigation: Introduction	15 min
Timeline Investigation: Create the Timeline	10 min
Timeline Investigation: Add Events	20 min
Wrap Up	5 min
This 60-minute lesson could be integrated into the Math Block.	**Total Time:** 60 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and introduce DQ, *"How can we use a timeline to think about the past?"*** 1. Show the prehistoric video and ask students for their ideas about how this environment looks similar to and different from the squirrel's environment that they have been learning about. 2. Remind students of the unit DQ and tell them that they are now going to spend time thinking about the second part of the DQ: why we can't find any stegosauruses. 3. Explain that the video shows a habitat from the Jurassic period and ask students for their ideas about how to relate the question back to the Jurassic period and the stegosaurus. 4. Introduce the lesson DQ. Solicit ideas about what students might be doing in this lesson to answer the driving question. Ask students about other timelines they have seen and/or used in the class, and ask them to describe a timeline and a time they needed to use one.	**10 min**

2	**Timeline Investigation: Introduction: Put known historical events in relative order**	**15 min**

1. Introduce the timeline investigation by asking students to think about events and how long ago they happened.

   Suggested Prompt: *“This morning, I got out of bed and brushed my teeth. Who did that, too? On the first day of 3rd grade, some of you were kind of nervous. Raise your hand if you remember being nervous.”*
   - *“Who can show how they were nervous when they came into the room? Which event (brushing teeth this morning or the first day of school) was longer ago? How do you know? Who can show with their hands how long ago getting up this morning was?”*
   - *“Can you show with your hands how long ago the first day of school was? We can show these differences in times with a timeline.”*
   - *“Our timeline will represent a short time ago, possibly brushing our teeth or the first day of school, and a very long period ago—4 ½ billion years ago when planet Earth was formed!”*
2. Place the [small images of events]() for sequencing (no dates) on the carpet in a random order, and have students help you describe the picture on each one.
3. Lead students in deciding an order for the events pictured. Show them the direction in which time is represented using an event in class or brushing teeth this morning.

   Suggested Prompts: *“What do you know about this event? Did any of these events happen when your mom, teacher(s), or grandparents were young? Why do you say that?”*
4. As the students place the events in order, do not let them know whether they are correct or incorrect, but acknowledge that the class is unsure of some ideas.

Discourse Move - Help students deepen their reasoning

Students will suggest that one event goes before another and include their reasoning (e.g., “I think Earth being created should go first *because* all the other events happen *on* Earth.”). Ask students to give a thumbs-up if they agree with their peer’s idea, thumbs-down if they disagree, or side-to-side if they can’t decide. Students take turns, with each student deciding who goes next.

3	**Timeline Investigation: Create the Timeline - Engage in mathematical thinking to consider relative time** 1. Place these numbers on the board: 1; 50; 100; 200; 50,000; 200,000; 65,000,000; 150,000,000; 1,000,000,000; and 4,600,000,000. Read the numbers to students and ask them to repeat the numbers with you. Let students know that these numbers correspond to the images they looked at earlier. (**Note:** In 3rd grade, students should be introduced to the number names, but they do not need to be familiar with place value and identifying numbers in millions and beyond.) 2. Take students to the area (outside or a hallway) that they will use for the timeline. Start at section 1 (pre-determined—e.g., a sidewalk square, tiles in the hallway, a link of a fence). 3. Have students place sheets to represent years on the tiles or sections you are using for the activity (paper copy of history timeline). **Suggested Prompt:** *"To show such a large number, we are going to have to break it down into smaller chunks. Each section of our timeline will represent 100 million years. This means we will need 46 sections in our timeline: 100 million, 200 million, 300 million… 900 million, 10 hundred million—that's a billion!."* (See the number grid if needed.)	**10 min**

4	**Timeline Investigation: Add Events: Students add events to the timeline** 1. Introduce the photos that represent events (with dates) that students will add to the timeline one at a time. **Suggested Prompt:** *"Because we are representing such a long period, we will only include certain things that have happened on Earth. We will place the events we were discussing on our timeline. Now the pictures will include information on periods when the events took place."* 2. Have a student place the first sheet on the timeline. Have another student read what it says. Do this with each photo, giving each student an opportunity to read the sheet or place it on the sidewalk, fence, tile, etc. Go through all the photos and support students in placing or taping them on the correct spot on the timeline. As the dates on the line get a greater distance away, students, or the whole class if you choose, may have to walk quite a distance to get there! 3. After placing all the events on the timeline, invite students to share what they notice about the location of and space between the different events. Emphasize that because each section of the timeline represents the same number of years (i.e., 100 million), by analyzing the timeline, students can measure and figure out the amount of time that passed between different events (*scale, proportion, and quantity*). Ask students to find on the timeline when they were born, when their parents and grandparents were born, when the school building or city was built, etc. The events when humans were alive will all be close together. **Suggested Prompt About *Scale, Proportion, and Quantity*:** "*Think about the events on the timeline. What does it mean that these events are all close together? What does it mean when an event is all the way down there?"* After returning to the classroom, students will probably have many questions. 4. Ask students about their observations of the timeline and the ordering of events. **Suggested Prompt About *Stability and Change*:** *"What does 150 million years ago mean? How long is this period over the entire history of Earth? When were people first on planet Earth? How does that compare with the other events?"* Return the conversation to questions related to survival and if one organism, like algae, could be stable across time. Press for evidence and reasoning. *"What about*	**20 min**

	algae? Have you ever seen algae? Were dinosaurs and people on Earth at the same time? How long were dinosaurs on Earth?" 5. Return the conversation to questions related to survival. **Suggested Prompt About *Stability and Change*:** *"Are there some organisms that lived in the past that do not live any more? How do you know? Can you show how the timeline supports your claim? How do scientists know about these events? How do they know which events come before other events?"* Point out that dinosaurs, though now extinct, were on Earth longer than our species of humans has been on Earth. Ask students what they notice about big changes and big periods of stability in the timeline (e.g., the span of time dinosaurs existed compared with the span of time humans have been on Earth).	
5	**Wrap Up: DQB** 1. Add questions to the DQB. Relate the timeline specifically to the unit DQ. **Suggested Prompt: "***Think about the squirrel and stegosaurus and our timeline of events in history. What questions do you have to add to our DQB?"*	**5 min**

4,600,000,000
4 Billion 600 Million
Years Ago

4,500,000,000
4 Billion 500 Million
Years Ago

4,400,000,000
4 Billion 400 Million
Years Ago

4,300,000,000
4 Billion 300 Million
Years Ago

4,200,000,000

4 Billion 200 Million Years Ago

4,100,000,000

4 Billion 100 Million Years Ago

4,000,000,000

4 Billion Years Ago

3,900,000,000
3 Billion 900 Million
Years Ago

3,800,000,000
3 Billion 800 Million
Years Ago

3,700,000,000
3 Billion 700 Million
Years Ago

3,600,000,000
3 Billion 600 Million
Years Ago

3,500,000,000
3 Billion 500 Million
Years Ago

3,400,000,000
3 Billion 400 Million
Years Ago

3,300,000,000

3 Billion 300 Million
Years Ago

3,200,000,000
3 Billion 200 Million
Years Ago

3,100,000,000
3 Billion 100 Million

Years Ago

3,000,000,000

3 Billion Years Ago

2,900,000,000

2 Billion 900 Million

Years Ago

2,800,000,000
2 Billion 800 Million
Years Ago

2,700,000,000
2 Billion 700 Million
Years Ago

2,600,000,000
2 Billion 600 Million
Years Ago

2,500,000,000
2 Billion 500 Million
Years Ago

2,400,000,000

2 Billion 400 Million

Years Ago

2,300,000,000

2 Billion 300 Million

Years Ago

2,200,000,000

2 Billion 200 Million Years Ago

2,100,000,000
2 Billion 100 Million Years Ago

2,000,000,000
2 Billion Years Ago

1,900,000,000
1 Billion 900 Million
Years Ago

1,800,000,000
1 Billion 800 Million
Years Ago

1,700,000,000

1 Billion 700 Million

Years Ago

1,600,000,000

1 Billion 600 Million

Years Ago

1,500,000,000
1 Billion 500 Million
Years Ago

1,400,000,000
1 Billion 400 Million
Years Ago

1,300,000,000

1 Billion 300 Million Years Ago

1,200,000,000
1 Billion 200 Million Years Ago

1,100,000,000

1 Billion 100 Million Years Ago

1,000,000,000
1 Billion Years Ago

900,000,000
900 Million Years Ago

800,000,000
800 Million Years Ago

700,000,000
700 Million Years Ago

600,000,000
600 Million Years Ago

500,000,000
500 Million Years Ago

400,000,000
400 Million Years Ago

300,000,000
300 Million Years Ago

200,000,000
200 Million Years Ago

100,000,000
The Last 100 Million Years

L4.0 Small Timeline Events (Teacher Key)

Timeline Events- Teacher Key

The Beatles
Approximately 50 years ago

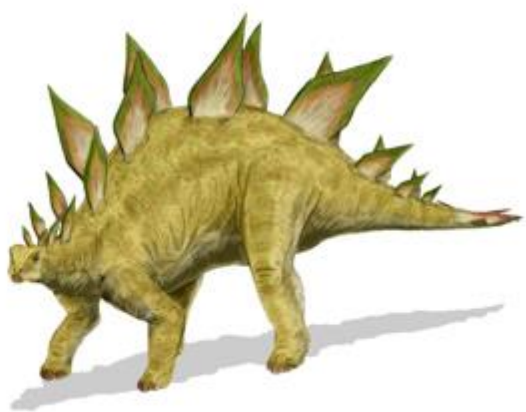
Martin Luther King Jr.'s "I Have a Dream" speech
Approximately 50 years ago

First cars and factories
Approximately 100 years ago

First stars and stripes flag
Approximately 200 years ago

Mary Anning discovered the *Ichthyosaurus* fossil
Approximately 200 years ago

"[Hunting Woolly Mammoth]" by [Cloud Ordinary] is licensed under [CC BY-SA 4.0]
An ice age
Approximately 50,000 years ago

 "Comparison of Neanderthal and Modern Human Skulls" by hairymuseummatt is licensed under CC BY-SA 2.0 First humans	 "The Death Pose" by Via Tsuji is licensed under CC BY-NC-ND 2.0 Dinosaur extinction
 Stegosaurus/Nobu Tamura/CC BY-SA 3.0 Stegosaurus	 Blue-green algae made oxygen
 Earth was formed	Event from this year or today

L4.0 Small Timeline Events for Sequencing

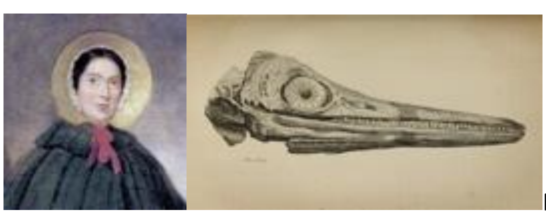
Timeline Events

The Beatles

Martin Luther King Jr.'s "I Have a Dream" speech

First cars and factories

First stars and stripes flag



Mary Anning discovered the *Ichthyosaurus* fossil

"Hunting Woolly Mammoth" by Cloud Ordinary is licensed under CC BY-SA 4.0

An ice age

 "Comparison of Neanderthal and Modern Human Skulls" by hairymuseummatt is licensed under CC BY-SA 2.0 First humans	 "The Death Pose" by Via Tsuji is licensed under CC BY-NC-ND 2.0 Dinosaur extinction
 Stegosaurus/Nobu Tamura/CC BY-SA 3.0 Stegosaurus	 Blue-green algae made oxygen
 Earth was formed	Event from this year or today

L4.0 Timeline Dates

1

50

100

200

50,000

200,000

65,000,000

150,000,000

1,000,000,000

4,600,000,000

L4.0 Timeline Dates and Images

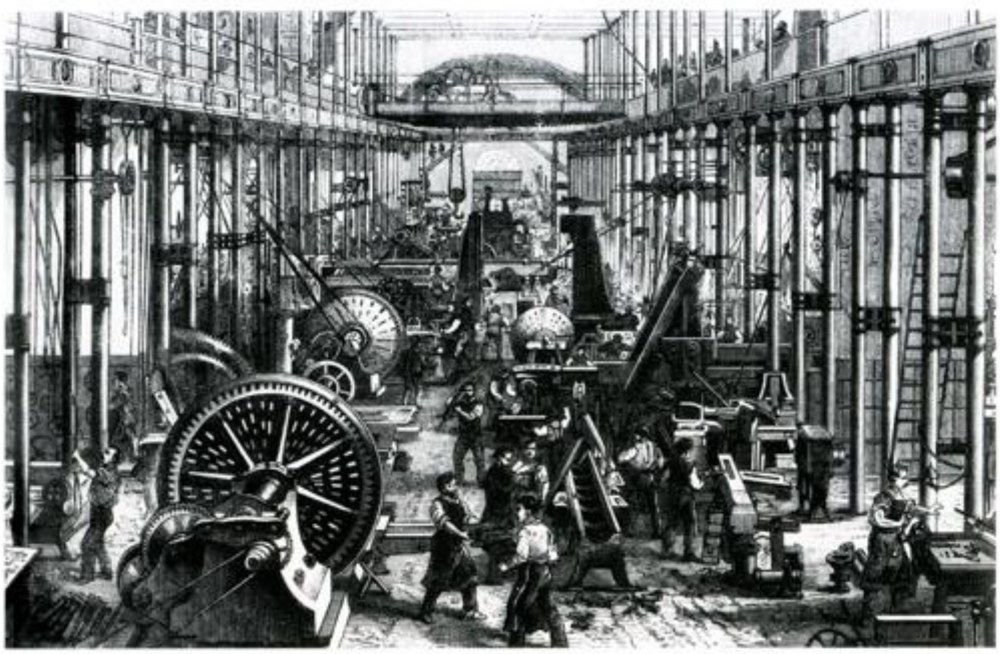
1 (This year)

50 years ago

The Beatles

Martin Luther King Jr.'s "I Have a Dream" speech

100 years ago



First cars and factories

200 years ago

First stars and stripes flag

Mary Anning discovered the *Ichthyosaurus* fossil

50,000 years ago

"Hunting Woolly Mammoth" by Cloud Ordinary is licensed under CC BY-SA 4.0

An ice age 200,000 years ago

“Comparison of Neanderthal and Modern Human Skulls” by hairymuseummatt is licensed under CC BY-SA 2.0

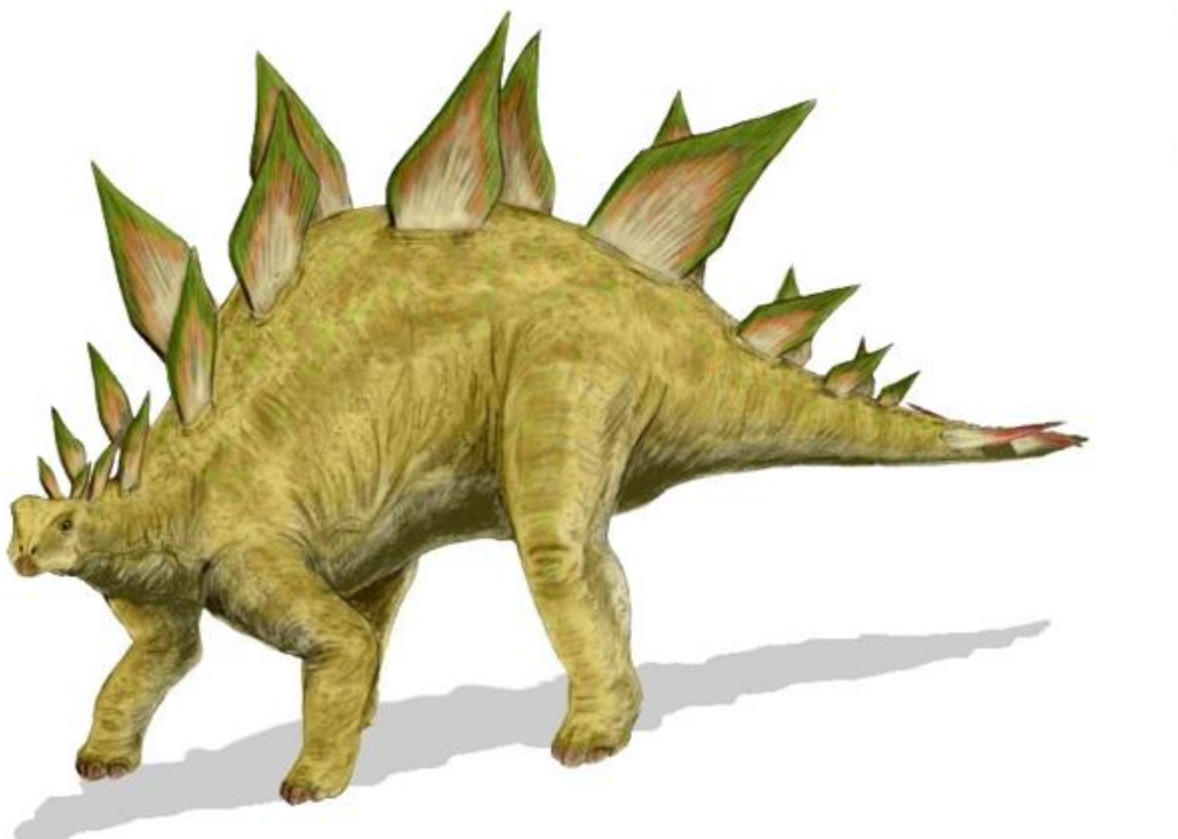
First humans

65,000,000 years ago

"The Death Pose" by Via Tsuji is licensed under CC BY-NC-ND 2.0

Dinosaur extinction

150,000,000 years ago



Stegosaurus/Nobu Tamura/CC BY-SA 3.0

Stegosaurus

1,000,000,000 years ago

Blue-green algae made oxygen

4,600,000,000

years ago

Earth was formed

L4.0 Timeline Grid Number Chart

Timeline Grid Number Chart

In this part of the lesson, students count down the sidewalk or in the hallway by 100 million years (first 100 million, then 200 million, etc. Discuss where to put the numbered sheets with images for 4,600,000,000; 1,000,000,000; 150,000,000; 65,000,000; 200,000; 50,000; 200; 100; 50; and 1.

> **Suggested Prompt:** *"To show such a large number, we are going to have to break it down into smaller chunks. Each section of our timeline will represent 100 million years. This means we will need 46 sections in our timeline: 100 million, 200 million, 300 million… 900 million, 10 hundred million—that's a billion!—."*

As you walk through the timeline, ask students to help place each sheet from the paper copy of the timeline on the hallway square or sidewalk section and state how many years (100 million) have passed (in the hundreds of millions). If working in a long hallway, you could tape these numbers to the wall.

Once all the numbers are placed and students have walked the length of the hallway, discuss where to put the photos from the earlier part of the lesson. *"On which square would we place the blue-green algae, Martin Luther King Jr.'s 'I Have a Dream' speech, etc.?"*

Note: This chart is just to help with counting in the hundred millions. You may want to tape down the numbers before the lesson to save time.

one hundred million 100,000,0 00	two hundred million 200,000,0 00	three hundred million 300,000,0 00	four hundred million 400,000,0 00	five hundred million 500,000,0 00	six hundred million 600,000,0 00	seven hundred million 700,000,0 00	eight hundred million 800,000,0 00	nine hundred million 900,000,0 00	ten hundred million **ONE BILLION 1,000,000, 000**
eleven hundred million 1,100,000, 000	twelve hundred million 1,200,000, 000	thirteen hundred million 1,300,000, 000	fourteen hundred million 1,400,000, 000	fifteen hundred million 1,500,000, 000	sixteen hundred million 1,600,000, 000	seventeen hundred million 1,700,000, 000	eighteen hundred million 1,800,000, 000	nineteen hundred million 1,900,000, 000	twenty hundred million **TWO BILLION 2,000,000, 000**
twenty-one hundred million 2,100,000, 000	twenty-two hundred million 2,200,000, 000	twenty-three hundred million 2,300,000, 000	twenty-four hundred million 2,400,000, 000	twenty-five hundred million 2,500,000, 000	twenty-six hundred million 2,600,000, 000	twenty-seven hundred million 2,700,000, 000	twenty-eight hundred million 2,800,000, 000	twenty-nine hundred million 2,900,000, 000	thirty hundred million **THREE BILLION 3,000,000, 000**
thirty-one hundred million 3,100,000, 000	thirty-two hundred million 3,200,000, 000	thirty-three hundred million 3,300,000, 000	thirty-four hundred million 3,400,000, 000	thirty-five hundred million 3,500,000, 000	thirty-six hundred million 3,600,000, 000	thirty-seven hundred million 3,700,000, 000	thirty-eight hundred million 3,800,000, 000	thirty-nine hundred million 3,900,000, 000	forty hundred million **FOUR BILLION 4,000,000, 000**
forty-one hundred million 4,100,000, 000	forty-two hundred million 4,200,000, 000	forty-three hundred million 4,300,000, 000	forty-four hundred million 4,400,000, 000	forty-five hundred million 4,500,000, 000	forty-six hundred million **FOUR BILLION SIX HUNDRED MILLION 4,600,000, 000**				

4.1.1_ALTERNATE Using a Timeline

Learning Set Driving Question
LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms?

L4.1 ALTERNATE LESSON Using a Timeline

Lesson Snapshot
Learning Set Driving Question LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms? **Lesson Driving Question** **Math:** How can we use a timeline to think about the past? **Lesson Overview** 1. Introduction: View the video and discuss the unit and lesson DQs; relate the question to the stegosaurus and the Jurassic period. Set the challenge of creating a timeline. 2. Timeline Investigation: Students order events and create a timeline to analyze the sequence and relative time between events. 3. Group Discussion: Guided discovery with the timeline. 4. Wrap Up: Relate the timeline to the unit DQ. Students consider how long the squirrel and squirrel-like organisms have survived and when the stegosaurus lived.

Objectives
Learning Performance *Students will* analyze data from the past to make claims about the times events occurred relative to each other (through the lenses of *stability and change* and *scale, proportion, and quantity*). **Building Toward PEs** **3-LS4-1** Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** they can analyze data from the past to make relative claims about when events occurred. **Look Fors** 1. **Look for** students thinking about and building on each other's ideas about how	***Embedded Language Supports*** • Multiple modalities • Authentic cross-disciplinary integration • Use of photos for supporting comprehensible input • Discourse moves from WIDA

to sequentially order the photos to indicate an understanding of relative time using standard measurements that communicate *scale, proportion, and quantity*. 2. **Look for** students describing periods of *stability and change*. **Evidence Statement** The analysis students make with their claims uses the timeline, the photos, and prior knowledge as evidence to describe the relative time during which events took place, using language that indicates the lenses of *stability and change* and *scale, proportion, and quantity.*	

Teacher Preparation	Materials
• Consider creating photos of events that have been discussed so far in class (pyramids, inventions, an event from a read aloud, a famous person in history, etc.). If you have a picture of yourself as a baby or of another older person (whom the students know) as a baby, that would help ground the timeline. We have included certain dates in the recent past, but it is best if students are familiar with some of the events. • ***Background Information*** ○ Earth timeline	***Teacher Materials*** • Driving Question Board (DQB) • Small images of events for sequencing (no dates) and teacher key (including dates) • Camera to take a picture of this lesson's timeline • Number grid (teacher resource) • Video: Prehistoric video ***Student Materials*** • Timeline images (for placing) • Sticky notes or sentence strips for inserting dates • Small images of events for sequencing

Lesson Segments	Estimated Time
Introduction	5 min
Timeline Investigation: Introduction	20 min
Timeline Investigation: Create the Timeline	10 min
Timeline Investigation: Add Events	20 min
Wrap Up	5 min
	Total Time: 60 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and introduce DQ, *"How can we use a timeline to think about the past?"*** 1. Show the Prehistoric video and ask students for their ideas about how this environment looks similar to and different from the squirrel's environment that they have been learning about. 2. Remind the students of the unit DQ and tell students that they are now going to spend time thinking about the second part of the DQ: why we don't see any stegosauruses. 3. Explain that the video shows a habitat from the Jurassic period and ask students for their ideas about how to relate the question back to the Jurassic period and the stegosaurus. 4. Introduce the lesson DQ. Solicit ideas about what students might be doing in this lesson to answer the question. Ask the students about other timelines they have seen and/or used in the class. Ask a student to describe a timeline and when they have needed to use one.	**5 min**

2	**Timeline Investigation: Introduction: Put known historical events in relative order** 1. Introduce the timeline investigation by asking students to think about events and how long ago they happened. **Suggested Prompts:** • *This morning, I got out of bed and brushed my teeth. ("Who did that, too?") On the first day of 3rd grade, some of you were kind of nervous. (Raise your hand if you remember being nervous.)* • *"Who can show how they were nervous when they came into the room? Which event (brushing teeth this morning or the first day of school) was longer ago? How do you know? Who can show with their hands how long ago getting up this morning was?"* • *"Can you show with your hands how long ago the first day of school was? We can show these differences in times with a timeline."* • *"Our timeline will represent a short time ago, brushing our teeth and the first day of school, and a very long period of time ago when planet Earth was formed!"* 2. Deliberately place the event cards (found here) without numbers on the carpet in a random order, and have students help you describe the picture on each one. 3. Lead students in deciding an order for the events pictured on the cards. Show them the direction in which time is represented using an event in class or brushing teeth this morning. **Suggested Prompt:** *"What do you know about this event? Do you think any of these events happened when your mom, your teacher(s), your grandparents, etc., were young? Why do you say that?"* 4. As the students place the events in order, do not let them know whether they are correct or incorrect, but acknowledge that the class is unsure of some areas. **Discourse Move - Help students deepen their reasoning**  Students will suggest that one event goes before another and include their reasoning (e.g., "I think Earth being created should go first because every event happens *on* Earth."). Ask students to give a quiet *thumbs-up* if they agree with their peer's idea, *thumb-down* if they disagree, or *side-to-side* if they can't decide. The first student decides which student is next to explain why they disagree or agree or are unsure.	**20 min**

3	**Timeline Investigation: Create the Timeline: Use mathematical thinking to consider relative time** 1. Take students to the area (outside or a hallway) that they will use for the timeline. Start at section 1 (pre-determined—e.g., a sidewalk square, tiles in the hallway, a link of a fence). Make sure you have 46 sections. Mark the 1st and 46th squares to show the distance between the two. 2. Introduce pictures that represent events that students discussed and made predictions about how to order sequentially in class. These are the events they will add to the timeline. **Suggested Prompt:** *"Each of these 46 sections represents the same amount of time. The first block represents the set of time closest to today, and block 46 represents a very long time ago."*	**10 min**

4	**Timeline Investigation: Add Events: Students add events to the timeline** 1. Tell students that they will begin placing the events on the timeline one at a time. **Suggested Prompt:** *"Because we are representing such a long period of time, we will only include certain things that have happened on Earth—the events we discussed in the classroom."* 2. Using the teacher key, have a student place the first sheet on the sidewalk timeline. Have another student read what it says. Do this with each photo, giving each student an opportunity to read the sheet or place it on the sidewalk, fence, tile, etc. Go through all the photos to support students in placing or taping them on the correct spot on the timeline. As the events get a greater distance away, the students, or the whole class if you choose, may have to walk quite a distance to get there! 3. After placing all the events on the timeline, invite students to share what they notice about the location of and space between the different events. Emphasize that because each section of the timeline represents the same amount of time (i.e., number of years), by analyzing the timeline, students can figure out the relative amount of time that passed between different events (*scale, proportion, and quantity*). **Suggested Prompt about *scale, proportion, and quantity*:** *"Think about the events on the timeline. What does it mean that these events are all close together (e.g., many events are in square 1)? What does it mean when an event is all the way down there?"* After returning to the classroom, students will probably have many questions. 4. Ask the students about their observations of the timeline and the ordering of events. **Suggested Prompts:** • *"When was algae first present on Earth? Have you ever seen algae? Were dinosaurs and people on Earth at the same time?"* Tell the students, *"These are questions about stability, meaning staying the same, and change."* Return the conversation to questions related to survival, and if one organism, like algae, could be stable across time. Press for evidence and reasoning. • *"Are there some organisms that lived in the past that do not live any more? How do you know? Can you show how the timeline supports your claim? How do you think scientists know about these*	**20 min**

	events? How do you think they might know which events come before other events? Point out that dinosaurs, although now extinct, were on Earth longer than humans have been on Earth so far. Ask students what they notice about big changes and big periods of stability in the timeline (e.g., the relative span of time dinosaurs existed compared with the relative span of time humans have been on Earth).	
5	**Wrap Up: DQB** 1. Add questions to the DQB. Relate the timeline specifically to the unit DQ. **Suggested Prompt:** *"Think about the squirrel and the stegosaurus and our timeline of events in history. What questions do you have to add to our DQB?"*	**5 min**

L4.1 Alt. Timeline Images

Timeline Images

The Beatles

Martin Luther King Jr.’s “I Have a Dream” speech

First cars and factories

First stars and stripes flag

Mary Anning discovered the *Ichthyosaurus* fossil

“Hunting Woolly Mammoth” by Cloud Ordinary is licensed under CC BY-SA 4.0

An ice age

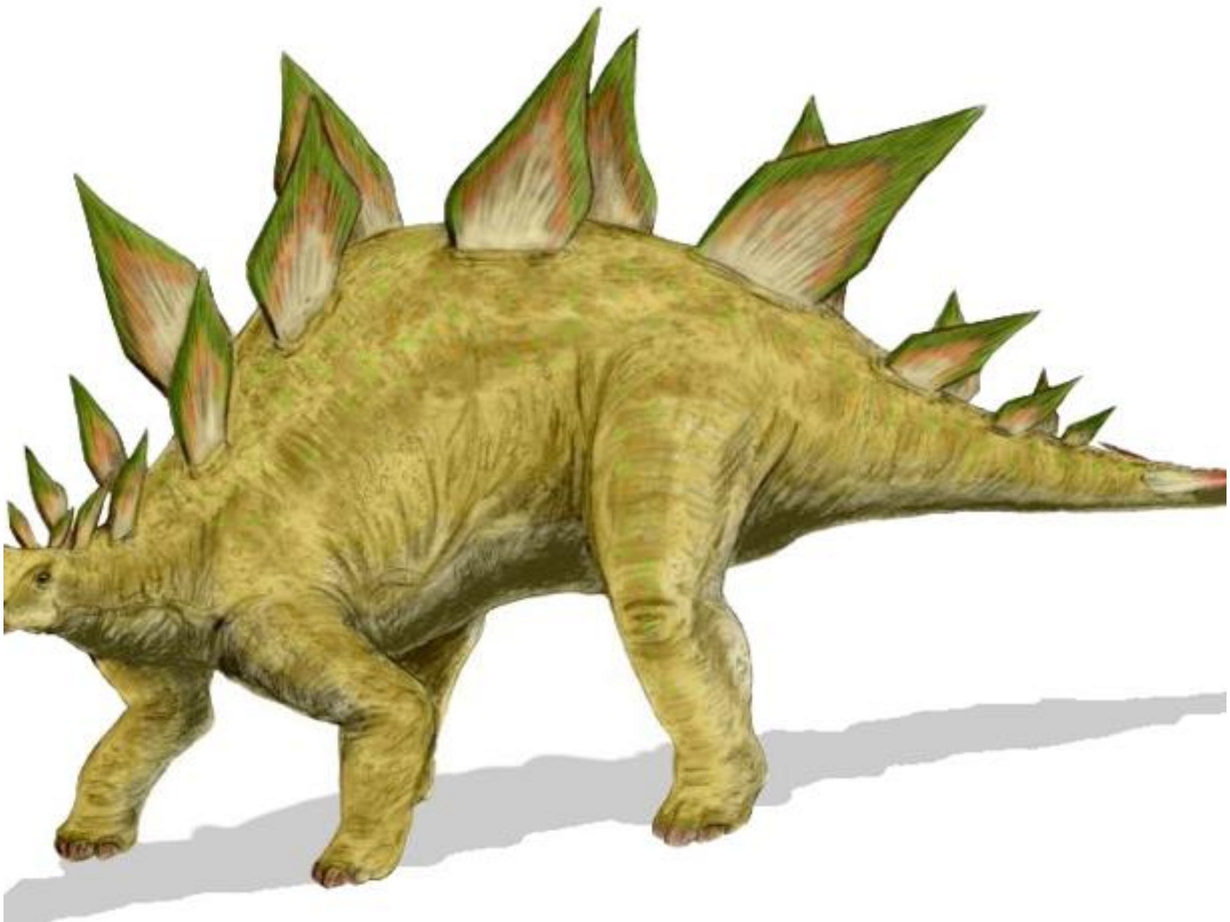
An ice age

"Comparison of Neanderthal and Modern Human Skulls" by hairymuseummatt is licensed under CC BY-SA 2.0

First humans


"The Death Pose" by Via Tsuji is licensed under CC BY-NC-ND 2.0

Dinosaur extinction



Stegosaurus/Nobu Tamura/CC BY-SA 3.0

Stegosaurus

Blue-green algae made oxygen

Earth was formed

Learning Set Driving Question
LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms?

L4.2 Time Periods

Lesson Snapshot

Learning Set Driving Question
LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms?

Lesson Driving Question
L4.2: What were past environments like?

Lesson Overview

1. Introduction: Introduce the lesson DQ. Students reflect on the timeline of events from the previous lesson.
2. Making Observations: Students make observations of living things, the environment, and climate on prehistoric time period posters. Students work together in a large group to try to order the posters.
3. Comparing Time Periods and Making Initial Claims: Students discuss observations, alternating whole-group and *turn-and-talk* discussions, and they generate initial claims regarding the order of the prehistoric time periods and the animals that lived in each.
4. Engaging in Text - Consider Claims: Students read short texts about different time periods and match the information to the posters. Students make initial claims with evidence about the time period that would have best supported the survival of the stegosaurus and the Juramaia.
5. Wrap Up: Students write in their science notebooks about whether they think the squirrel would survive in any of these time periods.

Objectives

Learning Performance
Students will analyze large photos of past environments to develop a claim about how past organisms survived in environments that fit their needs and some did not (through the lenses of *stability and change* and *scale, proportion, and quantity*).

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-ESS2-2 Obtain and combine information to describe **climates** in different regions of the world.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out	***Embedded Language Supports***

Students are figuring out that climates and environments in the past have been changing over time and that scientists use fossils as evidence to figure out their questions about animals that lived in the past. **Look Fors** 1. **Look for** student claims that use evidence. 2. **Look for** students' ideas and questions that indicate thinking about change over time and events that took place relative to (simultaneously, before, or after) other events. **Evidence Statement** The claims students develop use evidence from the timeline activity and the prior three Learning Sets to explain that the Juramaia is not the same as other organisms today and that scientists have clues (fossils) to find out about the past. The language of the claims indicates the lenses of *stability and change* and *scale, proportion, and quantity.*	• Employment of multiple domains for language learning • Explicit support for analyzing data (e.g., large group description and comparison of the data) • Use of graphs and photos for supporting comprehensible input • Discourse moves from WIDA

Teacher Preparation	Materials
• To prepare for the discussion, read the information on the different kinds of fossils and eras during the prehistoric period. • If using hard copies, print time period paragraphs - enough for each student or for two to share, or one for the overhead projector • ***Background Information*** ○ Squirrels and survival; Teacher resource on the Juramaia	***Teacher Materials*** • Driving Question Board (DQB) • Timeline from last lesson • Prehistoric time period posters • Paragraphs about the prehistoric periods (to match with posters) ***Student Materials*** • Science notebooks

Lesson Segments	Estimated Time
Introduction	10 min
Making Observations	10 min
Comparing Time Periods and Making Initial Claims	20 min
Engaging in Text	30 min
Wrap Up	10 min

Thirty minutes of this 80-minute lesson could be integrated into the Literacy Block.	**Total Time:** 80 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and introduce DQ, *"What were past environments like?"*** 1. Review the timeline activity from L4.1. In a *turn-and-talk*, ask students to review their observations from the activity and think about where the stegosaurus was on the timeline and what they know about the stegosaurus and the time when stegosauruses lived. **Suggested Prompt:** *"How do you think people know about the stegosaurus? Did scientists living then write down their observations of stegosauruses?"* 2. Preview what students will be doing and learning for the rest of the learning set. Students will learn more about the environment in which the stegosaurus and other prehistoric organisms lived. **Suggested Prompt:** *"When we were studying squirrels, we learned that the squirrel behaviors had a lot to do with their structures and the organisms around them. In these next few lessons, we're going to work backward We're going to figure out behaviors of prehistoric organisms by using what we can tell about organisms' structures, from fossils and from what we know about the organisms around them. Sometimes scientists have only the structure of a prehistoric plant or animal. How do they figure out what the organism was like?"* 3. Introduce the lesson DQ. Tell students to *turn-and-talk* to reflect and respond to the question. Have a few students share out their ideas. Ask students what other questions they have. Write these questions in the DQ space provided.	**10 min**
2	**Making Observations: Students observe posters depicting different prehistoric time periods and make class claims about what they notice** 1. Display the posters that represent different time periods to students one by one. For each poster, ask students to do a brief *turn-and-talk* to share what they notice on the poster. After each *turn-and-talk*, allow students to share out their noticings with the class. Record students' observations on sticky notes or sentence strips and place the notes under or beside the poster. 2. Ask students to share what they notice about similarities and differences between posters.	**10 min**

3	**Comparing Time Periods: Make claims based on evidence and reasoning** 1. Ask students to use what they learned from creating the timeline in L4.1 and information about how the environment and living things changed over time to put the posters in order from *longest ago* to *most recent*. 2. You can have one student start this discussion by stating which time period they think was the *longest ago* and explaining their thinking. You may link back to certain events on the timeline and help students identify during which time these events would have happened (e.g., finding when the stegosaurus appears on the timeline). 3. Focusing on one poster at a time, have students first *turn-and-talk* with a partner about the organisms they notice in the poster, then share out with the class. Record students' ideas on the board or chart paper. Also, as a class, discuss what the environment was like in each poster. After discussing the individual posters, invite the students to discuss similarities and differences between the different time periods and to describe the ways in which the environment and organisms changed over time. 4. Continue the discussion as a whole group, using *turn-and-talk* when needed, to decide on an order for the posters. If undecided or more than one idea is shared, repeat both ideas and ask students if they can explain and justify how there can be more than one idea. Do not worry at this time if the climate posters are in order because the students will later use paragraphs to determine the correct order. 5. As a class, briefly reflect on the prehistoric video. Ask students to recall two of the organisms featured in this video: the stegosaurus and a small squirrel-like mammal (the Juramaia, a small eutherian mammal similar to a squirrel). Brainstorm initial claims based on evidence from the posters and the timeline when the stegosaurus and Juramaia most likely lived. Write these on the whiteboard or chart paper as students share so that the class can return to these claims in L4.4. **Suggested Prompt:** Stegosaurus: *"Where do you think the stegosaurus would go? Why do you think that? What about the environment in this time period would help the stegosaurus survive?"* Juramaia (small squirrel-like mammal): *"Where do you think the Juramaia would go? Why do you think that? What about the environment in this time period would allow the Juramaia to survive?"*	**20 min**

	Discourse Move - Make ideas public • As students make suggestions, have other students come up to the posters and point to the object under inquiry. If a student points out a feature in the poster, check with him or her, *"Do you mean this animal? Are you talking about the water here?"* Make sure all ideas are publicly displayed using the poster.	
4	**Engaging in Text: Consider claims** 1. Tell students that they will read together paragraphs about the different periods and work together to determine whether their order for the posters was correct. Students may access this text digitally, or you may project and/or print the texts to place beside the posters. As the class matches the paragraphs about the periods with the posters, help students make connections to the timeline from the previous lesson (*scale, proportion, and quantity*). 2. Read the time period paragraphs aloud with the class and challenge students to figure out which poster the paragraph matches. Support students to identify information in the text that they think matches illustrations on the posters. As students make claims, press them to provide evidence from the text and poster to support their claims. You may choose to highlight pieces of information students identify in the text that they think are illustrated in a particular poster. 3. After reading and matching the paragraphs about the different periods to the posters, revisit students' earlier claims about where the stegosaurus and the Juramaia would fit. Ask students if they still agree with their initial claims after reading the paragraphs. What additional evidence did the paragraphs provide to support their claims or make them reconsider their original claims?	**30 min**
5	**Wrap Up: Review the DQB and free write** 1. Add any new questions or answers to the DQB. 2. Students write in their science notebooks, stating whether they think the squirrels of today would have survived in any of these periods. Students should support their thinking by telling why. Have a few students share their responses. **Suggested Prompt:** *"Do you think a modern-day squirrel could have survived in any of these periods? Why or why not?"*	**10 min**

Time Period Paragraphs

Ordovician and Silurian Periods

The **Ordovician period** was 495 to 443 million years ago. During this time, most life was in the oceans. You could find jellyfish, sea scorpions, and trilobites. In the beginning of this period, Earth had a mild climate. This means that the weather was warm and wet. The oceans were warm and shallow. There was less oxygen in the air and water than there is today. Bacteria were the only living things in the soil. At the end of the Ordovician period, large glaciers formed and caused an ice age, killing many of the organisms that were living in the oceans.

During the **Silurian period**, from 443 to 417 million years ago, the ice age ended, the climate warmed up, and oceans covered much of the earth. Corals, sponges, and bony fish, similar to the fish we have today, appeared in the water. Plants began to grow on land near the shores of rivers and lakes.

Devonian Period

The **Devonian period** was 420 to 360 million years ago. The Devonian period had a very warm climate. There was a lot of oxygen in the air that plants and animals could use to breathe. Many new animals and plants appeared during this period. In fact, scientists call it the "Age of Fish" because many kinds of fish appeared and changed a lot. Some fish developed jaws and teeth! The first land animals may have also started as fish. One of the first land animals looked like a combination of a fish and a crocodile. Insects without wings and scorpions also appeared during this time. Plants looked very different than they do today. Plants in the Devonian period did not have roots or seeds and did not grow very tall.

Triassic and Jurassic Periods

The **Triassic period** was between 251 and 199 million years ago. The climate was still warm, there was not much rain, and the land had deserts and lakes. There was no ice at the North and South Poles. Instead, large forests with pine trees and ferns grew at the poles. Dinosaurs appeared during this period. Some dinosaurs lived on land, and others lived in the oceans. Some of the dinosaurs were bipedal (walked on two legs), and some hunted in packs. Insects like dragonflies and grasshoppers also appeared.

The **Jurassic period** came right after the Triassic period. It was between 199 and 145 million years ago. The climate changed from warm and dry to very hot and humid, which was great for growing plants. Large forests covered a lot of the land. More kinds of dinosaurs and the first birds appeared during this period. Very large plant-eating dinosaurs, like the stegosaurus, and smaller, faster meat-eating dinosaurs roamed the Earth. Small mammals that looked like mice also appeared. Near the end of the Jurassic period, the climate became cooler.

Cretaceous Period

The **Cretaceous period** was from 145 to 66 million years ago. The climate was colder and wetter than it had been. Dinosaurs still ruled the land, but other animals, like frogs, snakes, and crocodiles, thrived as well. Flowering plants appeared during this time. Forests began to look more like forests we see today. The forests now included some kinds of oak trees and grasses. Small mammals lived in the forests. More insects began to fly, and the first butterflies appeared. New birds appeared, including the ancestor of the pelican. Near the North and South Poles, ice began to form. At the end of this period, all dinosaurs, except birds, became extinct.

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Learning Set Driving Question
LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms?

L4.3 Fossils

Lesson Snapshot

Learning Set Driving Question
LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms?

Lesson Driving Question
L4.3: What are fossils and how do they help us understand prehistoric organisms and environments?

Lesson Overview

1. Introduction: Discuss lesson DQ. Revisit posters and information about time periods from L4.2.
2. Investigation - Fossil Sorting: Introduce photographs of fossils from different time periods. Students receive fossils and sort them, using the identification sheet in the kit to place them in a time period. Students choose one of the fossils from the kit to investigate more closely.
3. Fossil Study - Video and Response: Students watch video clips to learn about how scientists use and study fossils.
4. Wrap Up - Science Notebooks: Students use evidence to determine in which epoch the fossil belongs. Students add questions and answers to the DQB.

Objectives

Learning Performance
Students will analyze fossils as evidence to support claims about the organisms, environments, and climates that existed long ago and how they changed over time (through the lenses of *stability and change* and *scale, proportion, and quantity*).

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-ESS2-2 Obtain and combine information to describe climates in different regions of the world.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** fossils provide a lot of evidence and can indicate climates and environments and changes in those climates and environments from long ago; and that events happened at a time scale that includes millions of	***Embedded Language Supports*** • Employment of multiple domains for language learning • Explicit support for constructing claims (e.g., large group authentic negotiation of meaning)

years. **Look Fors** 1. **Look for** student claims that use evidence and students' ideas and questions that indicate that some things change over time because of factors that create change instead of events that create stability. 2. **Look for** students showing facility with the use of fossils as evidence of the past. **Evidence Statement** The claims students make will indicate the lenses of *stability and change* and *scale, proportion, and quantity*. Claims will indicate that the students understand and use the ideas that 1) fossils serve as evidence and 2) that scientists use fossils to figure out environments and climates from long ago and how the organisms changed as a result of these climate and environment changes.	• Use of realia, diagrams, and photos for supporting comprehensible input • Discourse moves from WIDA

Teacher Preparation	Materials
• To prepare for the discussion, read the information on the different kinds of fossils and eras during the prehistoric period. • ***Background Information*** ○ Squirrels and survival; Juramaia; Quick read about an early Eutherian mammal called Juramaia	***Teacher Materials*** • Driving Question Board (DQB) • Prehistoric time period posters and paragraphs • Fossils from a kit for students to sort • Slides with photos of fossils from different time periods (photographs that can be printed for use in class) • Videos: Meet the paleontologists, *Did Dinosaurs Travel in Herds or Packs?* • Fossil sorting guide from a kit: teacher resource (hard copy for students in the kit—each group will need one copy of the fossil identification key) • Supplemental video and text: *How Does a Dinosaur Become a Fossil?* (video) and Fossils: Preserved Remains and Trace Fossils (text) ***Student Materials*** • Fossil sorting student sheet

Lesson Segments	Estimated Time
Introduction	10 min
Investigation - Fossil Sorting	15 min

Fossil Study - Video and Response	15 min
Wrap Up - Science Notebooks	10 min
Portions (15–30 minutes) of this 50-minute lesson could be integrated into the Math Block (fossil sorting and video done in math or other centers).	**Total Time:** 50 min

<table>
<tr><th>Part</th><th>Lesson Steps</th><th>Estimated Time / Materials</th></tr>
<tr><td>1</td><td>Introduction: Engage with phenomenon and introduce DQ, “What are fossils and how do they help us understand prehistoric organisms and environments?”

1. Introduce the lesson DQ and revisit the time period posters and information that students sequenced and discussed in L4.2. Ask students to share what they noticed about how the environments and organisms (plants and animals) changed as time passed. Ask students if they can identify an event that might have made change happen. Accept all reasonable answers. Ask students what questions they have regarding fossils, changes in climate, or the DQ. Write these down in the space provided.

2. Tell students that during this lesson, they will be examining and identifying actual fossil remains and investigating the time period in which the fossilized organisms lived. Before beginning the sorting activity, engage students in making observations of examples of photographs of fossilized remains (slides) from the different periods, and describe how fossils from different time periods show evidence of how organisms change over long periods (stability and change).

Suggested Prompt: “What do you notice about these fossils? How do they match our posters and notes about organisms from different time periods? What do you notice about how the fossils from different time periods change over time?”</td><td>10 min</td></tr>
</table>

2	**Investigation: Sort fossils** 1. Have students form groups of three or four. Then give each group some of the fossils from the kit to identify using the identification key in the kit. Once students have sorted and identified their fossils, groups should use the fossil identification key in the kit to identify the time period the fossils are from. 2. After groups have had some time to identify and sort some of their fossils into time periods, allow a few groups to share about the fossils they have identified, the features of the fossil that they were able to "match" to the fossil identification key, and the time period the fossil is from. 3. In their groups or individually, students choose one of the fossils they have identified to analyze more closely and record their observations, claims, and evidence, using the student sheet (*structure and function*). Some groups may have time to analyze more than one fossil. Emphasize to students that their evidence to support their claim (in the student sheet) could come from the photographs of fossils from the different time periods, the time period posters, or the paragraphs about the time periods.	**15 min**
3	**Fossil Study - Video and Response: Students watch video clips and discuss how fossils give clues about animals that are no longer living** 1. Show and discuss two short videos about how paleontologists give clues about the structures of plants and animals that no longer live today (*structure and function*). Help students make connections to their own fossil sorting activity. • Meet the paleontologists • *Did Dinosaurs Travel in Herds or Packs?* 2. After viewing the videos about fossils, ask students to *turn-and-talk* with a partner about how fossils provide evidence of change over long periods (*stability and change*; *scale, proportion, and quantity*). **Suggested Prompt:** *"What are some examples of organisms (plants and animals) that have changed, no longer exist today, or did not exist long ago? How do fossils give us evidence that plants and animals change over long periods?"*	**15 min**

4	**Wrap Up - Science Notebooks: Students use evidence to determine in which epoch a fossil belongs** 1. Students continue analyzing and describing the fossil they chose in their science notebooks, and they make a claim (using evidence from the posters, paragraphs, and fossil images) about the organisms and environment during the time period the fossil is from. 2. Students share their writing with one other student. Some students share with the whole class. 3. Go to the DQB to see if students can offer answers to previous student questions. 4. Look over the claims from L4.2. Ask students if they would like to add to or revise these claims based on the evidence. **Discourse Move - Emphasize a particular idea**  Emphasize ideas related to change in climate and distribution of land and water, and solicit evidence from the fossils that organisms respond to change over time.	**10 min**

L4.3 Claims (student sheet)

Fossils: Making Claims with Evidence

FOSSIL #1

Which fossil did you choose? ___________________________________

Tape, glue, or draw a picture of your fossil here:

What time period is the fossil from? ______________________________

Directions: Make a claim about the different kinds of organisms (plants and animals) that lived during this time and what the environment was like. Use **evidence** from the time period poster, paragraph, or fossil photos to support your answer.

Claim: ____

____

____

____

Evidence: ____

____

____

____

FOSSIL #2 (Optional)

Which fossil did you choose? ___________________________________

Tape, glue, or draw a picture of your fossil here:

What time period is the fossil from? ______________________________

Directions: Make a claim about the different kinds of organisms (plants and animals) that lived during this time and what the environment was like. Use **evidence** from the time period poster, paragraph, or fossil photos to support your answer.

Claim: ____

____

____

____

Evidence: ____

____

____

____

L4.3 Fossils from different time periods

Fossils from Different Time Periods

Fossils from the Ordovician and Silurian Periods

 Xenocrinus baeri fossil crinoids/James St. John/CC BY 2.0	 Homotelus bromidensis fossil/James St. John/CC BY 2.0
 Manitobia newlinii fossil algae/James St. John/CC BY 2.0	 Ectenocrinus simplex fossil /James St. John/CC BY 2.0
 Eurypterus remipes/H. Zell/CC BY-SA 3.0	 Halysites louisvillensis fossil /James St. John/CC BY 2.0

Fossils from the Devonian Period


Chaleuria cirrosa fossil /James St. John/CC BY 2.0

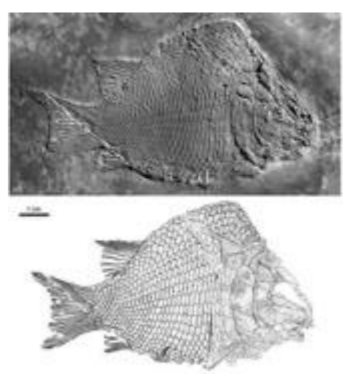

Diplacanthus striatus fossil/James St. John/CC BY 2.0


Crinoidal vuggy chert /James St. John/CC BY 2.0


Isoprusia tafilaltana fossil/James St. John/CC BY 2.0


Wholly, holey, holy fossil coral/cobalt 123/CC BY-NC 2.0

Fossils from the Triassic and Jurassic Periods

	
 Eomaia/Dinoguy2/CC SA 1.0	 Dactylioceras commune fossil ammonite /James St. John/CC BY 2.0
 Solnhofen Cymatophlebia longialata/Dr. Alexander Mayer/CC BY-SA 3.0	
 Camarasaurus lentus sauropod/James St. John/CC BY 2.0	 Kyphosichthys grandei/XU GuangHui & WU FeiXiang/CC BY-SA 3.0

Fossils from the Cretaceous Period

Pachyophis Vienna/Pachyophis/CC BY 2.0

Cucullaea vulgaris fossil bivalve (Upper Cretaceous)/James St. John/CC BY 2.0

Plesioplatecarpus planifrons/MCDinosaurhunter/CC BY-SA 3.0

Early Cretaceous Plant Fossils/Georgialh/CC BY-SA 3.0

Shenzouraptor/Laikayiu/CC BY-SA 3.0

L4.3 Fossils_ Preserved Remains and Trace Fossils (text)

Fossils

The word *fossil* comes from the Latin word *fossilis*, which means "dug up." Many fossils are covered and need to be dug up, so they can be seen.

Fossils can be the preserved remains of organisms or the traces left behind by organisms that lived long ago.

Preserved Remains

An example of preserved remains is the plant fossil in the following photograph. The plant was buried under layers of *sediment* (SED-uh-munt), or fine dirt or sand at the bottom of a river or lake. Over time, more and more sediment piled up on the plant. The pressure on the plant caused it to change. The chemicals that made up the plant started to heat up. The carbon in the plant was left while the other chemicals were burned away.

"Neuropteris flexuosa Sternberg" by James St. John is licensed under CC BY 2.0

Plant fossil

Preserved remains can also be the actual bones of an organism. At the Dinosaur National Monument in Utah, visitors can touch dinosaur bones that are embedded in rock.

"Dinosaur National Monument" by Rob Glover is licensed under CC BY-SA 2.0

Dinosaur bones embedded in rock

A sign for the Dinosaur National Monument

Some preserved remains are trapped in amber. *Amber* is a substance that began as sticky tree sap that then hardened. Seeds and insects that got stuck in the sap were preserved as the sap turned into amber. Scientists study prehistoric remains trapped in amber.

"Amber Plant Seed" by Oregon State University is licensed under CC BY 2.0

Plant seed in amber

"Amber Mosquito" by Oregon State University is licensed under CC BY 2.0

Mosquito in amber

In the *Jurassic Park* movies, scientists used DNA from organisms trapped in amber to create dinosaurs. That could not happen in real life because the DNA would not survive.

Trace Fossils

Trace fossils are other kinds of fossils. Some examples of trace fossils are footprints, tracks, holes in the ground dug by organisms, and even *feces*, or an organism's waste matter. Fossilized feces are called *coprolites* (COP-ruh-lites).

Coprolite

Dinosaur track

Using preserved remains and trace fossils, *paleontologists* (pay-lee-un-TOL-uh-jists) can piece together important information about organisms that no longer exist. They can answer questions such as the following:

How big was the organism?
What was the shape of the organism?
What did the organism eat?
How did the organism move?
How did the organism get its food?
What organisms lived in the same area?

Studying preserved remains and trace fossils can also show what organisms were not living at a certain time.

Learning Set Driving Question
LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms?

L4.4 Making Claims

Lesson Snapshot

Learning Set Driving Question
LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms?

Lesson Driving Question
L4.4: Which organisms could live in prehistoric environments?

Lesson Overview

1. Introduction: Introduce lesson DQ and revisit students' initial claims from L4.2.
2. Shared Reading: Engage students in interactive readings of two texts, one about the Juramaia and one about the stegosaurus.
3. Developing Claims: Using evidence from the photographs of fossils and information from the text, help students further develop their initial claims and evidence about the time periods in which the stegosaurus and Juramaia would have survived best.
4. Sharing Claims: Allow students to share their claims and discuss as a class.
5. Wrap Up: Students add questions and answers to the DQB.

Objectives

Learning Performance
Students will analyze data and engage in texts to construct arguments about the evidence that prehistoric environments could support some animals more than others (through the lenses of *stability and change* and *scale, proportion, and quantity*).

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-ESS2-2 Obtain and combine information to describe climates in different regions of the world.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** fossils provide a lot of evidence and can indicate climates and environments and changes in those climates and environments from long ago (millions of years ago). **Look Fors** 1. **Look for** student claims that use evidence and students' ideas and questions that	***Embedded Language Supports*** • Employment of multiple domains for language learning • Use of realia, diagrams, and photos for supporting comprehensible input • Discourse moves from WIDA

indicate that some things, due to natural events, change over time. 2. **Look for** students showing facility with the use of fossils as evidence of the past. 3. **Look for** students discussing the past and organisms whose fossil record indicates that they lived in a scale of millions of years ago, and referring to the timeline when discussing these periods. **Evidence Statement** The arguments that students provide use the lenses of *stability and change* and *scale, proportion, and quantity*, as well as evidence from the analyzed data from the fossils and texts to form claims about the traits, climate, and environment of the Juramaia.	

Teacher Preparation	Materials
• To prepare for the discussion, review fossil information from the previous lessons and preview readings about the Juramaia and stegosaurus. • Copy the claims sheet for individual students in steps 2 and 3. Or you can display the claims sheet on Whiteboards and record the whole-group discussion.	***Teacher Materials*** • Driving Question Board (DQB) • Paragraph about prehistoric time periods (matched with posters) ***Student Materials*** • Readings: The Juramaia and The Stegosaurus

Lesson Segments	Estimated Time
Introduction	10 min
Shared Reading	15 min
Developing Claims	10 min
Sharing Claims	10 min
Wrap Up	5 min
This 50-minute lesson could be integrated into the Literacy Block.	**Total Time:** 50 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and introduce DQ, *"Which organisms could live in prehistoric environments?"*** 1. Introduce the DQ, (***"Which organisms could live in prehistoric environments?"***, and revisit students' initial claims from L4.2 about which period(s) would have supported the survival of the Juramaia and the stegosaurus. 2. Ask if there are some questions that the students would like to add to the DQB about these organisms, when they lived, or how they lived. Write these down. 3. Tell students that in this lesson, they will observe photographs and read about how scientists have examined fossil evidence to learn about the environments and climates during the times these organisms lived.	**10 min**

2	**Shared Reading: Interactive reading and discussion** 1. Engage students in interactive read alouds of two texts. The first text contains images and information about fossilized remains of the Juramaia. The second text contains images and information about fossilized remains of the stegosaurus. Tell students that you will pause to ask questions about their thinking and the ideas in the text. As you read, help students carefully analyze the images and the structures the fossils show and make connections between the text and images. Gather ideas from students about the structures they can see (and read about) in the Juramaia and stegosaurus fossils, how the structures changed, and what those structures tell us about when they lived (*stability and change*). • **Note:** *If students are using digital version of the readings in a Collabrify Roadmap, or printed copies of the text with response boxes, you may pause to allow students to discuss their ideas with the class and respond, in writing, to the supporting questions embedded in the text.* 2. Record students' ideas about the Juramaia and stegosaurus structures (based on the text and illustrations) on the driving question board or chart paper. You could record notes about these ideas in a T-chart during reading: **Structure and Function** (left side) and **Clues This Gives Us About the Time Period** (right side). See the following examples: • **Juramaia Examples:** 1)*"The fossil provides evidence that the Juramaia was a good climber and could live in trees." This tells us that the Juramaia lived during a time when there were trees.* 2) *"The structure of its teeth provides evidence that insects were its most likely prey." This tells us that the Juramaia lived during a time when there were insects*. • **Stegosaurus Examples:** 1) *I can see spikes on the tail of the stegosaurus that look dangerous. "Paleontologists… know that the spikes on the tail of the stegosaurus were used for defense. They have found fossils with puncture wounds that match the spikes." This tells us that the stegosaurus lived with other large dinosaurs and had to protect itself from predators.* 2) *"The stegosaurus had small rounded teeth that looked like pegs." This tells us that stegosaurus teeth were not sharp, and they probably ate plants.*	**15 min**

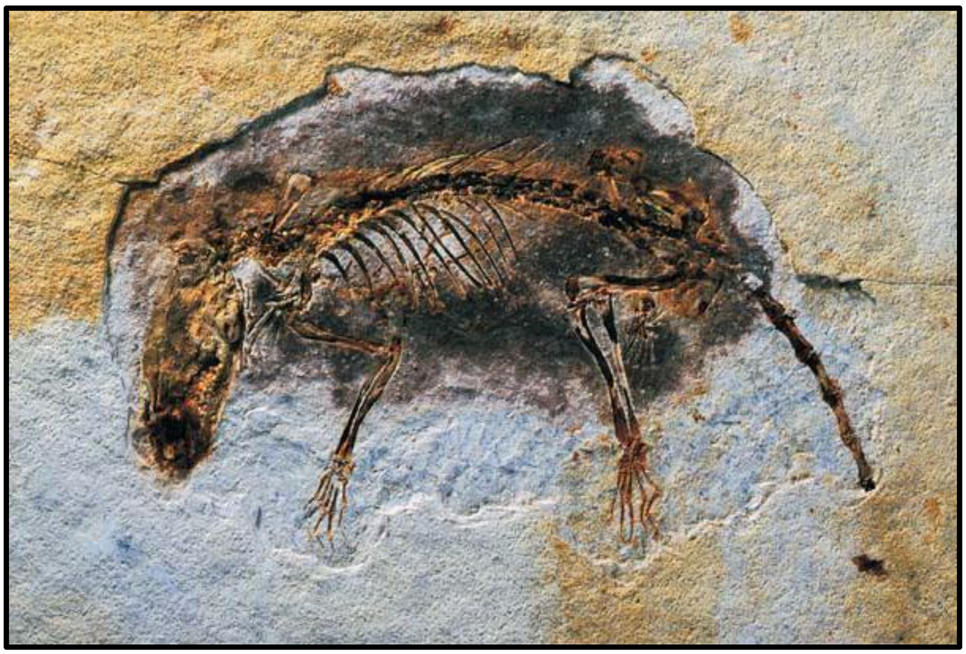
3	**Developing Claims: Students make claims using evidence** 1. Direct students' attention back to the prehistoric time period posters, and briefly revisit students' descriptions of how organisms and the environment changed over long periods (*stability and change*). Using evidence from the photographs of fossils and information from the text, help students further develop their initial claims and evidence about the time periods in which the stegosaurus and the Juramaia would have survived best. Help students connect the time period(s) they identify to the timeline they created in L4.1 (*scale, proportion, and quantity*). 2. As students make claims about which prehistoric time period would have best supported these organisms' survival, remind them to support their claims with evidence from fossils, readings, the posters, and the timeline. 3. After discussing together as a class, allow students to choose one of the two organisms (stegosaurus or Juramaia) and write a claim, with evidence, about the time period in which the animal lived. **Discourse Move - Help students deepen their reasoning**  **Suggested Prompt**: As students offer claims, ask for reasoning from volunteers as part of the discussion at this time. *"How do you think the fossil of the Juramaia provides clues (or evidence) about when it lived? Do the Juramaia's structures tell you about the place where it lived? How do you think the fossil of the stegosaurus provides clues (or evidence) about when it lived? Do the structures of the stegosaurus structures tell you about the place where it lived?"*	**10 min**
4	**Sharing Claims** 1. Allow students to share their claims and evidence, and discuss as a class environments where they think the stegosaurus and the Juramaia lived. If students present competing claims, support them to compare and discuss the evidence they used to support their claim (argumentation). 2. If time allows, ask students to think-pair-share about which time periods *would not* have supported these organisms' survival. Students should try to provide evidence about this as well.	**10 min**
5	**Wrap Up: Revisit DQB** 1. Students add questions and answers to the DQB.	**5 min**

L4.4 Juramaia Fossils (text)

The Juramaia
What Can We Learn from a Fossil?

Not all the animals in the Jurassic period were huge dinosaurs. Some animals were very small. One of these small animals was the *Juramaia* (jur-uh-MAY-uh). The Juramaia was a furry animal. It looked like a squirrel or mouse. It lived among the ferns that covered the ground. It also lived up in trees.

Following is a photograph of a fossil.



"Eomaia" by Zofia Kielan-Jaworowska is licensed under CC BY 2.0

Fossil of a eutherian mammal similar to the Juramaia

What structures do you notice?
How do you think these structures helped the Juramaia survive in its environment?

The following drawing shows what *paleontologists* (pay-lee-un-TOL-uh-jists) think the Juramaia looked like. Paleontologists are scientists who study fossils. You can find photographs of Juramaia fossils and other drawings here.

“Juramaia” by Nobu Tamura is licensed under CC BY-SA 3.0

How do we know how the Juramaia looked and lived? Paleontologists have fossil evidence of the Juramaia, like the fossil you studied above. Fossils show that Juramaia was only 3–4 centimeters (about 2 inches) long. It weighed about 15 grams (half an ounce). Imagine this little mammal among the giant dinosaurs that lived during the Jurassic period!

The fossils also show that the Juramaia had legs and feet for climbing. It could climb up and down trees during the night to catch and eat insects. It could also hide in trees to escape other animals.

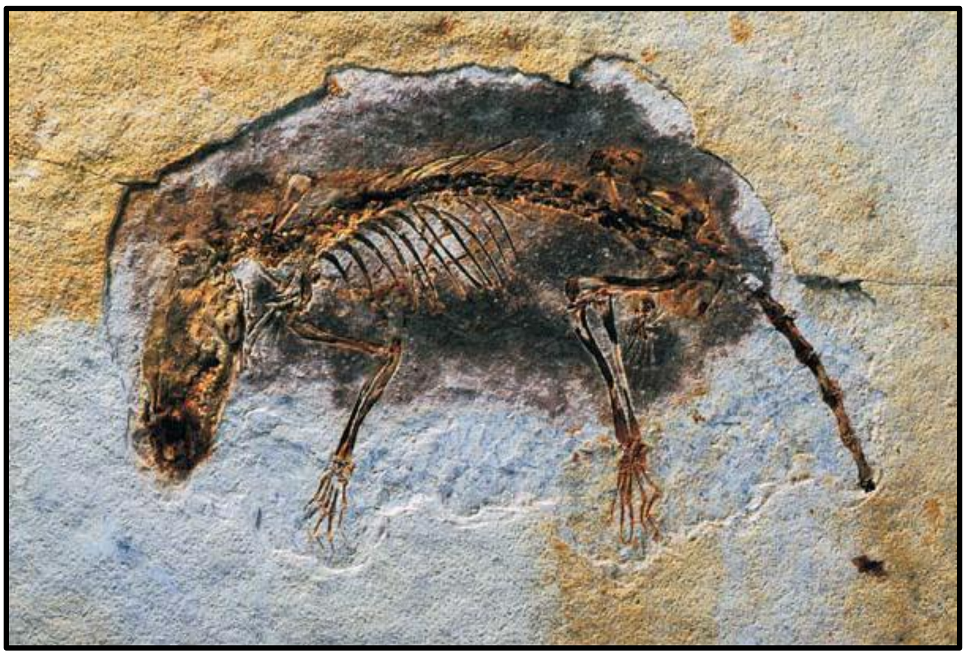
Why do you think it was able to survive during the Jurassic period? What structures and behaviors allowed the Juramaia to survive?

L4.4 Juramaia Fossils (no boxes)

The Juramaia
What Can We Learn from a Fossil?

Not all the animals in the Jurassic period were huge dinosaurs. Some animals were very small. One of these small animals was the *Juramaia* (jur-uh-MAY-uh). The Juramaia was a furry animal. It looked like a squirrel or mouse. It lived among the ferns that covered the ground. It also lived up in trees.

Following is a photograph of a fossil.



"Eomaia" by Zofia Kielan-Jaworowska is licensed under CC BY 2.0

Fossil of a eutherian mammal similar to the Juramaia

What structures do you notice?
How do you think these structures helped the Juramaia survive in its environment?

The following drawing shows what *paleontologists* (pay-lee-un-TOL-uh-jists) think the Juramaia looked like. Paleontologists are scientists who study fossils. You can find photographs of Juramaia fossils and other drawings here.

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The fossils also show that the Juramaia had legs and feet for climbing. It could climb up and down trees during the night to catch and eat insects. It could also hide in trees to escape other animals.

Why do you think it was able to survive during the Jurassic period? What structures and behaviors allowed the Juramaia to survive?

L4.4 Stegosaurus Fossils (text)

The Stegosaurus
What Can We Learn from a Fossil?

What dinosaur looked like an Army tank? If you said the *stegosaurus* (steg-uh-SAW-rus), you are right. Look closely at the fossil of the stegosaurus below.

Stegosaurus fossil

What structures do you notice?
How do you think these structures helped the stegosaurus survive in its environment?

Paleontologists (pay-lee-un-TOL-uh-jists) are scientists who study fossils. Stegosaurus fossils include complete skeletons. From the skeletons, paleontologists have learned that the teeth of the stegosaurus were small and rounded. The teeth looked like pegs. Its jaws moved up and down, so it could not grind its food. Instead, it held food in its cheeks and slowly chewed and chewed. The stegosaurus was huge. A full-grown stegosaurus weighed about 7,000 pounds. It had to eat about 200 pounds of plants a day! Plant-eating dinosaurs are called ***herbivores*** (HERB-uh-vores).

Study the stegosaurus skeleton in the photograph below.

Stegosaurus, American Museum of Natural History by Rachel So is licensed under CC BY-SA 2.0

Stegosaurus skeleton and model of baby stegosaurus
American Museum of Natural History

What structures do you notice in this photograph?
How might those structures have helped the stegosaurus?

The first structures you probably noticed were the plates on the back and the spikes on the tail. Paleontologists are not sure about what the plates did. They do know that a stegosaurus had 17 plates, or ***scutes*** (scoots), along its back in two rows. The scutes were made of a bony material, but they were not hard or stiff. Paleontologists think that the plates might have looked dangerous to predators. But the plates were not used for defense.

The spikes on the tail of the stegosaurus were used for defense. Paleontologists have found spike fossils with damaged tips. Fossils of other dinosaurs have holes that match the spikes.

You might have also noticed that the front legs of the stegosaurus are shorter than its back legs. That means that it could not move very fast. If it did move fast, its back legs would get tangled up in its front legs. Paleontologists have also found trace fossils of stegosaurus footprints. Those footprints show that the slow stegosaurus traveled in large herds with other stegosauruses.

So how do you think a slow-moving stegosaurus survived?
How might traveling in a group help the stegosaurus survive?

L4.4 Stegosaurus Fossils (no boxes)

The Stegosaurus
What Can We Learn from a Fossil?

What dinosaur looked like an Army tank? If you said the *stegosaurus* (steg-uh-SAW-rus), you are right. Look closely at the fossil of the stegosaurus as follows.

Stegosaurus fossil

What structures do you notice?
How do you think these structures helped the stegosaurus survive in its environment?

Paleontologists (pay-lee-un-TOL-uh-jists) are scientists who study fossils. Stegosaurus fossils include complete skeletons. From the skeletons, paleontologists have learned that the teeth of the stegosaurus were small and rounded. The teeth looked like pegs. Its jaws moved up and down, so it could not grind its food. Instead, it held food in its cheeks and slowly chewed and chewed. The stegosaurus was huge. A full-grown stegosaurus weighed about 7,000 pounds. It had to eat about 200 pounds of plants a day! Plant-eating dinosaurs are called *herbivores* (HERB-uh-vores).

Study the stegosaurus skeleton in the following photograph.

Stegosaurus, American Museum of Natural History by Rachel So is licensed under CC BY-SA 2.0

Stegosaurus skeleton and model of baby stegosaurus
American Museum of Natural History

What structures do you notice in this photograph?
How might those structures have helped the stegosaurus?

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So how do you think a slow-moving stegosaurus survived?
How might traveling in a group help the stegosaurus survive?

Learning Set Driving Question
LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms?

L4.5 Comparing Organisms

Lesson Snapshot

Learning Set Driving Question
LS4: How do scientists use evidence from the past and present to find out about prehistoric organisms?

Lesson Driving Question
L4.5: What do fossils tell us about which organisms were here a long time ago, which are still here, and which are new?

Lesson Overview
1. Introduction: Discuss the lesson DQ. Review some of the claims made during the previous lesson and claims from L4.2.
2. Analyzing and Comparing Images: Students analyze and compare pictures of the skeleton of a squirrel and the fossilized remains of a small eutherian mammal (similar to the Juramaia) and create a Venn diagram of the similarities and differences.
3. Shared Reading: Students do a shared reading comparing the Juramaia and the squirrel, add to the Venn diagram, make claims, and argue that the Juramaia's structures are similar to but also different from the squirrel's structures.
4. Developing Initial Model and Argument: Students draw an initial model, using evidence from the fossil, the text, and information about the environment and climate where it lived, to explain how the Juramaia survived in its environment.
5. Wrap Up: Students record "Big Ideas" from the Learning Set and add questions and answers to the DQB.

Objectives

Learning Performance
Students will analyze data and engage in texts to argue that fossils provide evidence about the traits, climate, and environment of the Juramaia (through the lenses of *stability and change* and *scale, proportion, and quantity*).

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-ESS2-2 Obtain and combine information to describe climates in different regions of the world.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** you can make comparisons between organisms' structures using fossils, that the squirrel and the small eutherian	***Embedded Language Supports*** • Employment of multiple domains for language learning

mammal are alike but also different, and that these differences might be important indications of the past. **Look Fors** 1. **Look for** students using specific information from the reading as evidence for their claims during discussion. 2. **Look for** students using language about time in terms of *scale, proportion, and quantity* and including in their claims evidence that things changed, or stayed the same, over time. **Evidence Statement** The arguments students develop use the evidence from LS2, the fossil, and the skeleton of the squirrel to claim that the structures of the squirrel and the Juramaia are similar but different in possibly important ways, indicating that the two creatures might be different, have similar but different needs, and live in different environments. The language students use will indicate the use of the lenses of *stability and change* and *scale, proportion, and quantity.*	• Opportunity for language of meaning support using models • Use of realia, diagrams, and photos for supporting comprehensible input • Discourse moves from WIDA

Teacher Preparation	Materials
• Be ready to review students' claims from the previous lesson	***Teacher Materials*** • Driving Question Board (DQB) • Images of squirrel skeleton and fossil of early eutherian mammal (like Juramaia) • "Interactions" model poster from LS3 to introduce Interactions" model for Juramaia • Venn diagram or slides ***Student Materials*** • Reading: Animals from Today and Long Ago (or reading with no response boxes) • Science notebooks

Lesson Segments	Estimated Time
Introduction	10 min
Analyzing and Comparing Images	10 min
Shared Reading	20 min
Developing Initial Model and Argument	20 min

Wrap Up	10 min
A portion of this 70-minute lesson (the 20-minute shared reading) could be integrated into the Literacy Block.	**Total Time:** 70 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage students in the DQ, *"What do fossils tell us about which organisms were here a long time ago, which are still here, and which are new?"*** 1. Remind students of the lesson DQ. Review or remind students of some of the claims made during the previous lesson. Tell them that in the last lesson, they focused on the structures and environments of the Juramaia and the stegosaurus and made claims about the time period in which these animals fit based on fossil evidence. 2. Today, students will analyze and compare images of a squirrel's skeleton and preserved remains of a small eutherian mammal (similar to the Juramaia) and will read about what scientists have learned from studying fossils of small eutherian mammals as well.	**10 min**
2	**Analyzing and Comparing Images: Discuss structures and use evidence to think about function** 1. Project the images of the squirrel skeleton and the preserved remains (fossil) of the small eutherian mammal. Have students do a quick *turn-and-talk* about the structures they observe for both animals (*structure and function*). 2. After the *turn-and-talk*, allow students to share out the structures they observed in each image. Record the structures students identify in a Venn diagram. As students share their observations, press them to identify how these structures are similar to or different from one another (teeth, tail, legs, claws, etc.). 3. After recording similarities and differences, ask students to *turn-and-talk* about how these animals used the structures they identified to help them survive. Then allow students to share out each other's ideas. **Discourse Move - Help students listen carefully and think about one another's ideas**  • **Suggested Prompt:** *"How do you think the squirrel uses its (teeth, claws, legs, etc.) to help it survive? Why do you think so? How do you think the Juramaia used its (teeth, claws, legs, etc.) to help it survive? Why do you think so? Check with your partner, did he or she get it right? Is that what you said?"*	**10 min**

3	**Shared Reading: Engage with text about prehistoric organisms** 1. Introduce the reading that provides more information about small eutherian mammals from long ago and how they are similar to and different from modern-day squirrels. Tell students that as you read, they will be looking for additional information to add to the Venn diagram about how the small eutherian mammal and the squirrel are similar and different. 2. Engage students in an interactive read aloud of the text, Animals from Today and Long Ago, pausing throughout to ask questions and help students identify similarities and differences in the structures of the squirrel and the Juramaia to add to the Venn diagram. You may also choose to pause to have students respond, in writing (digitally through Collabrify or with paper and pencil), to the supporting questions in the text. Use the embedded questions as you read aloud to fuel discussion about the ideas in the text and make connections to other related experiences from the unit. 3. After reading, students use the notes in the Venn diagram (based on their observations of the fossils and information in the text) to make claims and argue that the Juramaia's structures and environment are similar to but also different from the squirrel's structures and environment. Record students' ideas on the Whiteboard or chart paper. • **Suggested Prompts:** *"What do you think the squirrel eats? What can you tell by its teeth or jaw? What do you think the Juramaia eats? What can you tell by its teeth or jaw? Think about how the squirrel escapes from predators. Do you think the Juramaia probably escaped from predators the same way? What can you tell by their legs, feet, or claws?"* As students make claims, help them use fossils, photographs, and the text as evidence that organisms and the environment may maintain stability over shorter periods but change over longer periods (*stability and change*; *scale, proportion, and quantity*).	**20 min**

4	**Developing Initial Model and Argument: Develop a model of prehistoric organism survival** 1. Remind students that scientists also use models to communicate their claims supported by evidence with other scientists' claims to compare ideas. Explain that when they compare their ideas, they argue. Not in a mean way, but by using evidence that supports claims and by comparing claims that have evidence with those that might not. 2. Based on students' claims about the Juramaia's structures and how it used them to survive in a prehistoric environment and climate, students develop an initial model (like the squirrel survival model) to explain how the Juramaia survived in its environment long ago. 3. Ask students to brainstorm what they could use as evidence for their claims that they include in their model. Sources of evidence include the Juramaia fossil, the text comparing the Juramaia's and the squirrel's structures, and information about the environment and climate where it lived (time period posters). Emphasize that evidence students can use in models comes from many different sources. Students individually draw their initial model and label how the Juramaia survived in its environment. Challenge students to show and label, in their model, at least one way the Juramaia used its structures to survive in its environment (*stability and change* in systems; that is, although systems change over long periods, they may appear stable over shorter periods). 4. Students share their initial models with a partner, explain their drawings, and compare their models. Help students engage in argumentation, contrasting the difference in the models according to evidence. 5. Select one or two students to share out what they wrote and drew and what they presented as their arguments.	**20 min**

5	**Wrap Up: Record "Big Ideas" from this learning set** 1. Revisit the DQB. Ask the students if they have any answers they'd like to add. Because this is the last lesson in the learning set, ask students to help you summarize the Big Ideas that they have learned in this Learning Set. Look at all the lesson DQs. Ask students to think of a "Big Idea" that could go in the oval in the middle of the learning set slide. Also, add the same phrase to this slide. • **Suggested Prompts:** *"Think about when we made the timeline. What did we figure out? Think about the posters about the prehistoric time periods. What did this help us figure out? Think about the fossils we sorted. What did we figure out? Think about the fossil and structures of the stegosaurus. What did this help us figure out? Think about the fossils of the Juramaia and the skeleton of the squirrel. What did we figure out?"* As students share their ideas, record them and post them on the DQB.	**10 min**

Animals from Today and Long Ago

Why do you see so many squirrels when you go outside? You have been making observations and studying squirrels. You have learned about where they live, what they eat, and how they move.

You have also learned about paleontologists. *Paleontologists* are scientists who study fossils to figure out how animals from the past survived in their habitats. Paleontologists also use what they know about animals that live today to help them understand how animals lived long ago.

Paleontology interns collect data at the Dinosaur National Monument

Paleontologists can't just go outside and observe animals from the past, but they can study their fossils. They can also compare fossils with animals that live today. Comparing squirrels to fossils of squirrel-like animals that lived long ago is a good example of this kind of investigation.

Squirrels are members of an animal group called *eutheria* (yu-THEER-e-uh). Eutherians are mammals. There are many different kinds of eutherians, such as elephants and mice. Fossils provide evidence that squirrel-like eutherians lived long ago.

In 2002, a fossil of a mouse-like animal was found in China. The fossil showed that the animal was covered in fur. Its skeleton showed that the animal could move fast and climb trees. Look at the following pictures.


“Eomaia” by Zofia Kielan-Jaworowska is licensed under CC BY 2.0

Squirrel skeleton (left); fossil of a small eutherian mammal similar to the Juramaia (right)

How is the fossil in the picture like the skeleton of a squirrel?

In 2011, another fossil was found. This fossil was also of a small mouse-like mammal called *Juramaia sinensis*. Its skeleton is also similar to the skeleton of a squirrel.

Scientists use what they observe in fossils and squirrels that live today to make claims. One claim is that early eutherian mammals, like the Juramaia, survived because they could climb trees like many squirrels you see today. Climbing above the ground may have protected early eutherians from dinosaurs. This is important because some dinosaurs would have eaten them.

Another claim is that early eutherians were smaller than squirrels. Squirrels you see today are about 9–12 inches long. Early eutherians, like the Juramaia, were much smaller.

How do you think being small helped early eutherian mammals, like the Juramaia, survive?

Animals from Today and Long Ago

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Paleontologists can't just go outside and observe animals from the past, but they can study their fossils. They can also compare fossils with animals that live today. Comparing squirrels to fossils of squirrel-like animals that lived long ago is a good example of this kind of investigation.

Squirrels are members of an animal group called *eutheria* (yu-THEER-e-uh). Eutherians are mammals. There are many different kinds of eutherians, such as elephants and mice. Fossils provide evidence that squirrel-like eutherians lived long ago.

In 2002, a fossil of a mouse-like animal was found in China. The fossil showed that the animal was covered in fur. Its skeleton showed that the animal could move fast and climb trees. Look at the following pictures.

Squirrel skeleton (left); fossil of a small eutherian mammal similar to the Juramaia (right)

How is the fossil in the picture like the skeleton of a squirrel?

In 2011, another fossil was found. This fossil was also of a small mouse-like mammal called *Juramaia sinensis*. Its skeleton is also similar to the skeleton of a squirrel.

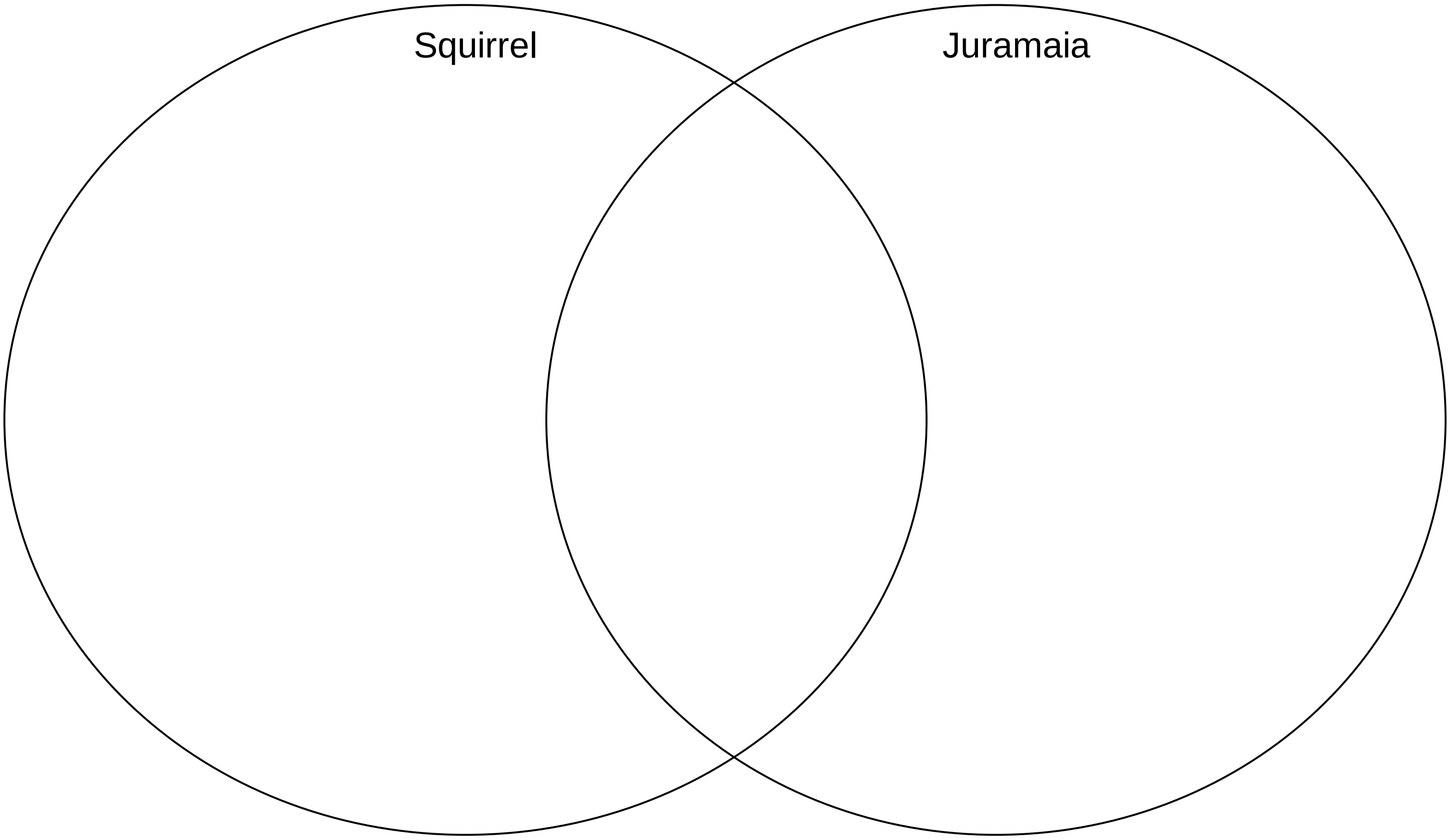
Scientists use what they observe in fossils and squirrels that live today to make claims. One claim is that early eutherian mammals, like the Juramaia, survived because they could climb trees like many squirrels you see today. Climbing above the ground may have protected early eutherians from dinosaurs. This is important because some dinosaurs would have eaten them.

Another claim is that early eutherians were smaller than squirrels. Squirrels you see today are about 9–12 inches long. Early eutherians, like the Juramaia, were much smaller.

How do you think being small helped early eutherian mammals, like the Juramaia, survive?

L4.5 Venn Diagram

Comparing Structures



Learning Set 5

LS_5 My Notes Tab
Learning Set # 5
Learning Set Driving Question: How can we use fossils to figure out how organisms change over long periods of time?

Lesson Abridged Comments:

Learning Set Description: (ML-PBL to create)

1. **L5.1 Equity focus lesson:** The students ask, how did the organisms change? They go outside and look for other organisms with similar structures in the environment that are shown in the fossils (fern, insect, and Juramaia) . - they ask, “Are there some plants and animals from the Jurassic period that structurally look like animals today?”
2. **L5.2 and L5.3 L2** Card sorting activity - the students look at present day *plants* and *animals* and look at fossil evidence of their existence in the past and place them in the Jurassic period model (like the one in learning set 3 of the present) or only in the present day model. Students analyze data to make a claim that some organisms, like ferns and pine cones have fossils, and some animals, like the hanging fly, fish,jellyfish and the “squirrel” are have fossils that are evidence of their existence 150 million years ago, and some, like the ant, the human, and the wolf do not. from 150 million years ago, and some, like flowers and grasses, do not. They discuss, “what can the fossils tell us about the changes to the environment?”
4. **L5.4** This lesson involves partner texts on the Jurassic period animals. Students partner read about more animals and add the plants and animals to the model of the environment of the Juramaia in the Jurassic period.
5. **L5.5 Math:** Students compare measurements of the Jurassic Organism the squirrel and the Juramaia and the marmot and stegosaurus, using and measurement. They compare the lengths and heights of Jurassic organisms with modern organisms.
6. **L5.6 SEL focus lesson:** The students read about one of the most successful female paleontologists, Mary Anning, and her discovery of Jurassic Era fossils. They use the story of Mary Anning to brainstorm how they could find more information to answer questions they find very interesting regarding squirrels or Jurassic Era fossils.

Phenomenon: The fossils show that there were different plants and animals long ago.

Learning Performance: *Students will* construct claims with evidence that as Earth environments changed, organisms and the interactions among organisms changed, too (through the lens of stability and change, systems models, and scale, proportion and quantity).

Figuring Out Statement/ DCI:
Students are figuring out that they, like scientists, can compare fossils from different times and come up with claims for how organisms changed and how both the existence and nonexistence of some fossils

provide evidence of how the environments were changing.

Practice Statement

Students are doing field work, analyzing data, and using math to construct claims about which organisms changed over time, which ones stayed the same, and which died out. They model their claims in an interactional Jurrasic model.

Practice Elements from NGSS

Developing and Using Models: Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.

Planning and Carrying Out Investigations: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence.

Analyzing and Interpreting Data: Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.

Using Mathematics and Computational Thinking: Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.

Constructing Explanations and Designing Solutions: Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design.

Engaging in Argument from Evidence: Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.

Crosscutting Concepts

Scale, Proportion, and Quantity: Observable phenomena exist from very short to very long time periods.

Stability and Change: Some systems appear stable, but over long periods of time will eventually change.

Structure and Function: Substructures have shapes and parts that serve functions.

Systems and System Models: A system can be described in terms of its components and their interactions.

Squirrels Learning Set 5– Embedded Language Supports

Lesson 1

- Employment of multiple domains for language learning
- Multiple modalities
- Use of the language of action, media, and photos for supporting comprehensible input
- Connection to home knowledge and LS1
- Discourse moves from WIDA

Lesson 2

- Employment of multiple domains for language learning
- Use of photos, and charts for supporting comprehensible input and practices
- Discourse moves from WIDA

Lesson 3

- Use of photos, models, and charts for supporting language of communication and collaboration
- Opportunity for authentic negotiation of meaning
- Discourse moves from WIDA

Lesson 4

- Employment of multiple domains for language learning
- Use of photos and charts for supporting comprehensible input and practices
- Discourse moves from WIDA

Lesson 5

- Opportunity for authentic negotiation of meaning in peer-to-peer interaction
- Specific support for interdisciplinary practices
- Multiple domains for language learning
- Use of photos and charts for supporting comprehensible input and practices
- Discourse moves from WIDA

Lesson 6

- Approach to organization of ideas from broad and general to specific
- Multiple domains for language learning
- Discourse moves from WIDA

Learning Set Driving Question
LS5: How can we use fossils to figure out how organisms change over long periods?

L5.1 Organisms, Present and Past

Lesson Snapshot

Learning Set Driving Question
LS5: How can we use fossils to figure out how organisms change over long periods?

Lesson Driving Question
L5.1: Can we find some modern plants and animals that look like organisms from the past?
Equity: How can I use my community-based knowledge to build classroom science knowledge?

Lesson Overview
1. Introduction: Discuss the learning set DQ and introduce the lesson DQ.
2. Gathering Information: Watch Prehistoric video (from LS1) again and discuss the plants and animals in the video. Record in writing each animal, then think about and record their structures.
3. Field Investigation: Students go outside and look for plants and animals that are (structurally) similar to those in the video.
4. Group Discussion: Students discuss their data.
5. Wrap Up: In their science notebooks, students independently write their thoughts from the discussion and their findings from the investigation.

Objectives

Learning Performance:
Students will engage in text and collect and analyze data to develop a claim about which organisms seem similar to organisms of the past (through the lenses of *stability and change* and *scale, proportion, and quantity*).

Equity Learning Goal: Place-based Knowledge
We can use what we know about our place and/or community to engage in science and make school science matter to us and to our community.

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all.
3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Students are figuring out that many plants and animals that they are familiar with and live around the school resemble plants and animals from the	***Embedded Language Supports*** • Employment of multiple domains for language learning

past and that scientists use fossils as evidence to figure out answers to their questions. **Look Fors** 1. **Look for** students identifying evidence from the field investigation around the school, their experiences, and the text to support each other's claims that an organism from today is similar to (and in some ways different from) an organism from the past. 2. **Look for** students using language about the past that indicates a scale of millions of years. They can refer to the timeline if necessary. **Evidence Statement** Students' claims state that some organisms from the Jurassic period look more similar to organisms today than others, and they use the lens of *structure and function*; the claims will include evidence from the texts about organisms today and fossils from the past.	• Multiple modalities • Use of the language of action, media, and photos for supporting comprehensible input • Connection to home knowledge and LS1 • Discourse moves from WIDA

Teacher Preparation	Materials
• Be prepared to go outside! If that isn't a possibility, have a video ready to show many different animals for comparison. • Find places beforehand where the students might see some animals and insects. • ***Background Information:*** ○ Jurassic Plants.	***Teacher Materials*** • Driving Question Board (DQB) • Prehistoric video ***Student Materials*** • Science notebooks • Clipboards for each student • Worksheet 5.1- list of animals from the Jurassic period

Lesson Segments	Estimated Time
Introduction	10 min
Gathering Information	15 min
Field Investigation	20 min
Group Discussion	10 min
Wrap Up	10 min
	Total Time: 65 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and DQ, *"Can we find some modern plants and animals that look like organisms from the past?"*** 1. Review the DQ, ***"Why do I see so many squirrels but I can't find any stegosauruses?"*** Ask students if they have more answers to the DQ, and explain their thinking. 2. Tell the students that to answer the DQ completely, and use fossils as clues to events in prehistoric environments, we must analyze the structures of organisms that are alive now and compare them with fossils of organisms from the time of the early eutherian mammals, like the Juramaia. Any organisms we see today that resemble those of prehistoric environments survived basically unchanged or by adaptation. Other prehistoric organisms like the stegosaurus did not survive, and we do not see animals today that look like the stegosaurus or other animals that became extinct. 3. Write the lesson DQ on the board: ***"Can we find some modern plants and animals that look like organisms from the past?"*** Tell the students that some organisms outside that have changed over time still have some structures that are similar to the ones 15 million years ago. 4. Ask students if they have any questions they would like to add to the DQB before they start. Add these in the space provided.	**10 min**
2	**Gathering Information: Think and gather information about the past** 1. Tell students that they will watch a video that they have seen before but now with a new task. Ask students to notice all the different plants and animals in the video because they will be going outside to look for organisms with similar structures. 2. Students watch the Prehistoric video together. Pause the video at certain moments, so the students can describe the structures of different plants and animals they see. 3. Distribute the list of plants and animals for students to look for outside, Worksheet 5.1, and ask some of them to share what structures they noticed. Discuss together each of the plant and animal structures. **Suggested Prompt:** *"How can we learn about the past? Can we do some of the work of scientists or paleontologists? How do you think we should start?"*	**15 min**

3	**Field Investigation: Investigate plants and animals outside** 1. Have students go outside and look for plants and animals that look structurally like those on their list. When you see an animal that has similar structures, the students need evidence to back the claim that they are similar.	**20 min**
4	**Group Discussion: Describe and compare the structures of some plants and animals living today and in the past** 1. Discuss whether some plants and animals are similar to ones that lived in the Jurassic period. Remind students to build on what they know. ● When a student presents an idea based on lived experiences, stress that the student used evidence and that scientists use evidence, too. Remind students that each person's experiences are different, so explanations are richer when the experiences are included in discussions. **Discourse Move - Help a student clarify his/her thinking**  **Suggested Prompt:** Help students with clearly expressing their ideas. If there is a word that they are stuck on, ask if another student can help. Then ask, "*Is that what you meant*?" If there is an idea they are attempting to express, they may draw it on a whiteboard. Demonstrate how important each idea is and how the classroom community perseveres and helps each other understand ideas.	**10 min**
5	**Wrap Up: Use questions for reflection in science notebooks** 1. Highlight ideas students presented that used evidence from lived experiences, and explain that lived experiences are sources of evidence. 2. Return to the lesson DQ, ***"Can we find some modern plants and animals that look like organisms from the past?"*** Have students write independently and draw in their science notebooks their thoughts on the field investigation and discussion. 3. Have some students share their writing with the class. Invite agreement, disagreement, and discussion. 4. Look at the questions on the DQB. Ask for volunteers who think they can answer any of the questions.	**10 min**

L5.1 Observation Worksheet

Jurassic Organism Observations

Jurassic Period Organism	Similar Structures on Organism Today
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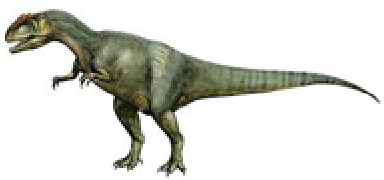
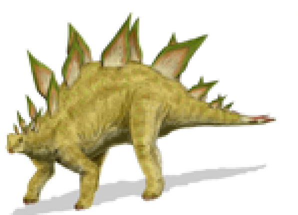
 Allosaurus/Nobu Tamura/CC BY-SA 3.0 Allosaurus	
 Stegosaurus/Nobu Tamura/CC BY-SA 3.0 Stegosaurus	
 © Illinois State Geological Survey Seed fern	
 Juramaia/Nobu Tamura/CC BY-SA 3.0	

Juramaia	

Learning Set Driving Question

LS5: How can we use fossils to figure out how organisms change over long periods?

L5.2 Fossils as Evidence - Plants

Lesson Snapshot

Learning Set Driving Question
LS5: How can we use fossils to figure out how organisms change over long periods of time?

Lesson Driving Question
L5.2: How can we use fossils as evidence to figure out what happened to the plants from the Jurassic period?

Lesson Overview

1. Introduction: Introduce the DQ. Tell students that they will create a chart that will help them figure out an answer.
2. Organizing Data: Students analyze photos and develop a chart showing fossils of plants. The chart indicates that some fossils of plants are not around anymore, and some plants around today have no fossils.
3. Group Discussion and Model Revision: The teacher uses this chart to ask, "Why are there no fossils of flowers?" and "What does it mean that there are fossils of ferns, and we still have ferns today?" The class adds to the shared Juramaia "interactions" model to show connections between the Juramaia, an early eutherian mammal from the Jurassic period, and plants in its environment (i.e., lines connecting Juramaia with plants [ferns, coniferous trees] it might need and taking notes on how it may have interacted with those plants).
4. Wrap Up: The students free write and draw, considering the models of the Juramaia and the squirrel and the environments of each. Possible teacher prompt: "What can we predict about the Juramaia since we know that there were no plants with nuts during the Jurassic period?"

Objectives

Learning Performance
Students will use models to develop evidence-based claims that some plants of today did not exist in the Jurassic period, that other plants that do not exist today did exist in the Jurassic period, and that changes in plants also changed the interactions among the organisms in the environment (through the lenses of *stability and change* and *scale, proportion, and quantity*).

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all.
3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out **Students are figuring out that** many plants that we see today did not exist in the Jurassic period, and these plants have changed how organisms may have survived. They figure out how fossils are used as evidence. **Look Fors** **Look for** students using the fossil pictures as evidence to put together a *stability and change* story about small- and large-scale events in the past (i.e., grass and acorns not being around in the early Jurassic period.) **Evidence Statement** The claims students develop include that some plants of today did not exist in the Jurassic period, that others that do not exist today did exist in the Jurassic period, and that changes in types of plants also changed the interaction among the organisms in the environment. Claims use the lenses of *stability and change*; *systems and system models*; *structure and function;* and/or *scale, proportion, and quantity*.	***Embedded Language Supports*** • Employment of multiple domains for language learning • Use of photos, and charts for supporting comprehensible input and practices • Discourse moves from WIDA

Teacher Preparation	Materials
• Have an *extra set* of plant pictures ready (one of each plant) for the class to use to put on the Juramaia "interactions" model. • Make four large index cards with these headings: **Plant Name**, **Living Today**, **Fossil from the Jurassic Period**, and **Living during the Jurassic (Prehistoric Plant)**. • Cut out the plant pictures on card stock and student charts. See the empty student chart. • Use the filled-in completed chart for reference. • Teacher science background resource	***Teacher Materials*** • Driving Question Board (DQB) • Student-made "interactions" models of the squirrel and the Juramaia • Tape to place photos on the "interactions" models • Plant pictures • Example of completed chart ***Student Materials*** • Science notebooks • Empty student chart

Lesson Segments	Estimated Time
Introduction	10 min
Organizing Data	15 min
Group Discussion and Model Revision	15 min
Wrap Up	10 min
	Total Time: 50 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and DQ, *"How can we use fossils as evidence to figure out what happened to the plants from the Jurassic period?"*** 1. Bring out the squirrel and the Juramaia "interactions" models from LS3 and LS4. Remind students of plants they identified in the Prehistoric video that looked structurally similar to present-day plants (they found in their field investigation/observation walk). Ask, *"How do scientists know which plants were around in the Jurassic period?"* (They found fossils that looked like the plants from today.) 2. Ask students what they think it means if scientists DON'T find fossils that look like an organism. 3. Write the DQ on the board: ***"How can we use fossils as evidence to figure out what happened to the plants from the Jurassic period?"*** Tell students that they will use a chart that will help them figure out an answer to the question.	**10 min**

2	**Organizing Data: Chart fossils and present-day plants** 1. In the large group, display the plant pictures that go in the chart. Ask students if any of the plants look like ones they've seen. Place a blank chart on the carpet for all to see and read the headings on the chart. (You may choose to enlarge the chart for viewing.) Use the large index card labels so that the titles are front and center. Place the index card headings on the top (see completed chart). Find the picture of the fern fossil, and let the students know that they will be looking for the fossil of a fern. Show them where they would put the fossil of the fern on the chart. 2. **Small Group Work:** Students work in small groups, select a fossil picture, and locate any photo or a picture drawn by an artist of the corresponding prehistoric plant or a plant living today. Once someone has found the fossil card, they can place it next to the original in the shared chart. **Note:** Some plants living today do not have fossils (because they aren't old enough). 3. Have student groups work together to organize the pictures on their own small group charts. If there are no pictures of present-day living plants, or there is no fossil picture going across, press students for reasoning, and point out that they are using the lens of *stability and change*. **Suggested Prompt:** "*Can there be a plant that was living in the Jurassic period and today? What does it mean that there is a fossil but no present-day living plant that looks like it? If there are no fossils that look like a plant, what would that mean?*"	**15 min**

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Group Discussion and Model Revision: Analyze fossil data

1. As a group, talk about what it might mean if there are no fossils of a plant that is living today, and ask what it means if there is a fossil that looks very similar to a plant living today.
2. Explain again that asking questions about similarity across time is important to scientists who use the lenses of *stability and change* and *scale, proportion, and quantity* to observe and make claims about fossils from very, very long ago.

Discourse Move - Help students deepen their reasoning

Press students for reasoning. How might the Juramaia have survived if the plants were so different?

Suggested Prompt, *stability and change* over time:
"The squirrel has a lot of connections with trees and with nuts, but in the early Jurassic period, there were no nuts. What does that mean for the Juramaia? How could it get the same needs met? In the Jurassic period, there was no grass. How might that have affected how the Juramaia survived?"

3. The class adds to the shared Juramaia "interactions" model to show connections between the Juramaia and plants in its environment.
4. Invite the entire class to add to the Juramaia "interactions" model. Together, look at the plants in the squirrel model, compare it with the Jurassic period version for the Juramaia, and make revisions when the students have new information (i.e., if students had an oak tree in the Jurassic period, this needs to be discussed and ultimately revised).
    a.
5. The photos of the plants can be added to both or one of the models. Discuss with the class how to indicate the connections among environment and organisms that they want to portray.

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15 min

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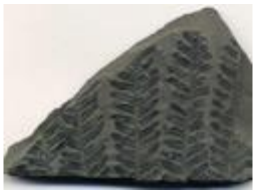
4	**Wrap Up: Free write or draw in science notebooks** 1. Introduce the writing prompt by discussing how the Juramaia survived if there were no plants with nuts or seeds during the Jurassic period. Students will respond to the prompt, considering *stability and change* with respect to the Juramaia. 2. Have students write and draw in response to the **writing prompt:** *“What can we predict about the Juramaia since we know that there were no plants with nuts during the Jurassic period?”* 3. Call on some students to share their writing with the class if they wish. Invite agreement, disagreement, and discussion. 4. Revisit the lesson DQ and add to the DQB. 5. Add questions and/or answers to the DQB. Examine the questions and see if any were answered?	**10 min**

L5.2 and 5.3 Chart and Fossils_present day organism pictures

Jurassic Organisms Present and Past


Fossil Ferns/James St. John/CC BY 2.0


Eomaia/Zofia Kielan-Jaworowska/CC BY 2.0


Fossil Tree/James St. John/CC BY 2.0


Amphibamus grandiceps/Nobu Tamura/CC BY 3.0

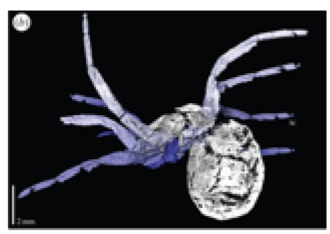

Stegosaurus/Nobu Tamura/CC BY 3.0


Spruce Trees/Sandra Richard/CC BY-NC 2.0


(c) J. A. Peñas

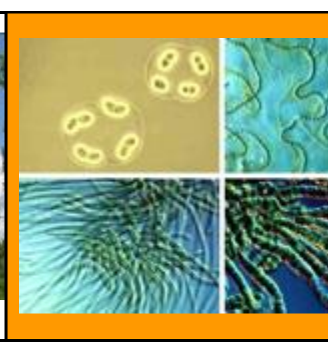

"*Jurassipanorpa sticta*"/Ding H/CC BY 4.0

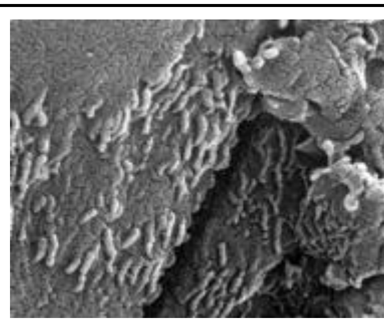

"Golden orb-weaver spider"/U. Kansas & Paul Selden


Digital visualization of Idmonarachne brasieri/Garwood via The Royal Society/CC BY 4.0


Allosaurus Skull/Etemenanki3/CC BY-SA 4.0


Spruce Trees/Sandra Richard/CC BY-NC 2.0





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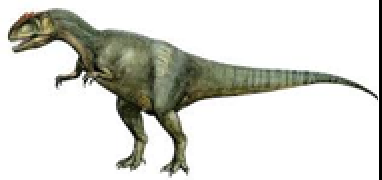
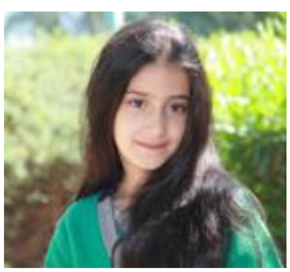
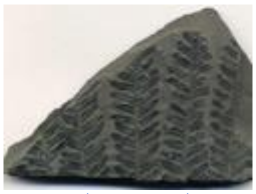
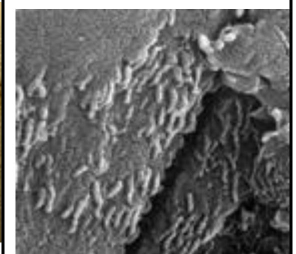
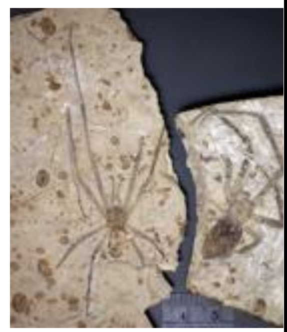
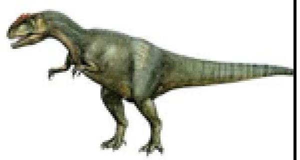
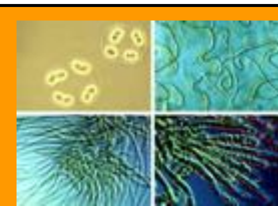
		 Allosaurus/Nobu Tamura/CC BY 3.0	
 Dragonfly macro/Daniel Schwen/CC BY-SA 3.0	 Garden Spider/Wilder Kaiser/CC BY-SA 3.0	 Weaver Ant/World Imaging/CC BY-SA 3.0	
 Red-tailed Hawk/Alan Vernon/CC BY 2.0		 Hylobittacus apicalis/Cody Hough/CC BY-SA 3.0	

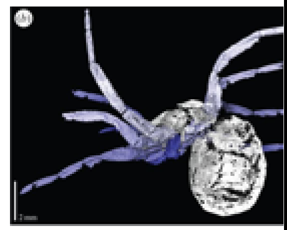
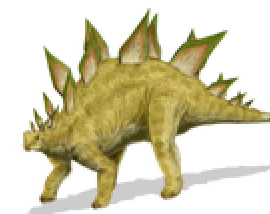
KEY

Images of Real Fossils

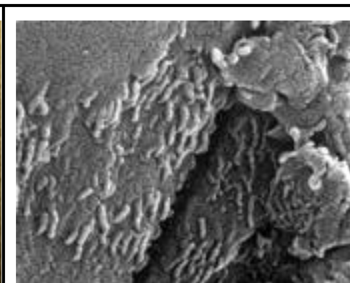
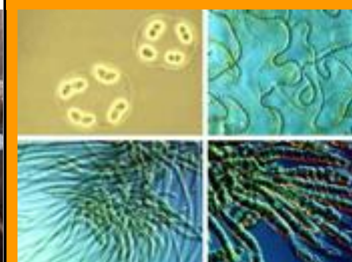
 Fossil Ferns/James St. John/CC BY 2.0	 Eomaia/Zofia Kielan-Jaworowska/CC BY 2.0	 Fossil Tree/James St. John/CC BY 2.0	 Solnhofen Cymatophlebia/Dr. Alexander Mayer/CC BY 3.0	
	 "Jurassipanorpa sticta"/Ding H/CC BY 4.0	 Allosaurus Skull/Etemenanki3/CC BY-SA 4.0	 "Golden orb-weaver spider"/U. Kansas & Paul Selden	

Drawings of the Organisms (correspond to the fossils above)

 © Karen Carr/Australian Museum https://australianmuseum.net.au/learn/australia-over-time/evolving-landscape/the-cretaceous-period/	 Allosaurus/*Nobu Tamura*/*CC BY 3.0*	 *Amphibamus grandiceps*/*Nobu Tamura*/*CC BY 3.0*		

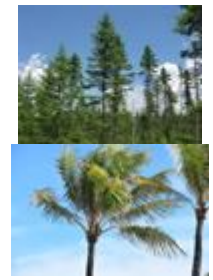
 *(c) J. A. Peñas*		 *Spruce Trees*/Sandra Richard/CC BY-NC 2.0 	 Digital visualization of Idmonarachne brasieri/Garwood via The Royal Society/CC BY 4.0	 *Stegosaurus*/*Nobu Tamura*/*CC BY 3.0*

Example of Matching Pictures with Images

 Fossil Ferns/James St. John/CC BY 2.0	 Eomaia/Zofia Kielan-Jaworowska/CC BY 2.0	 Solnhofen Cymatophlebia/Dr. Alexander Mayer/CC BY 3.0	
 © Karen Carr/Australian Museum			

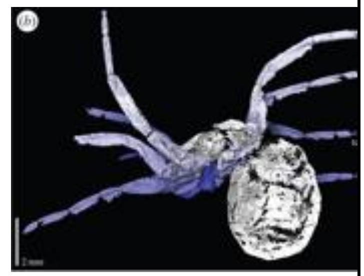
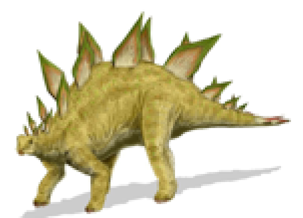
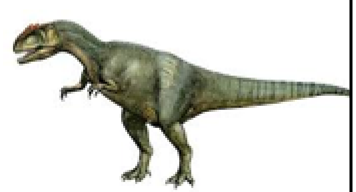
Filled-in Teacher Chart (plants first, then animals)

Name	Living Today	Fossil from the Jurassic Period	Living during the Jurassic Period

1. Fern		 *Fossil Ferns/James St. John/CC BY 2.0*	 © Karen Carr/Australian Museum
2. Conifer tree *Trees were like the conifers we see today (they are mostly not classified as plants). Many trees had fern-like leaves.*		 *Fossil Tree/James St. John/CC BY 2.0*	 *Spruce Trees*/Sandra Richard/CC BY-NC 2.0
3. Flower	 *https://www.flickr.com/photos/atiretoo/6905809144*	*None*	
4. Grass		*None*	
5. Flowering plant		*None*	

6. Plant with a fruit or nut		*None*	

Name	Living Today	Fossil from the Jurassic Period	Living during the Jurassic Period
1. Squirrel-like organism	 Eastern Gray Squirrel/KirinX/CC BY-SA 2.5	 Eomaia/Zofia Kielan-Jaworowska/CC BY 2.0	
2. Dragonfly *The dragonfly from the Jurassic period grew four times as big.*	 Dragonfly macro/Daniel Schwen/CC BY-SA 3.0	 Solnhofen Cymatophlebia/Dr. Alexander Mayer/CC BY 3.0	

3. Spider	 Garden Spider/Wilder Kaiser/CC BY-SA 3.0	 "Golden orb-weaver spider"/U. Kansas & Paul Selden	 Digital visualization of Idmonarachne brasieri/Garwood via The Royal Society/CC BY 4.0
4. Hanging fly	 *Hylobittacus apicalis/Cody Hough/CC BY-SA 3.0*	 *"Jurassipanorpa sticta"/Ding H/CC BY 4.0*	 *(c) J. A. Peñas*
5. Stegosaurus	*None*		 *Stegosaurus/Nobu Tamura/CC BY 3.0*
6. Allosaurus	*None*	 *Allosaurus Skull/Etemenanki3/CC BY-SA 4.0*	 *Allosaurus/Nobu Tamura/CC BY 3.0*
7. Ants *Ants appeared 100 million years ago.*	 *Weaver Ant/World Imaging/CC BY-SA 3.0*	*None*	*None*

8. Rabbit *Rabbits appeared 65 million years ago.*	 *Eastern Cottontail/Jim/CC BY 2.0*	*None*	*None*
9. Hawk *Archaeopteryx (ancestor to birds) appeared in the same year that the stegosaurus disappeared.*	 *Red-tailed Hawk/Alan Vernon/CC BY 2.0*	*None*	*None*
10. Human		*None*	*None*

L5.2 Blank Student Chart

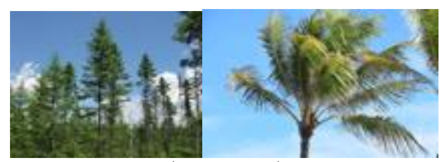
Jurassic Organisms Past and Present

Plant Name	Living Today	Fossil from the Jurassic Period	Prehistoric Plant
1. Fern			
2. Conifer tree			
3. Flower			
4. Grass			
5. Flowering plant			

6. Plant with a fruit or a nut			

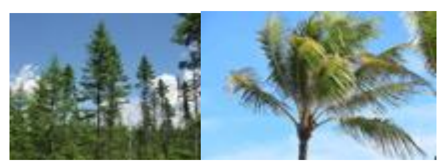
L5.2 Plant Chart Teacher KEY

Filled-in Teacher Chart

Plant Name	Living Today	Fossil from the Jurassic Period	Prehistoric Plant
1. Fern		 Fossil Ferns/James St. John/CC BY 2.0	 © Karen Carr/Australian Museum
2. Conifer tree Trees were like the conifers we see today. Some trees had fern-like leaves, and some had cones and needles.		 Fossil Tree/James St. John/CC BY 2.0	 Spruce Trees/Sandra Richard/CC BY-NC 2.0
3. Flower	 Prairie Violet/Drew Tyre/CC BY-NC 2.0	*None*	
4. Grass		*None*	

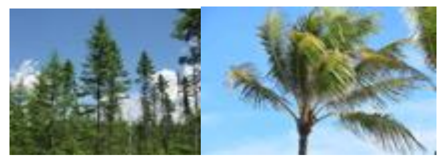
5. Flowering plant		*None*	
6. Plant with a fruit or a nut Angiosperms first appeared 140 million years ago.		*None*	

Filled-in Student Chart

Plant Name	Living Today	Fossil from the Jurassic Period	Prehistoric Plant
1. Fern		 *Fossil Ferns/James St. John/CC BY 2.0*	 © Karen Carr/Australian Museum
2. Conifer tree		 *Fossil Tree/James St. John/CC BY 2.0*	 *Spruce Trees/Sandra Richard/CC BY-NC 2.0*
3. Flower	 *Prairie Violet/Drew Tyre/CC BY-NC 2.0*	*None*	

4. Grass		*None*	
5. Flowering plant		*None*	
6. Plant with a fruit or a nut		*None*	

Student Chart

Plant Name	Living Today	Fossil from the Jurassic Period	Prehistoric Plant
1. Fern		 [Fossil Ferns/James St. John/CC BY 2.0]	 © Karen Carr/Australian Museum
2. Conifer tree		 [Fossil Tree/James St. John/CC BY 2.0]	 Spruce Trees/Sandra Richard/CC BY-NC 2.0
3. Flower	 *Prairie Violet/Drew Tyre/CC BY-NC 2.0*	*None*	
4. Grass		*None*	
5. Flowering plant		*None*	

6. Plant with a fruit or a nut		*None*	

L5.2 Plant Pictures

Images to Cut Out for Each Group

		 Fossil Ferns/James St. John/CC BY 2.0	 © Karen Carr/Australian Museum
		 Fossil Tree/James St. John/CC BY 2.0 	 Spruce Trees/Sandra Richard/CC BY-NC 2.0 
	 Prairie Violet/Drew Tyre/CC BY-NC 2.0		

Learning Set Driving Question
LS5: How can we use fossils to figure out how organisms change over long periods?

L5.3: Fossils as Evidence - Animals

Lesson Snapshot

Learning Set Driving Question
LS5: How can we use fossils to figure out how organisms changed over long periods of time?

Lesson Driving Question
L5.3: How have animals from the past changed?

Lesson Overview

1. Introduction: Read the lesson DQ together. Read the questions on the board from L5.2. Focus on the squirrel and Juramaia "interactions" models. Review science notebooks from L5.2.
2. Gathering and Analyzing Information: Students match the animal fossils and discuss the "noticings."
3. Model Revisions: Students use labeled pictures to revise the Juramaia "interactions" model.
4. Group Discussion and Claim Construction: What might have been the Juramaia's predator?
5. Wrap Up: Students respond to the possible prompt, *"What can fossils tell us about how organisms have changed over time?"***,** in their science notebooks.

Objectives

Learning Performance
Students will use models to develop claims that some animals today did not exist in the Jurassic period, that other animals that do not exist today did exist in the Jurassic period, and that changes in animals also changed the interactions among the organisms in the environment (through the lenses of *stability and change* and *scale, proportion, and quantity*).

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out 1. **Students are figuring out that** many animals that we see today did not exist in the Jurassic period, that the interactions of organisms were different from today, and that fossils provide evidence of the prehistoric environment. 2. **Students are figuring out that** they are using a relative scale of millions of years in the past. They can refer to the timeline if they need to check the time periods.	***Embedded Language Supports*** • Use of photos, models, and charts for supporting language of communication and collaboration • Opportunity for authentic negotiation of meaning • Discourse moves from WIDA

Look Fors 1. **Look for** students using the fossils as evidence to collaboratively develop a story about events in the past with the understanding that some events caused broad environmental changes. 2. **Look for** and support questions relating to *stability and change*; *systems and system models*; *structure and function*; and *scale, proportion, and quantity*. **Evidence Statement** The claims students develop state that some animals that live today did not exist in the Jurassic period, and others that do not live today did live in the Jurassic period. The claims use the lenses of *stability and change*; *systems and system models*; *structure and function*; and/or *scale, proportion, and quantity*.	

Teacher Preparation	Materials
• Have an *extra set* of pictures (one of each animal for each period) ready for the class to use to put on the interactions models. • Fossil and present day organism pictures in color • Look over the science notebooks from L5.2. Find a good example of a claim about how an animal, the environment, or plants have changed since the Jurassic period. • Make (or use from L5.2) four large index cards with these headings: **Animal Name**, **Living Today**, **Fossil from the Jurassic Period**, and **Living during the Jurassic Period**.	***Teacher Materials*** • Driving Question Board (DQB) • Animal cards from both periods • "interactions" models of the squirrel and the Juramaia • Tape to place photos on the models • Index cards ***Student Materials*** • Science notebooks

Lesson Segments	Estimated Time
Introduction	10 min
Gathering and Analyzing Information	20 min
Model Revisions	10 min
Group Discussion and Claim Construction	10 min
Wrap Up	10 min
	Total Time: 60 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and DQ, *"How have animals from the past changed?"*** 1. Read the L5.2 DQ. *Turn-and-talk*: *"What did you figure out yesterday?"* Have three student volunteers share. Read the Lesson questions on the board from L5.1 and L5.2. Read the L5.3 DQ. Solicit ideas about what you will be figuring out today and how you might go about it. 2. Bring out the "interactions" models of the squirrel and the Juramaia. Have a student describe why the class agreed to make additions or revisions based on the investigation of plants in L5.2. 3. Look and examine a peer's writing: Display or project the student writing that you selected from the free write from L5.2. **Suggested Prompt:** With the student's help, ask the class, *"Where is the claim here? Where is the evidence? Do you agree with the claim? Do you have more evidence to add?"* 4. Explain that today the students will be again comparing the two periods, the present and 155 million years ago, but this time, they will be analyzing animal life.	**10 min**

2	**Gathering and Analyzing Information: Match the animal fossils and discuss "noticings"** **Suggested Prompts:** *"How can we learn about the past? Can we do some of the work of scientists? How do you think we should start?"* 1. Place the headings on the large index cards on the carpet: **Animal Name**, **Fossil from the Jurassic Period**, **Living Today**, and **Living during the Jurassic Period**. 2. Project one set of photos: Fossil and present-day organism pictures. Explain that the students will be doing a task similar to what they did in L5.2, but with animals. Ask if they have any predictions about which extant animals have similar structures to those shown in fossils from the prehistoric time. **Suggested Prompt:** *"What does it mean if we find a fossil of an animal that looks a lot like, but not the same as an animal that is living today?"* Emphasize that asking questions about similarity across time is important to scientists who use the lenses of *stability and change* and *scale, proportion, and quantity* to make claims based on examining fossils from very, very long ago. 3. Have the students work in small groups, pass out the color photos of the animals, and have each group record their "noticings" on a whiteboard. 4. When you're ready, have each group share out some of their "noticings." (Here is a slide for optional use.)	**20 min**
3	**Model Revision: Revising the Juramaia "interactions" model** 1. The entire class should look at the "interactions" models. They will look at the animals in the squirrel model, compare those animals with the Juramaia in the Jurassic version, and make revisions when they have new information. 2. The photos of the organisms can be added to one or both of the models. The class should discuss how they want to show the various connections among and between organisms.	**10 min**

<table>
<tr>
<td>4</td>
<td>Group Discussion and Claim Construction

Present 5.3: Analyzing Fossils slides.
Students will work together to construct a shared claim about how fossils are evidence of the past existence of animals and that the fossils give clues not only about the organism but also about the environment.
Discussion: The squirrel has predators today that the Juramaia did not. What do you think might have been a predator of the Juramaia? Why do you think that?

Discourse Move - Help students apply their thinking to others' ideas


Suggested Prompt: Look for students thinking about others' ideas. Tell students to think about the ideas that their friends share.</td>
<td>10 min</td>
</tr>
<tr>
<td>5</td>
<td>Wrap Up: Free write or draw in science notebooks

Have students write independently and draw in the science notebooks their thoughts on the field work investigation and discussion.

Suggested Prompt: "What can fossils tell us about how organisms have changed over time?"
Call on some students to share their writing with the class if they wish. Invite agreement, disagreement, and discussion.
Add questions and/or answers as well as any vocabulary to the lesson DQB.
</td>
<td>10 min</td>
</tr>
</table>

Learning Set Driving Question
LS5: How can we use fossils to figure out how organisms change over long periods?

L5.4 Revising Interactions Model

Lesson Snapshot
Learning Set Driving Question LS5: How can we use fossils to figure out how organisms change over long periods? **Lesson Driving Question** L5.4: How did our prehistoric organism interact with the other organisms in its environment? **Lesson Overview**

1. Introduction: Read the lesson DQ together. Some students share their current thoughts about the DQ.
2. Shared Reading: Share the whole-class reading: The Allosaurus, Dinosaur of the Jurassic Period.
3. Partner Reading: Students read about other organisms that lived during the Jurassic period and answer questions.
4. Model Revision and Discussion: Students return to the “interactions” model and revise, add to, or change it based on the information from the reading. Students discuss the changes to the “interactions” model and what they read that made them rethink their claims.
5. Wrap Up: Students discuss their answers board - final review of the DQB.

Objectives

Learning Performance
Students will use new information about organisms that lived during the Jurassic period to analyze and revise their claims about the eutheria (Juramaia) and how it survived, met its needs, and interacted with other organisms (student ideas may use the lenses of *stability and change*; *systems and system models*; *structure and function*; and *scale, proportion, and quantity*).

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all.
3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Students are figuring out that that obtaining additional information about organisms in the environment can cause new thinking about individual organisms and how they survived, what their needs were, and how they interacted with the other organisms around them. **Students are figuring out** how to think about scale and relative time scales. **Look Fors** 1. **Look for** students offering reasoning and building on others' reasoning to revise their claims. 2. **Look for** and support thinking and connections relating to *stability and change*; *systems and system models*; *structure and function*; and *scale, proportion, and quantity*. **Evidence Statement** In revising their claims, students will use the lenses of *stability and change*, *systems and system*	***Embedded Language Supports*** • Employment of multiple domains for language learning • Use of photos and charts for supporting comprehensible input and practices • Discourse moves from WIDA

models, *structure and function*, and/or *scale, proportion, and quantity*. They will also use evidence from the field work, the squirrel poster about interactions, and the "present-day/past fossil chart." Students will use logic and evidence to argue for revising the claims or disagreeing with the proposed revision.	

Teacher Preparation	Materials
• Be ready to review students' claims from the previous lesson. • Select a few partners to re-read the shared text. • Select a class-generated claim about how plants and animals have changed or stayed the same from an earlier discussion or free write. • Preview how you will demonstrate the Allosaurus reading and response: Jurassic organism questions.	***Teacher Materials*** • Driving Question Board (DQB) • Interactive reading guide • Readings about plants and animals of the Jurassic period: The Allosaurus, Dinosaur of the Jurassic Period • Questions for reading: Jurassic organism questions • Partner readings: Insects in the Jurassic period; Juramaia, eutherian mammal, in the Jurassic period; The Stegosaurus; The Allosaurus, Dinosaur of the Jurassic Period; Plants of the Jurassic Period **Note:** Some students will read the shared reading (allosaurus) again, and others will re-read the Juramaia and stegosaurus readings that you read aloud with the class during LS4. • Shared reading (optional): Fossils: Evidence of What Lived in the Past **Note:** You can also find digital versions of all the readings in WeRead, where they can be read aloud to students. ***Student Materials*** • Science notebooks

Lesson Segments	Estimated Time
Introduction	10 min
Shared Reading	15 min
Partner Reading	20 min
Model Revision and Discussion	15 min
Wrap Up (including optional reading)	20 min
This 80-minute lesson could be integrated into the Literacy Block.	**Total Time:** 80 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and DQ, *"How did our prehistoric organism interact with the other organisms in its environment?"*** 1. Students read the unit DQ together. Invite discussion at this time, especially regarding the last couple of lessons about the changes in plants and animals in the Jurassic period. Ask students, "*How are we thinking about the DQ now?"* 2. Present a claim you selected from student free writes—one that many students had about plants and animals during prehistoric times (i.e., plants from the Jurassic period are all the same as they are now; animals have changed completely since the Jurassic period) 3. Read the lesson DQ: Students gather information about the plants and animals from the Jurassic period. ***"****What made us change our thinking about how the Juramaia interacted with the organisms in its environment?"* Do a *turn-and-talk*, and share out responses to the lesson DQ question.	**10 min**
2	**Shared Reading: Demonstrate how to locate answers to questions in the texts** 1. Put the reading on the overhead projector: The Allosaurus, Dinosaur of the Jurassic Period. 2. Hand out sticky notes for students to use to write a question or an idea from the reading. Have students share their sticky notes in groups of two to four. Then ask each group to plan to share out one idea or question from their discussion. 3. Pass out or display the questions that go with the readings, using these questions to guide your discussion: Jurassic organism questions. Work together as a class, figuring out the answers to the questions for the shared reading and how one would go about finding the information in the allosaurus reading. The students will use this to work independently with their own readings.	**15 min**

3	**Partner Reading: Look for evidence in texts** 1. Tell students they will be learning about several different organisms (insects, Juramaia, allosaurus, plants, and stegosaurus) to place each on the "interactions" model: Insects in the Jurassic Period? Juramaia; The Stegosaurus; The Allosaurus, Dinosaur of the Jurassic Period, and Plants of the Jurassic Period. Remind students that they are already familiar with some of these texts because they have read them before. The class read about the Juramaia and stegosaurus together during LS4, and they just read about the allosaurus together at the beginning of this lesson. 2. Pass out sticky notes for students to take notes about the texts (e.g., the structures of the organism and/or how they interact with other organisms), if needed. In addition, students may work with their partner or group to respond to the supporting questions embedded in the text, digitally or on printouts, as they read. Use paper copies of the Jurassic organism questions. Ask students to read the text together at least once before passing out the questions. • **Options for Supporting Students' Independent, Partner, or Small Group Reading:** 1) Consider using mixed-performance groups, where one student reads the text aloud for the group, as other group members follow along. 2) You may choose to read the text aloud to some groups, while the group follows along. 3) You can also find digital versions of all texts in WeRead, where the texts can be read aloud to students. Students can listen to these texts individually with headphones, or the text can be played aloud for a small group. To use text-to-speech in WeRead, the students should highlight the word, paragraph, or page they want to hear, then click on the green speaker at the top right of the screen.	**20 min**

4	**Model Revision and Discussion: Look for more interactions between organisms and the Juramaia** 1. Have student pairs share what they learned, using their responses to the Jurassic organism questions as a guide. 2. As during the last two lessons, as a group, revisit the Juramaia "interactions" model to make changes. Help students figure out why to make revisions (based on new evidence) and why they might be necessary. 3. Present the class-generated claim (that you selected before the lesson). 4. Talk about all the different kinds of evidence you have collected about organisms and environments in the past (i.e., fossils, climate posters, photos, texts, videos, field work, home experiences, and "interactions" models). During the discussion, point out the lenses that students are using as they think about animals, environments, and events in the past. Possible lenses include *systems and system models*; *stability and change*; *scale, proportion, and quantity*; *cause and effect*; etc. • **Discuss:** *"Did you change your mind about something? What made you change your mind (what evidence)?"* **Discourse Move - Make ideas public**  Take a moment to have students discuss ideas from the partner share. **Suggested Prompt:** *"Whose idea is interesting to you? Why is it interesting? How does your thinking seem the same as or different from your partner's thinking?"*	**15 min**
5	**Wrap Up: DQB and optional shared reading** 1. Go over the DQB. This could be a time to revisit LS4 claims (from L4.2 and L4.4) that have been discarded and discuss when and how they realized that these claims needed to be changed. 2. Shared reading (optional): Fossils: Evidence of What Lived in the Past. Tell students that you will read the text aloud as they follow along on their print copy or screen. Tell them that you will pause to ask questions about the text. Say, *"Consider how the text helps us figure out how scientists can use evidence to make claims."* 3. Ask students, based on their own experiences collecting fossil data in this classroom, if they can describe how using fossils as evidence and recreating the Jurassic period is like putting together a puzzle. Share out ideas.	**20 min**

L5.4 Stegosaurus (text)

The Stegosaurus
What Can We Learn from a Fossil?

What dinosaur looked like an Army tank? If you said the *stegosaurus* (steg-uh-SAW-rus), you are right. Look closely at the fossil of the stegosaurus as follows.

Stegosaurus fossil

What structures do you notice?
How do you think these structures helped the stegosaurus survive in its environment?

Paleontologists (pay-lee-un-TOL-uh-jists) are scientists who study fossils. Stegosaurus fossils include complete skeletons. From the skeletons, paleontologists have learned that the teeth of the stegosaurus were small and rounded. The teeth looked like pegs. Its jaws moved up and down, so it could not grind its food. Instead, it held food in its cheeks and slowly chewed and chewed.

The stegosaurus was huge. A full-grown stegosaurus weighed about 7,000 pounds. It had to eat about 200 pounds of plants a day! Plant-eating dinosaurs are called *herbivores* (HERB-uh-vores).

Study the stegosaurus skeleton in the photograph below.

"Stegosaurus, American Museum of Natural History" by Rachel So is licensed under CC BY-SA 2.0

Stegosaurus skeleton and model of baby stegosaurus

What structures do you notice in this photograph?
How might those structures have helped the stegosaurus?

The first structures you probably noticed were the plates on the back and the spikes on the tail. Paleontologists are not sure about what the plates did. They do know that a stegosaurus had 17 plates, or *scutes* (scoots), along its back in two rows. The scutes were made of a bony material, but they were not hard or stiff. Paleontologists think that the plates might have looked dangerous to predators. But the plates were not used for defense.

The spikes on the tail of the stegosaurus were used for defense. Paleontologists have found spike fossils with damaged tips. Fossils of other dinosaurs have holes that match the spikes.

You might have also noticed that the front legs of the stegosaurus are shorter than its back legs. That means that it could not move very fast. If it did move fast, its back legs would get tangled up in its front legs. Paleontologists have also found trace fossils of stegosaurus footprints. Those footprints show that the slow stegosaurus traveled in large herds with other stegosauruses.

So how do you think a slow-moving stegosaurus survived?
How might traveling in a group help the stegosaurus survive?

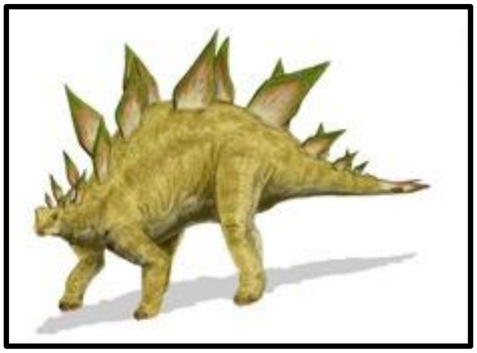
L5.4 Interactive reading guide

<table>
<tr><th>Text</th><th>Interactive Discussion Prompts/Questions</th></tr>
<tr><td>

FOSSILS
Evidence of What Lived in the Past

Evidence of animals that lived in the past

How do we know about animals, like dinosaurs, that lived in the past and what they looked like? Look closely at the image of the stegosaurus.



"Stegosaurus" by Nobu Tamura is licensed under CC BY-SA 3.0

How would you describe what it looks like?

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Make a connection between students' fossil investigation and the reading. Read the title and subtitle aloud.

Suggested Prompt: *"Based on what we already know, how do you think fossils provide evidence of what lived in the past? What kinds of things did you figure out by examining fossils from prehistoric times?"*

Prompt students to look closely at the illustration of the stegosaurus. Remind them about how they have been analyzing squirrels' structures, and the structures of other organisms that live in the squirrels' environment.

Suggested Prompt (and Write): *"What structures can you observe on the stegosaurus? How would you describe what it looks like?"*

Have students *turn-and-talk* about their noticings with a partner, enter their responses, and share out with the class.

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Fossils provide information about life that existed thousands or millions of years ago. Think of a fossil as evidence of a plant or animal that lived long ago. For example, the fossilized bones of a dinosaur give us evidence that it existed. Take a look at these fossilized remains of a stegosaurus.

How is the fossil similar to the drawing of the stegosaurus above?

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Prompt students to look closely at the photograph of the stegosaurus fossil.

Suggested Prompt: *"Do you notice similar structures in the fossil as the structures you identified in the illustration above? How is the fossil similar to the drawing of the stegosaurus?"*

Invite students to share their comparisons with a neighbor and/or with the class.

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Evidence of plants that lived in the past How do we know that ferns and conifers existed long ago, but that many trees we see today, like maple and oak trees, did not? Look at the photograph of the fern plant that exists today (left). Then look closely at the photograph of the fossil (right).   "Fern Plants" by Sanjay Ach is licensed under CC BY-SA 3.0 /"Carboniferous fossil fern" by Black County Museums is licensed under CC BY-NC-SA 2.0 **What similarities and differences do you notice?**	Prompt students to look closely at the photograph of the fern plant and the fossil of a fern from prehistoric times. **Suggested Prompt:** *"How is the fossil similar to the fern plant in the photograph? How are they different?"* Invite students to share their comparisons with a neighbor and/or with the class.
The fossilized remains of the fern give us evidence that these plants existed at the same time as some dinosaurs. Why do you think paleontologists (scientists who study fossils) claim that many trees we see today, like oak and maple trees, did not exist when dinosaurs like the stegosaurus were alive? The evidence that supports this claim is that scientists have found **no evidence** of those plants during these periods. This means that scientists have not discovered any fossils of oak and maple trees from the times when dinosaurs were alive.	**Suggested Prompt:** *"Why do you think paleontologists claim that many trees we see today, like oak and maple trees, did not exist when the stegosaurus was alive?"* Invite students to explain, in their own words, why scientists claim that oak and maple trees did not exist at the time.
Can fossils tell us everything about when dinosaurs were alive? Paleontologists do not know everything about the plants and animals that lived when the dinosaurs existed. For example, we probably do not know about all of the life forms—plants and animals—that existed in the Devonian, Jurassic, or Triassic periods you have been exploring. If an organism that lived during those times did not form a fossil or leave a trace fossil (such as a footprint) or if no one has discovered the fossil yet, paleontologists have no way of knowing whether it existed or not!	Point out the heading of this section and invite students to make a prediction. **Suggested Prompt:** *"Can fossils tell us everything about when dinosaurs were alive? Why or why not?"*

After reading:
Show students the following videos from the American Museum of Natural History:

- Meet the paleontologists—In this video, three paleontologists describe the work of searching for and discovering fossils, becoming interested in studying fossils as kids, and how they use new technologies to help them learn even more from the fossils they find (e.g., simulations to model how dinosaurs moved). (2 minutes, 44 seconds)

- *Did Dinosaurs Travel in Herds or Packs?*—In this video, one paleontologist describes using evidence from trace fossils (footprints) to learn about dinosaurs' behavior and to answer the question: *"Did dinosaurs travel in herds or packs?"* (0 minutes, 58 seconds)

Revisit the lesson DQ (suggested prompts): *"How did our prehistoric organism react with the other organisms in its environment?"* Across both videos, encourage students to make connections among the information in the videos, the reading, and their own investigation with fossils in this lesson.

L5.4 Plants of the Jurassic Period (text)

Plants of the Jurassic Period

Earth was a warm and wet place during the Jurassic period. Large areas were flooded. The water kept temperatures from becoming too hot or too cold. Many plants lived during the Jurassic period.

What kinds of plants do you think lived during the Jurassic period?
Can you still see those plants today?

Study the following pictures. Which plants have you seen before? What do you know about them?

"Fern" by Sanjay ach is licensed under CC BY-SA 3.0

1

2

Alishan Forest stump moss by Jpatokal is licensed under CC BY-SA 4.0

3

"Ginko bilboa" by Magnus Manske is licensed under CC BY-SA 3.0

4

"Cycad" by Steve-SF is licensed under CC BY 2.0

5

These are the plants in the photographs:

1. *Ferns* have stems, leaves, and roots. Instead of seeds, they have spores. The spores grow on the underside of their leaves, which are called fronds.
2. *Conifers* are trees that have needle-like leaves. They stay green through all seasons. Their seeds are inside cones.
3. *Mosses* are small plants that usually grow in shady places near water.
4. *Ginkgo trees* have fan-shaped leaves. They produce seeds inside a soft covering.
5. *Cycads* (SY-kadz) are seed-bearing, palm-like plants. Some grow very tall. Others grow close to the ground. Cycads are related to conifers.

Paleontologists (pay-lee-un-TOL-uh-jists), scientists who study fossils, have found fossils of all these plants. But you can see these plants today, too. They are living fossils of the Jurassic period.

Plant-eating dinosaurs of the Jurassic period ate these plants for their survival. But these dinosaurs did not have other kinds of plants to eat. There were no apple trees or oak trees in the Jurassic period. So they did not eat fruits or nuts. They had to survive on the leaves of plants that they could find.

Why did plants survive during the Jurassic period?
Why were plants important for animals during the Jurassic period?

Jurassic Organism Questions

Organism name (circle one): Allosaurus Plants Juramaia
Stegosaurus Insects

What is super interesting about your organism (plant or animal)?

____

____

What did your organism look like? If you read about Jurassic plants or insects, describe **one** that you read about.

____

____

What is one of your organism's structures?

____

How did the structure help your organism survive in its environment?

____

____

Does your organism look like any plants or animals we know today? Why do you think so (evidence)?

____

____

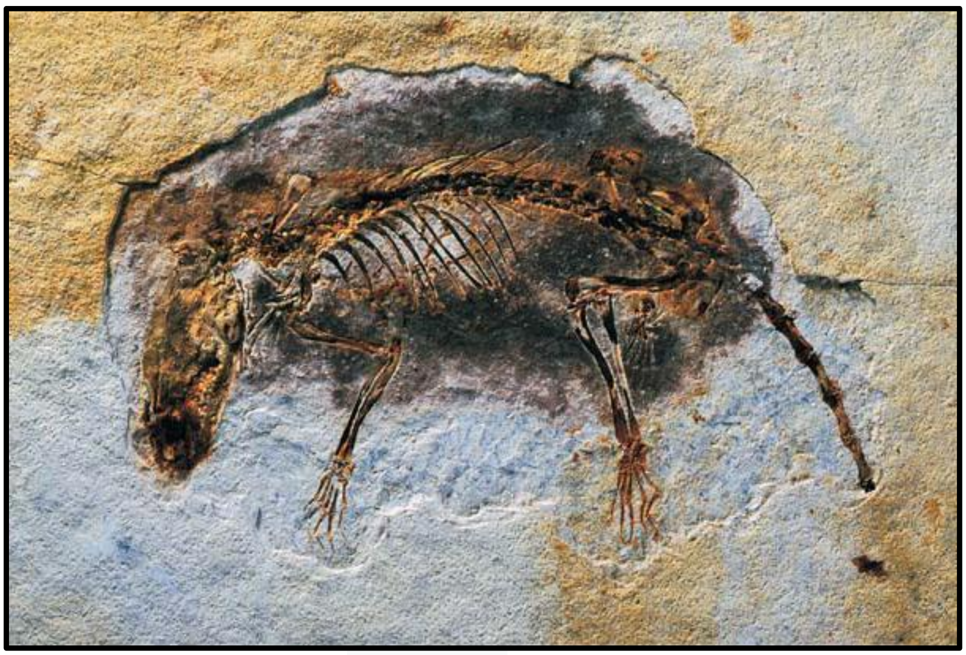
Draw a picture of your organism on the back of this page. Make sure you draw and label one or more of the structures you learned about!

L5.4 Juramaia (text)

The Juramaia
What Can We Learn from a Fossil?

Not all the animals in the Jurassic period were huge dinosaurs. Some animals were very small. One of these small animals was the *Juramaia* (jur-uh-MAY-uh). The Juramaia was a furry animal. It looked like a squirrel or mouse. It lived among the ferns that covered the ground. It also lived up in trees.

Following is a photograph of a fossil.



"Eomaia" Zofia Kielan-Jaworowska is licensed under CC BY 2.0

Fossil of a eutherian mammal similar to the Juramaia

What structures do you notice?
How do you think these structures helped the Juramaia survive in its environment?

The following drawing shows what *paleontologists* (pay-lee-un-TOL-uh-jists) think the Juramaia looked like. Paleontologists are scientists who study fossils. You can find photographs of Juramaia fossils and other drawings here.

“Juramaia” by Nobu Tamura is licensed under CC BY-SA 3.0

Juramaia Reconstruction

How do we know how the Juramaia looked and lived? Paleontologists have fossil evidence of the Juramaia, like the fossil you studied above. Fossils show that the Juramaia was only 3–4 centimeters (about 2 inches) long. It weighed about 15 grams (half an ounce). Imagine this little mammal among the giant dinosaurs that lived during the Jurassic period!

The fossils also show that the Juramaia had legs and feet for climbing. It could climb up and down trees during the night to catch and eat insects. It could also hide in trees to escape other animals.

Why do you think it was able to survive during the Jurassic period? What structures and behaviors allowed the Juramaia to survive?

L5.4 Insects (text)

Were There Insects Living During the Jurassic Period?

Did you know that insects are the largest group of living organisms on Earth today?
There are 900,000 different kinds of living insects.
And, on any given day, 10 quintillion insects are alive on our planet. That's 10 followed by 18 zeros—
10,000,000,000,000,000,000!


"Coccinella magnifica" by Gilles San Martin is licensed under CC BY-SA 2.0


"Closeup of Housefly" by Gladson Machado is licensed under CC BY 3.0


"Carniolan honey bee" by Richard Bartz is licensed under CC BY-SA 2.5


"Limenitis archippus" by Benny Maruz is licensed under CC BY 2.0

Stop and think about the kinds of insects that you already know about. What are some insects that you see every day?

The most common kinds of insects alive today are the following:
- Beetles
- Flies
- Ants, bees, and wasps
- Butterflies and moths

Do you think insects were living 150 million years ago during the Jurassic period? Why or why not?

If you said “yes,” you are right. Scientists have found evidence of insects living in prehistoric times. One of these insects looked like fleas that live today. You may have seen dogs that scratch because they have fleas.

When fleas land on an animal, they use a tube that is like a hollow needle. The tube has rough edges like a saw. That tube can dig into the skin. Once the tube is under the skin, the flea sucks out blood. Fleas are *bloodivores* (BLUD-uh-vors), organisms that live on blood.

Look closely at the following drawing and photograph. Find the tube that is used for sucking blood.

“Pseudopulex” by Oregon State University is licensed under CC BY-SA 2.0

Drawing of a flea-like insect from the Jurassic period

“Adult male montana flea” by Kat Masback is licensed under CC BY-SA 2.0

Photograph of a flea from today

What other structures do you notice?

Did you see the claw-like structures at the end of the legs on both fleas? Those structures allow the flea to hold onto its *host*, or the organism it is using for food.

Scientists discovered Jurassic flea-like fossils in China. These fossils show that these insects lived during the Jurassic period. Fleas and other insects living in the Jurassic period were also much bigger than the insects we see today. Imagine insects with wings about as long as your arm! Such insects once existed. But these extra-large insects from the past did not survive. Scientists claim that once flying dinosaurs, birds, and bats came on the scene, they ate the large insects. The smaller insects were harder to find, so they survived.

Dragonflies are examples of insects from the Jurassic period that still exist today. Look at the following photograph of the dragonfly fossil from the Jurassic period.

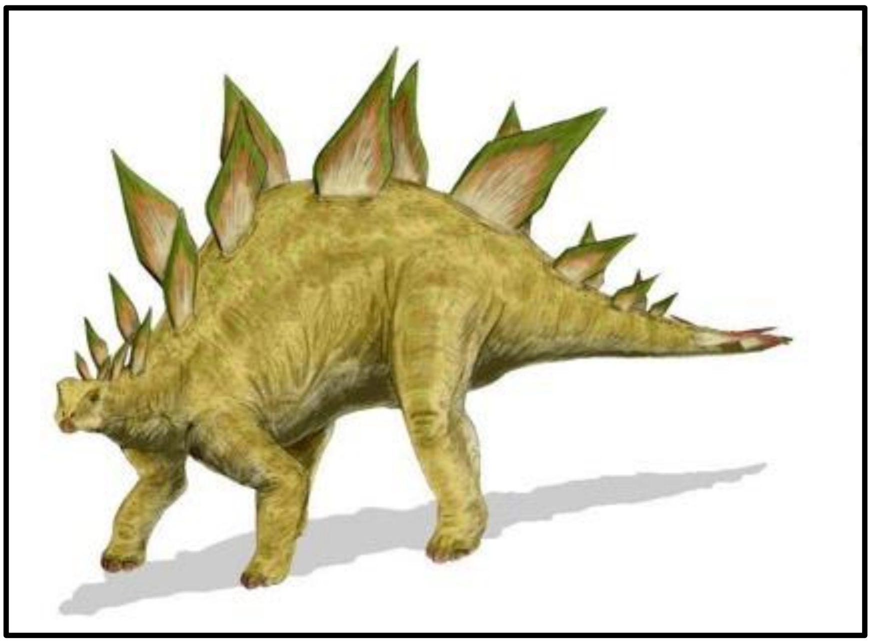
Dragonfly fossil from the Jurassic period

What structures do you notice?
How do you think the dragonfly's structures helped it survive?

Fossils
Evidence of What Lived in the Past

Evidence of animals that lived in the past

How do we know about animals, like dinosaurs, that lived in the past and what they looked like? Look closely at the image of the stegosaurus.



"Stegosaurus" by Nobu Tamura is licensed under CC BY-SA 3.0

How would you describe what it looks like?

Fossils provide information about life that existed thousands or millions of years ago. Think of a fossil as evidence of a plant or animal that lived long ago. For example, the fossilized bones of a dinosaur give us evidence that it existed. Take a look at these fossilized remains of a stegosaurus.

How is the fossil similar to the drawing of the stegosaurus above?

Evidence of plants that lived in the past

How do we know that ferns and conifers existed long ago, but that many trees we see today, like maple and oak trees, did not? Look at the photograph of the fern plant that exists today (left). Then look closely at the photograph of the fossil (right).

"Fern Plants" by Sanjay Ach is licensed under CC BY-SA 3.0

"Carboniferous fossil fern" by Black County Museums is licensed under CC BY-NC-SA 2.0

What similarities and differences do you notice?

The fossilized remains of the fern give us evidence that these plants existed at the same time as some dinosaurs.

Why do you think paleontologists (scientists who study fossils) claim that many trees we see today, like oak and maple trees, did not exist when dinosaurs like the stegosaurus were alive? The evidence that supports this claim is that scientists have found **no evidence** of those plants during these periods. This means that scientists have not discovered any fossils of oak and maple trees from the times when dinosaurs were alive.

Can fossils tell us everything about when dinosaurs were alive?

Paleontologists do not know everything about the plants and animals that lived when the dinosaurs existed. For example, we probably do not know about all of the life forms—plants and animals—that existed in the Devonian, Jurassic, or Triassic periods you have been exploring. If an organism that lived during those times did not form a fossil or leave a trace fossil (such as a footprint), or if no one has discovered the fossil yet, paleontologists have no way of knowing whether it existed or not!

L5.4 Allosaurus (text)

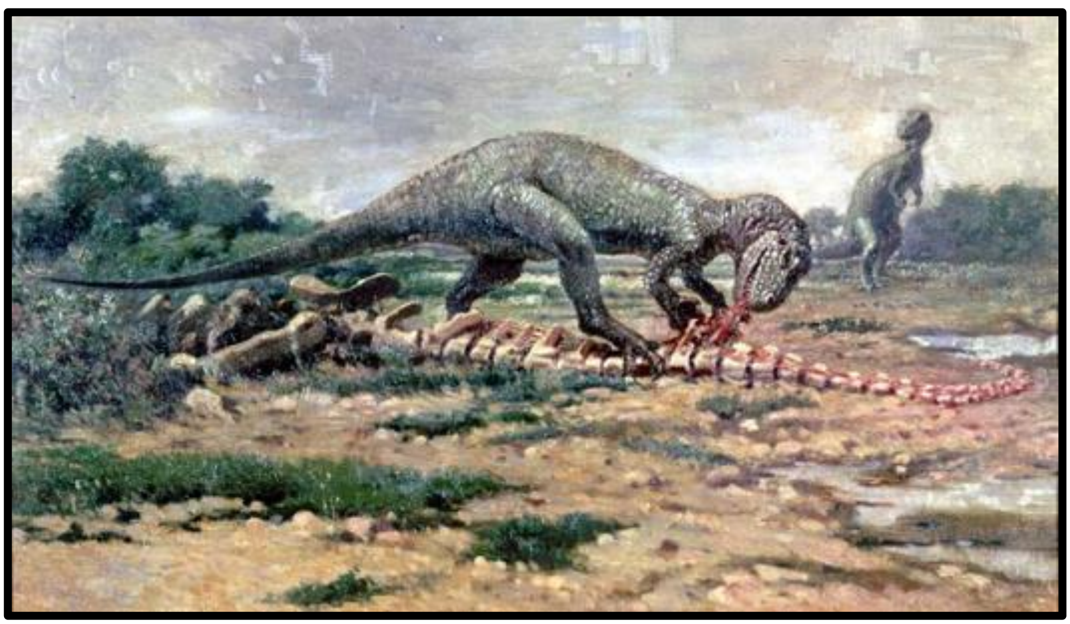
The Allosaurus, Dinosaur of the Jurassic Period

What animals might you see if you took a walk outside? You probably wouldn't be surprised to see dogs, squirrels, birds, and maybe some deer.

Now think about taking an imaginary walk during the Jurassic period. You would be walking through a world that existed almost 200 million years ago and ended about 145 million years ago. What animals do you think you would see?

The most common meat-eating dinosaur of the Jurassic period was the *allosaurus* (al-uh-SAW-rus). Meat-eating dinosaurs are called *carnivores* (KAR-nuh-vores).

The allosaurus was big, strong, and fast. It could run on two legs. It could also stand and keep its balance because of its tail and strong back legs. The following drawing shows what an allosaurus might have looked like.



The following images show the skeleton and skull of an allosaurus. These fossils allow *paleontologists* (pay-lee-un-TOL-uh-jists) to identify important allosaurus structures. Paleontologists are scientists who study fossils.

Look closely at the following images.

Allosaurus-crane by Bob Ainsworth is licensed under CC BY 2.0

What structures do you notice that might have helped the allosaurus survive?

Allosaurus skeletons provide evidence that the allosaurus was a mighty predator. Predators hunt prey. The prey of the allosaurus were plant-eating dinosaurs and any dead dinosaurs. The allosaurus had sharp teeth with saw-like edges. New teeth would grow if any broke off. The allosaurus had very strong jaws that it could use to bite into its prey.

From what you have learned about the allosaurus, why do you think it was able to survive during the Jurassic period? What structures allowed it to be a successful predator?

Learning Set Driving Question
LS5: How can we use fossils to figure out how organisms change over long periods?

L5.5 Comparing Organisms - Math/Measurement

Lesson Snapshot

Learning Set Driving Question
LS5: How can we use fossils to figure out how organisms change over long periods?

Lesson Driving Question
L5.5: **Math:** Can we imagine how big these animals were? How would it look if they were next to each other?

Lesson Overview

1. Introduction: Read the lesson DQ together, and press students for initial responses to the lesson DQ. Present the learning set question to the class. Students make predictions about the relative sizes of the animals.
2. Investigation: The class analyzes and graphs the measurements of some animals during the Jurassic period and compares them with each other and with some present-day animals. Students show the size of their animal by measuring, then showing the measurement on a string or sentence strips taped together.
3. Creating a Bar Graph: Together, the students line up all the measurements to compare them. With partners, students create bar graphs comparing two animals or animal parts.
4. Group Discussion: Students present their bar graphs. The class discusses the differences in the measurements and the differences between animals today and during the Jurassic period.
5. Wrap Up: Lesson DQB—Generate one shared claim about the various sizes of the different animals in both periods. Optional reading for review of this Learning Set: Fossils Are Like Pieces of a Puzzle.

Objectives

Learning Performance
Students will use mathematical thinking and data to compare the measurements of animals in the Jurassic period and make claims (and wonder) about how the animals might have interacted based on their relative sizes (through the lens of *scale, proportion, and quantity*).

Math Standards: Measurement and Data: Represent and Interpret Data
CCSS.MATH.CONTENT.**3.MD.B.4**
Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.

CCSS.MATH.CONTENT.**3.MD.B.3**

Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. **Number and Operations: Fractions:** Develop Understanding of Fractions as Numbers CCSS.MATH.CONTENT.**3.NF.A.1** Understand a fraction 1/*b* as the quantity formed by 1 part when a whole is partitioned into *b* equal parts; understand a fraction *a*/*b* as the quantity formed by *a* parts of size 1/*b*. **Math Competency Statements** I can generate data by measuring lengths to the half and fourth of an inch. I can draw a scaled picture graph and a scaled bar graph to represent a data set. I can describe a fraction 1/*b* as the quantity formed by one part when a whole is divided into *b* equal parts.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Students are figuring out that animals in the Jurassic period had really different sizes from animals today. Some were much bigger, and some were much smaller. Students figure out that size also changed as the environment changed. **Look Fors** **Look for** students explaining with words or pictures how to use measurement tools accurately to *compare* sizes of different organisms during the Jurassic period and today with a lens of *scale, proportion, and quantity*. **Evidence Statement** The claims students make will include language using the lens of *structure and function* and how organisms may have changed as their environments changed. *Scale, proportion, and quantity* ideas in math will be based on the relative sizes of the different animals.	***Embedded Language Supports*** • Opportunity for authentic negotiation of meaning in peer-to-peer interaction • Specific support for interdisciplinary practices • Multiple domains for language learning • Use of photos and charts for supporting comprehensible input and practices • Discourse moves from WIDA

Teacher Preparation	Materials
• Students should have already had a lesson in the basic rules for measurement. • Working groups for optimal participation. • Teacher resource	***Materials*** • Rulers or measuring tape in inches and feet **or** centimeters and meters. Both units of measurements are given on the chart. • String, jute, or sentence strips for representing the measurements. • Scissors for student groups • Tape • Graph paper • Animal Measurements Chart for each group of students

	• Optional: 1 square foot (possibly in a hallway) tiles for showing large lengths • Optional reading: Fossils Are Like Pieces of a Puzzle **Note:** You can also find digital versions of all the readings in WeRead, where they can be read aloud to students.

Lesson Segments	Estimated Time
Introduction	10 min
Investigation	20 min
Creating a Bar Graph	20 min
Group Discussion	10 min
Wrap Up	5 min
This 65-minute lesson could be integrated into the Math Block.	**Total Time:** 65 min

Co-developed by the Multiple Literacies in Project-based Learning Project at Michigan State University and the University of Michigan 2018–2019

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and DQ: *"Can we imagine how big these animals were? How would it look if they were next to each other?'"*** 1. Have students read the unit DQ together. Ask for a *turn-and-talk* about what they figured out the day before (L5.3) and have a few students share. • Direct the students to the two animals in the DQ: *"Can we imagine how big the stegosaurus and the Juramaia were? How would it look if they were next to each other? How would they compare to some modern day animals?"* Write *Juramaia* on the board. • Ask if they think the two animals were about the same size. Ask if they think the stegosaurus was taller than an elephant. Was the Juramaia longer than a squirrel from today? 2. Have the students *turn-and-talk* and share estimates with evidence to explain their thinking. 3. Focus on the questions on the DQB. Ask, *"How are we doing with all our questions?"*	**10 min**
2	**Investigation: Measure lengths** 1. Tell students that they are going to demonstrate measurements of the Juramaia and squirrel using string or taped-together sentence strips. They will also compare measurements of other present-day animals and Jurassic period animals (using the crosscutting concept of *scale, proportion, and quantity*). When finished with the animal measurements, the students will compare the various measurements by laying them on the floor, possibly in a hallway. 2. Project the evidence chart. Examine the measurement chart and develop a system for students to select which measurement they will make. 3. Give students the measurement tools and string, or sentence strips and tape, needed to show their animal's length.	**20 min**

3	**Creating a Bar Graph: Line up all the measurements to compare them** 1. When students have taken their measurements, each will have a string or sentence strip that is the length of their animal or a body part of their animal. Along with the string, they should write on a card or paper the name of their animal or animal part and its length/height. 2. Each pair shares out the animal or body part measurement they made. They can say the centimeters/meters or inches/feet. 3. Have students put all strings/sentence strips next to each other to compare the different animal sizes. 4. Give each student a piece of graph paper. On the paper, students should choose two animals to compare in a bar graph. One should be the animal or animal part they measured, and the second should be a comparable animal or animal part. (If the animals are large, students should make a scaled bar graph—one square on the bar graph might represent 2 feet.) Comparison examples: • The length of the stegosaurus and allosaurus and the length of an African elephant • The length of the Jurassic dragonfly wingspan and the length of the modern-day dragonfly wingspan • The length of the Juramaia and the length of the eastern gray squirrel • The height of a stegosaurus and the height of a 3rd grader 5. If there is time, have students calculate the difference in sizes for each of the animals on their graphs.	**20 min**

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Group Discussion: Class discussion on relative sizes

1. The class will discuss what they notice about the animals and their relative sizes.
2. Discuss what students notice about the lengths of the animals and about the differences of the measurements between today and the prehistoric period.
3. As a class, generate one shared claim about the various sizes of the different animals in both periods (i.e., insects were bigger during the Jurassic period, and my evidence is…; Mammals were a lot smaller in the Jurassic period than today. I think the reason was… and my evidence is….). Place the claim on the DQB.

Possible Discussion Prompts:

- *"How did the African elephant, the largest land animal today, compare with the stegosaurus and allosaurus? What does that tell you about land animals today and land animals during the Jurassic period?"*
- *"How did the Juramaia and the squirrel compare in length? What was the difference in their sizes? How did you figure this out? Why might the squirrel need to be larger to survive today?"*
- *"What was larger, the modern-day dragonfly or the Jurassic period dragonfly? What was the difference in their sizes? Why do you think that might be?"*
- *"What animals are about the same length? Do you think (based on the fact that they are about the same size) that they ate the same kind of food? Why do you think sizes of insects (larger) and mammals (smaller) during the Jurassic period helped animals to survive?"*

Discourse Move - Help students apply their thinking to others' ideas

Students should try to process what they hear and put up one finger if they agree, two if they disagree, and three if they have an idea that builds on the last one.

Suggested Prompt: *"What is a comparison that you expected? What is one that you did not expect? Can anyone use new words to explain why they agree with that idea?"*

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10 min

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5	**Wrap Up: DQB and overview statement for the learning set** 1. Generate one shared claim about the various sizes of the different animals in both periods. Focus on the idea that 1) animals change over time, and 2) changes in the environment cause animals to change. 2. Go to the DQB. Write down any new questions (or answers to questions) that arose from this investigation. 3. Optional reading for discussion, if the teacher determines that the students need a review of the learning set: Fossils Are Like Pieces of a Puzzle.	**5 min**

L5.5 Animal Measurements Chart

Animal Measurements Chart

(Measured in Inches and Feet)

Jurassic Period Animal	Body or Body Part Measurement	Modern-Day Animal	Body or Body Part Measurement
Allosaurus length	Typical length about 28 feet but could reach as long as 39 feet	African elephant	Typical length between 12 and 22 feet (Longer if you include the trunk!)
Stegosaurus length	As long as 30 feet		
Allosaurus tooth length	Between 2 and 3 inches	Siberian tiger tooth length	5 inches
	About 6 inches	Dragonfly wingspan	Between 2 and 5 inches

Jurassic dragonfly wingspan			
Juramaia length	Between 2 ¾ and 4 inches	Eastern gray squirrel length (head and body)	Between 8 and 10 inches
Stegosaurus height	14 feet	3rd grade student height	

Animal Measurements Chart: Teacher Key

(Measured in Inches and Feet)

Jurassic Period Animal	Body or Body Part Measurement	Modern-Day Animal	Body or Body Part Measurement
Allosaurus length 28 feet = 336 inches 39 feet = 468 inches	Typical length about 28 feet but could reach as long as 39 feet	African elephant 12 feet = 144 inches 22 feet = 264 inches	Typical length between 12 and 22 feet (Longer if you include the trunk!)
Stegosaurus length 30 feet = 360 inches	As long as 30 feet		
Allosaurus tooth length	Between 2 and 3 inches	Siberian tiger tooth length	5 inches
Jurassic dragonfly wingspan	About 6 inches	Dragonfly wingspan	Between 2 and 5 inches
Juramaia length	Between 2 ¾ and 4 inches	Eastern gray squirrel length (head and body)	8 to 10 inches
Stegosaurus height 14 feet = 168 inches	14 feet	3rd grade student height	

Note: Dinosaurs are typically measured by **length** instead of **height** because they did not stand up straight (they leaned forward).

Animal Measurements Chart

(Measured in Centimeters and Meters)

Jurassic Period Animal	Body or Body Part Measurement	Modern-Day Animal	Body or Body Part Measurement
Allosaurus length	Typical length about 8 ½ meters but could reach as long as 12 meters	African elephant	Typical length between 3 ½ and 6 ½ meters (Longer if you include the trunk!)
Stegosaurus length	As long as 8 or 9 meters		
Allosaurus tooth length	Between 5 and 10 centimeters	Siberian tiger tooth length	12 ½ centimeters
Jurassic dragonfly wingspan	About 15 centimeters	Dragonfly wingspan	Between 5 and 12 ½ centimeters
Juramaia length	Between 7 and 10 centimeters	Eastern gray squirrel length (head and body)	Between 23 and 30 centimeters
Stegosaurus height	4 meters	3rd grade student height	

Animal Measurements Chart: Teacher Key

(Measured in Centimeters and Meters)

Jurassic Period Animal	Body or Body Part Measurement	Modern-Day Animal	Body or Body Part Measurement
Allosaurus length 8 ½ meters = 850 centimeters 12 meters = 1,200 centimeters	Typical length about 8 ½ meters but could reach as long as 12 meters	African elephant 3 ½ meters = 350 centimeters 6 ½ meters = 650 centimeters	Typical length between 3 ½ and 6 ½ meters (Longer if you include the trunk!)
Stegosaurus length 8 meters = 800 centimeters 9 meters = 900 centimeters	As long as 8 or 9 meters		
Allosaurus tooth length	Between 5 and 10 centimeters	Siberian tiger tooth length	12 ½ centimeters
Jurassic dragonfly wingspan	About 15 centimeters	Dragonfly wingspan	Between 5 and 12 ½ centimeters
Juramaia length	Between 7 and 10 centimeters	Eastern gray squirrel length (head and body)	Between 23 and 30 centimeters
Stegosaurus height 4 meters = 400 centimeters	4 meters	3rd grade student height	

***Note:** Dinosaurs are typically measured by **length** instead of **height** because they did not stand up straight (they leaned forward).

Fossils Are Like Pieces of a Puzzle

To put together a puzzle, you have to figure out how the pieces fit together. When you finish the puzzle, you see the big picture.

Paleontologists (pay-lee-un-TOL-uh-jists) use fossils to piece together a picture of organisms and their habitats that no longer exist. They use fossils as evidence to make claims about the organisms. Sometimes those claims have to be changed as new evidence is found. That's what happened with the dinosaur known as the *iguanodon* (ig-WAN-uh-don). You can find out about the iguanodon by reading your parts below (Curious Students) and listening while your teacher reads the paleontologist part.

Curious Students: An iguana is a kind of lizard, right?

"San Salvador Rock Iguana" by James St. John is licensed under CC BY 2.0

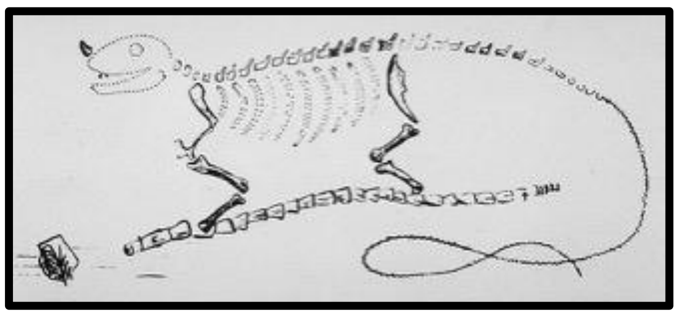
Iguana

Paleontologist: Yes. The iguana is a lizard with sharp teeth that can tear leaves. It can climb trees and runs on its four legs.

The iguanodon got its name because of Gideon Mantell, an Englishman who found fossils of the dinosaur's bones and teeth. He claimed that the iguanodon was like an iguana. He added “don” (which means “tooth”) to “iguana” because he claimed that the tooth fossils he found were like the teeth of an iguana—only about 20 times bigger.

Mantell’s wife also found a horn or spike fossil. Mantell thought the spike belonged on the head of the iguanodon because iguanas had spike-like structures on their head.

The first drawing below shows the slab of rock with the iguanodon fossils that Mantell used. The second drawing was done by Mantell. He claimed that the iguanodon walked on four legs and had a horn or spike on its head.

Iguanodon fossils (left); Mantell’s drawing of an iguanodon (right)

Paleontologist: Mantell published his claims in a paper in 1825. The paper included a drawing showing the iguanodon’s teeth and the teeth of an iguana.

Curious Students: So Mantell based his claim on the idea that the iguanodon was like a giant iguana?

Paleontologist: That's right. But that's not the end of the story.

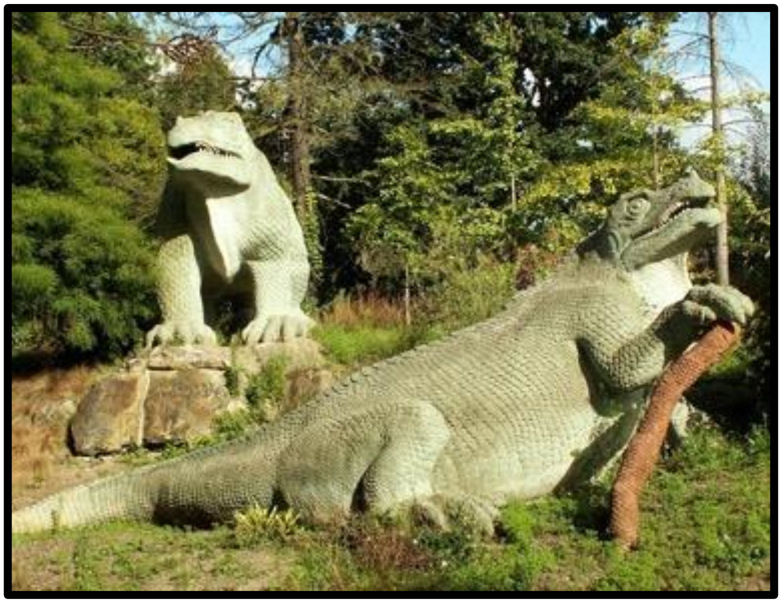
Curious Students: More evidence?

Paleontologist: Not really. Another idea about how the iguanodon looked and moved.

In 1842, Richard Owen was given a commission to create models of dinosaurs for an important exhibition. These models would be the same size as scientists believed the dinosaur to be.

Owen worked with an artist named Benjamin Waterhouse Hawkins. Owen told Hawkins to make the iguanodon model look like an iguana with thick legs to hold up its big body.

Hawkins used iron rods as a skeleton and painted pieces of cement for the skin. His models still stand in a park in England.



“Iguanodon Crystal Palace” by Jes is licensed under CC BY-SA 2.0

Iguanodon models

Curious Students: So Owen and Hawkins put skin and muscle on the iguanodon fossil?

Paleontologist: That’s exactly what they did. But they had no evidence for the thick legs or the horn on the head. And they didn’t know for sure that the iguanodon walked on all four legs like an iguana.

Curious Students: So what happened next?

Paleontologist: A trace fossil was found—footprints. The footprints showed feet with three toes. Close to the footprints was a fossil of the hind leg and foot of an iguanodon. Owen put the fossils together to claim that the iguanodon was a biped—an organism that walks on two feet or legs.

"Iguanodon Footprint" by Jurassicjay is licensed under CC BY-SA 3.0

Curious Students: So with more evidence, Owen could make a better claim about the iguanodon?

Paleontologist: Yes, but even better evidence had yet to be discovered. In 1878, several complete iguanodon skeletons were found in a coal mine in Belgium. These skeletons showed that the forelegs of the iguanodon were shorter than the hind legs. Also, the spike was not on the head but was a thumb claw.

Based on this evidence, Belgian scientists reconstructed the iguanodon skeleton and showed it standing on its hind legs. They thought the iguanodon was like a wallaby, which is similar to a kangaroo.

They claimed that the iguanodon walked on its hind legs and dragged its tail along the ground like a wallaby.

"Iguanodon bernissartensis" by Drow Male is licensed under CC BY-SA 4.0/Wallaby de Bennett Photo: Thomas Bresson

Curious Students: So that's what we see today in museums?

Paleontologist: Not quite. Scientists re-examined the Belgian skeletons and decided that the iguanodon mostly walked on all four of its legs. And it held its tail out straight.

In 1997, scientists at the European Association for Research in Legged Robots created a half-sized iguanodon robot. The robot moved the way the iguanodon would have walked.

So what puzzle pieces helped us to understand the iguanodon?

Curious Students: Fossils of iguanodon bones and teeth. Whole fossil skeletons. Trace fossils of footprints. Comparing fossils with animals living today—iguanas and wallabies. Even robots built like an iguanodon.

Paleontologist: Now you have the big picture.

Learning Set Driving Question
LS5: How can we use fossils to figure out how organisms change over long periods?

L5.6 Finding Fossils: SEL Literacy

Lesson Snapshot

Learning Set Driving Question
LS5: How can we use fossils to figure out how organisms change over long periods?

Lesson Driving Question
L5.5: Where have scientists and other citizens found fossils from the Jurassic period?
SEL: What do I want to know more about?

Lesson Overview

1. Introduction: Discuss the lesson DQ and review the climate chart that students created during LS4.
2. Shared Reading: Read *Stone Girl Bone Girl: The Story of Mary Anning of Lyme Regis.*
3. Video: Watch *Great Minds: Mary Anning*
4. Making Comparisons and Wrap Up: Add questions to the DQB that students are interested in. Then construct, discuss, and record a learning set "Big Idea" as a class.

Objectives

Learning Performance
Students will engage in texts and create an SEL argument about fossil findings and how they give clues to the past (through the lenses of *stability and change*; *systems and system models*; *structure and function*; and *scale, proportion, and quantity*).

SEL: Students can find answers to questions that interest them. They are intentional in fostering and extending their learning.

Building Toward PEs
3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all.
3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Students are figuring out that some of the fossils scientists have used to make claims about the climates of prehistoric times were discovered by	***Embedded Language Supports*** • Approach to organization of ideas from broad and general to specific

citizens, not by scientists. **SEL: Students are figuring out that** they can ask questions that are important to them and contribute to science. **Look Fors** **Look for** students providing examples of ideas in the unit that they find interesting and ways that they could learn more about the topics using the lenses of *structure and function*; *stability and change*; and *scale, proportion, and quantity*. **Evidence Statement** The information students provide from the story and video describe Mary's traits and her motivations to find fossils. The information is used to explain how her actions led to important discoveries for putting together environments in the past. The information employs at least one of the following crosscutting concepts: *structure and function*; *stability and change*; and *scale, proportion, and quantity*.	• Multiple domains for language learning • Discourse moves from WIDA

Teacher Preparation	Materials
• Number the pages of this book, so the first page is the title page. • Set up the video: *Great Minds: Mary Anning*	***Teacher Materials*** • Driving Question Board (DQB) • Video clip about Mary Anning's life and discoveries: *Great Minds: Mary Anning* • *Stone Girl Bone Girl: The Story of Mary Anning of Lyme Regis* by Laurence Anholt • Interactive reading guide for *Stone Girl Bone Girl* • Writing Prompt (find two other video options in the interactive reading guide) • **Other options for children's books about Mary Anning include the following:** *Mary Anning and the Sea Dragon* by Jeannine Atkins (Author) and Michael Dooling (Illustrator) OR *Rare Treasure: Mary Anning and Her Remarkable Discoveries* by Don Brown ***Student Materials*** • Science notebooks

Lesson Segments	Estimated Time
Introduction	10 min
Shared Reading	20 min

Making Comparisons	10 min
Wrap Up	5 min
This 45-minute lesson could be integrated into the Literacy Block.	**Total Time:** 45 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and DQ, *“Where have scientists and other citizens found fossils from the Jurassic period?”*** 1. Remind students of the unit DQ. Review or remind them of some of the claims they made during the previous lesson. 2. Review the climate posters that students have been working with, and ask students to summarize what they have learned about the prehistoric environments and how those environments and organisms in those environments changed over time (emphasize the lenses of *scale, proportion, and quantity* and *stability and change*). 3. Ask students to summarize what they have learned so far about how scientists have used fossils to learn about the organisms that lived during different periods, the environments in which they lived, and how organisms change over time (*stability and change*). 4. Introduce the lesson DQ.	**10 min**

2	**Shared Reading: Read shared text** 1. Introduce the reading about Mary Anning, who lived in England from 1799 to 1847. She was one of the first paleontologists, which is even more impressive because she was a woman. She lived in Lyme Regis, a town on the southern coast of England. The cliffs at Lyme Regis have been called the Jurassic Coast because so many fossils from the Jurassic period have been discovered there. Mary and her family discovered many of those fossils. 2. Read aloud the story *Stone Girl Bone Girl* (or one of the alternative options). As you read, help students begin to identify Mary's character traits and motivations that led her to search for fossils. See the interactive reading guide for suggested prompts, questions, and additional resources to engage students in discussion during before, during, and after reading. 3. After reading, refer back to the timeline from L4.1 and allow students to identify when the Jurassic period occurred on the timeline in relation to when Mary Anning discovered fossils (*scale, proportion, and quantity*). Prompt students to *turn-and-talk* with a partner before sharing out with the class about how Mary's fossil discoveries provided evidence of the environment and organisms that lived long ago during the Jurassic period (*systems and system models*; *stability and change*). **Suggested Prompt:** *"How did the fossils Mary discovered give evidence about life in the Jurassic period?"* Encourage students to draw on other evidence they have explored, throughout the unit, about the environment and organisms that lived during the Jurassic period (e.g., time period posters, Jurassic organism readings, Juramaia survival model) to support their ideas. Emphasize when an idea employs the lenses of *stability and change*; *systems and system models*; *structure and function*; or *scale, proportion, and quantity*, and leverage the students' ideas to explain how the lens is being applied).	**20 min**

3	**Making Comparisons: Consider ideas and characters in the text** 1. After concluding the interactive reading, show the video about Mary Anning's life. Pause the video periodically as it plays to check for comprehension and ask questions that support students in making connections between the information in the story, *Stone Girl Bone Girl* (or one of the alternative options), and the information in the clip. Also, pause the video to allow students to observe and analyze the structures of the ichthyosaur skull (1 minute, 50 seconds) and plesiosaur fossil (3 minutes, 00 seconds) that Mary Anning found (*structure and function*). **Suggested Prompts:** "*What structures do you notice? What do the structures tell you about the environment where this organism lived? What do these structures tell you about how this organism might have survived in its environment?"* 2. After watching the video, ask students to compare the story with the information in the video, identifying similarities and differences in key details. Were there differences between the story they read and the video they watched? Ask students to identify evidence in the story and video to support their responses. 3. Next, ask students what they noticed about Mary Anning's character. **Suggested Prompts:** *"How would you describe Mary? What kinds of qualities (or traits) did you notice?"* 4. Emphasize ideas that students provide about the development of Mary's interests and motivations in finding fossils and her agency in continuing to find fossils even after her father died. • As one of the formative assessments for this lesson, students may respond in writing to the prompt that asks them to describe Mary's traits and motivations to search for fossils and to explain how her actions led to important discoveries. You may choose to allow students to share their responses if time allows.	**10 min**

4	**Wrap Up: Make connections and DQB** 1. Ask students what they can learn from Mary's story and apply to their own lives. In other words, what can students learn about their own ability and agency to pursue their interests even when faced with obstacles? Allow students to share ideas and briefly discuss before wrapping up the lesson. 2. Remind students that when they learn more about their topic or question, they can add this information below their question on the DQB. 3. Look over the class-made claim students created in L5.4. Ask the class to add any revisions or additions to the claim. 4. Look over and review the lesson DQ. Decide as a class how to describe a "Big Idea(s)" for the whole learning set. Add this idea to the oval on the DQB. Also, add the same "Big Idea" for the overarching theme to this slide.	**5 min**

Interactive Reading Guide for
Stone Girl Bone Girl: The Story of Mary Anning of Lyme Regis
Laurence Anholt (1999)

Materials and Preparation

- *Stone Girl Bone Girl: The Story of Mary Anning of Lyme Regis* by Laurence Anholt (1999). Number the pages of this book so that the first page is the title page.
- Video, *Why You Should Know the Princess of Paleontology*, produced by the Smithsonian Institution that provides information about Mary Anning's discovery of the pterosaurus (3 minutes, 49 seconds)
- Video, *Mary Anning: Sea Monster Hunter*, produced by Past Time, Stony Brook University, that provides information about Mary Anning's life and discoveries (4 minutes, 30 seconds)
- Video, *Great Minds: Mary Anning "The Greatest Fossilist in the World"*, that provides information about Mary Anning's life and discoveries (4 minutes, 29 seconds)

Introduction

There are several options regarding how to introduce and use this text. One option is to show the first 1 minute and 44 seconds of this video (Why You Should Know the Prolific Princess of Paleontology). It can serve as a hook for the text.

The second option is to begin with the text. Share with students that Mary Anning, who lived in England from 1799 to 1847, was one of the first paleontologists. *Paleo* is the Greek word for *ancient*. A paleontologist is someone who studies ancient life by studying fossils. Mary lived in Lyme Regis, a town on the southern coast of England. The cliffs at Lyme Regis have been called the Jurassic Coast because so many fossils from the Jurassic period have been discovered there. Mary and her family discovered many of those fossils.

Today, students will listen to a story about Mary Anning. The story is not a biography, so some of the information about Mary Anning has been crafted and changed by the author. The changes will be discussed after reading.

Interactive Reading Guide for
Stone Girl Bone Girl: The Story of Mary Anning of Lyme Regis

Text	Interactive Discussion Prompts/Questions
Book cover, endpapers, title page	• Open the book so you can display the front and back covers. • Read the title, author, and illustrator. • Explain that the illustration shows the location of Lyme Regis, which is on the southern coast of England. • Mary and her dog are standing on a cliff above many layers, which cover the plants and animals of the Jurassic period. • Show the endpapers, which pick up on the layers of Lyme Regis. • Then show the title page spread, which shows Mary walking along the shore. Ask students to notice what Mary is carrying (small hammer and a book).
pages 2–3	• Read page 2 and show the illustration. • Share that the majority of people who are struck by lightning do survive, but they can be affected in different ways, and some do die.
pages 4-5	• Read page 5 and show the illustration. • What kind of a place is Lyme Regis (cliffs by the sea, land sloping down the cliffs to the shore)?
pages 6–7	• Read pages 6 and 7 and show the illustration. • What was the Curiosity that Mary's father had found (a fossil)? • Why do you think he called it a Curiosity? (Curious people are people who notice things and ask questions. A *curiosity* is something rare, unusual, or intriguing. It raises questions in the minds of curious people.)
page 8	• Read page 8 and show the illustration. • Why do you think people gave names like Thunderbolts and Devil's Toenails to the treasures that Mary and others found? (They probably didn't understand what they really were, so they gave them names based on what they looked like or reminded them of.)
page 9	• Read page 9 and show the illustration.
pages 10–11	• Read page 10 and show the illustration. • Mary is excited to meet the Philpot sisters because they too are interested in Curiosities. But what does she learn from them? (The Curiosities are really fossils.)
pages 12–13	• Read pages 12 and 13 and show the illustrations.

Co-developed by the Multiple Literacies in Project-based Learning Project at Michigan State University and the University of Michigan 2018–2019

	• What does Mary learn from the Philpot sisters? (Fossils are the remains of sea creatures preserved in clay. They had a giant tooth fossil that they believed was from a giant sea monster that was yet to be found.)

Text	Interactive Discussion Prompts/Questions
pages 14–15	• Read page 14 and show the illustration. • Why do you think Mary was so glad to find the dog? (Mary spent much of her time alone. “Out on your own, girl.” She had no friends and her father was gone, so the dog was important to her.)
pages 16–17	• Read pages 16 and 17. • What was Mary’s plan and how did it turn out? (She decided to try to sell her Curiosities and people bought them. The money helped her family to survive.)
pages 18–19	• Read page 18 and show the illustration. • So Mary is learning about fossils and the creatures that had once lived near Lyme Regis.
pages 20–21	• Read page 20 and show the illustration. • Share that a quarry is a deep pit where rocks are extracted. The limestone rocks in Lyme Regis were used in buildings. *Quarrymen* are the workers who extract the rocks. • What did Mary think she had found (the skeleton of the sea monster she had been thinking about)?
pages 22–23	• Read page 23 and show the illustration. • Notice how many quarrymen were needed to carry the fossil. • You can see Mary with her dog and the Philpot sisters in the illustration. • At this point, no one would really know how old the fossil was (165 million years).
page 24	• Read page 24 and show the illustration. • Why was the fossil so important? (It was a complete skeleton.) • Why did scientists call the fossil *icthyosaurus*? (*Ichthyosaurus* means “fish lizard,” and the fossil looked like a fish.)
page 25	• Read page 25 and remind students that the book is a story, not a biography. • According to several sources, Mary’s brother Joseph was the one who found part of the icthyosaurus fossil. Mary’s mother was also a fossil hunter. • Although the ichthyosaurus fossil is perhaps the most famous fossil associated with Mary Anning, her discovery of the plesiosaurus fossil,

	another reptile that lived in the sea, was also important. She also discovered a fossil of the *pterosaurus*, which means "winged reptile," a flying dinosaur.

Wrap Up

Share additional video clips with students, and invite them to compare the information in the videos and the information in the story about Mary Anning.

- Video, *Why You Should Know the Princess of Paleontology*, produced by the Smithsonian Institution that provides information about Mary Anning's discovery of the pterosaurus (3 minutes, 49 seconds)
  https://www.youtube.com/watch?v=itN4sv25UvE
- Video, *Mary Anning: Sea Monster Hunter*, produced by Past Time, Stony Brook University, that provides information about Mary Anning's life and discoveries (4 minutes, 30 seconds)
  https://www.youtube.com/watch?v=fDEYD-Jk_Hk
- Video, *Great Minds: Mary Anning "The Greatest Fossilist in the World*, that provides information about Mary Anning's life and discoveries (4 minutes, 29 seconds)
  https://www.youtube.com/watch?v=jBuc8VnZShY

Students May Notice That

- The videos emphasize that although the story focused on the icthyosaurus, Mary Anning's discoveries of other fossils were also important, especially the fossils of the plesiosaurus and the pterosaurus.
- The Past Time video emphasizes the importance of Mary's work in helping people understand that the organisms of the past were not the same as the organisms that live today. This planted the seed that organisms changed over time, which was an important idea developed by Charles Darwin.
- The Past Time video also emphasizes the struggle Mary had in having her work acknowledged by scientists because she was a woman and had no scientific degree.

L5.5 Writing prompt

Stone Girl Bone Girl: The Story of Mary Anning of Lyme Regis

Characters in a story do, feel, say, and think things just like people in real life. Characters' actions tell us what kind of people they are. For example, the things a character does can tell us if the character is happy, sad, curious, determined, excited, or that they don't give up when things are tough. When we say that a character is happy or creative, we are describing the character's traits.

What do Mary Anning's actions tell us about her character traits?

Mary's Traits	What Did Mary Say or Do To Show This Trait?

Describe what motivated Mary to search for fossils.

____

____

____

How did Mary's actions in the story lead her to make important discoveries?

____

____

____

What is something you have been learning about in science that you think is interesting and would like to learn a lot more about?

____

____

____

You may draw a picture of what you described in the box as follows.

Learning Set 6

LS_6 My Notes Tab
Learning Set #6
Learning Set Driving Question: Why did some animals die out and some live?

Lesson Abridged Comments:

Learning Set Description: (ML-PBL to create)
1. **L6.1:** The students review charts to discuss differences and speculate on changes that could have happened. They write a short story of what happened to the stegosaurus and the Juramaia. The students will create and use charts to discuss differences and consider changes that could have happened. They write a short story of what happened to the stegosaurus and the Juramaia. They share their stories in small groups. The groups choose one story to act out.
2. **L6.2:** Modeling (acting, pictures) using evidence to describe what structure/environment/part of life cycle allowed the squirrel to adapt and not the stegosaurus. Students share artifacts and invite critique or questions and then fix one thing. .SEL focus lesson: The students write a sketch, act out the story and make a model explaining the factor in the environment that changed and impacted the stegosaurus to not survive, but at the same time, did not have the same effect on the early eutherian mammal.
3. **L6.3:** Bringing it all together and why the stegosaurus died out and why the eutherian mammal survives. Literacy Lesson: Students are given a scenario and draw a picture with labels of how they think the squirrel would change. Students share pictures and reasoning.

Phenomenon: There are lots of squirrels around today, but no stegosauruses.

Learning Performance: *Students will* communicate information and develop and revise a model to argue that the extinction event of the stegosaurus was caused by changing environment making it impossible for it to meet at least one need. (through the lenses of systems and system model and cause and effect).

Figuring Out Statement/ DCI:
The students figure out that the climate and the environment changed during the Jurassic period and may have caused some animals to die out and others to survive. The reasons have to do with the animals' needs, how they meet those needs, and the changing environment, which kept them from meeting at least one basic need. (cause and effect)

Practice Statement
Students are synthesizing all of what they have learned in the unit to create a story (in writing and on a model) of the extinction of the stegosaurus and the adaptation, and continued survival of the squirrel-like organism.

Practice Elements from NGSS
Developing and Using Models: Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.

Engaging in Argument from Evidence: Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.

Obtaining, Evaluating, and Communicating Information: Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Crosscutting Concepts

Systems and System Models: A system can be described in terms of its components and their interactions.

Cause and Effect/Mechanism and Prediction: Cause and effect relationships are routinely identified, tested, and used to explain change.

LS_6 Educative Supports

Lesson 1

- Multiple domains for language development
- Use of models to support the practice of constructing explanations
- Support for comprehensible input through posters, photos and graphic displays
- Discourse moves from WIDA

Lesson 2

- Multiple domains for language development
- Use of overarching structure to organize thinking
- Support for metacognitive reflection
- Comprehensible input scaffold through posters, photos, and graphic displays
- Discourse moves from WIDA

Lesson 3

- Multiple domains for language development
- Use of a model to support the practice of constructing explanations
- Support for comprehensible input through photos and graphic displays
- Discourse moves from WIDA

Learning Set Driving Question
LS6: Why did some animals die out and some live?

L6.1 Survival and Extinction Stories

Lesson Snapshot

Learning Set Driving Question
LS6: Why did some animals die out and some live?

Lesson Driving Question
L6.1: How can we bring together everything we know to answer our Driving Question?

Lesson Overview

1. Introduction: Read the lesson DQ together. The teacher displays all the models, charts, and claims generated or used in the units.
2. Sharing Ideas: Students write down their ideas about changes that could have occurred that caused the Juramaia, or other early eutherian mammals, to adapt and live, and the stegosaurus to become extinct.
3. Shared and Independent Writing: The teacher models a quick write showing how to write the story of what happened to the stegosaurus and the squirrel. Students independently write their own stories about what happened to the stegosaurus and the squirrel.
4. Sharing in Small Groups: Students share their stories in small groups. They choose one story to act out for the rest of the class. Students share their dramas.
5. Wrap Up: DQB: Review vocabulary from the DQB to see if any of those words can be used to revise sections of the stories presented.

Objectives

Learning Performance
Students will write a story that explains that the extinction event of the stegosaurus was caused by changing environment, making it impossible for it to meet at least one need (through the lenses of *systems and system models* and *cause and effect*).

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out 1. **Students are figuring out that** the climate and the environment (including the plants and animals in the environment) changed during the Jurassic period and caused some animals to die out and others to survive. 2. **Students are figuring out that** the reasons for survival have to do with the changing environment (climate, other organisms moving in and replacing food sources, predators changing, etc.) favorably	***Embedded Language Supports*** • Multiple domains for language development • Use of models to support the practice of constructing explanations • Support for comprehensible input through posters, photos and graphic displays • Discourse moves from WIDA

interacting with animals (i.e., providing new niches) and adaptation; inability to survive was caused by changes that resulted in organisms not being able to meet at least one basic need. **Look Fors** 1. **Look for** students discussing relationships between organisms and their environment (*systems and system models*) and causality to their stories. 2. **Look for** students offering more than one idea for the same phenomenon. 3. **Look for** students' stories to include *cause and effect* events that can be used to explain why the stegosaurus became extinct. **Evidence Statement** The story describes how the stegosaurus couldn't meet its needs, but the Juramaia (eutheria) could because of how the environment was changing. The language in the story uses the lenses of *systems and system models* and *cause and effect*. The story includes at least one piece of evidence of the changing world and how the stegosaurus was affected by this change and how the eutheria was not affected and was able to survive.	

Teacher Preparation	Materials
• Look over some of the science notebooks so you can have a good idea of what you may need to address before starting the story. • Have a comparison template ready for all students or those who may be struggling with the writing. • ***Background Material:*** ○ "Stegosaurus Facts: Fossils Found on Four Continents";"Stegosaurus" **Note:** Stegosauruses lived all over the planet, similar to squirrels today. But they became extinct, and the science community is undecided about the cause. Scientists suggest different reasons for why the stegosaurus became extinct millions of years before the volcanic activity: 1) Herding was interfered with by the increasing number of trees on Earth, making the stegosaurus vulnerable to predators. 2) The seasonal changes became too extreme. 3) The increasing number of trees caused fewer ferns and similar plant foods to grow. In contrast, the Juramaia was	***Teacher Materials*** • Driving Question Board (DQB) ***Student Materials*** • Science notebooks, climate posters, and all texts • "Interactions" models of the squirrel and the Eutheria • "Structure" model of the Juramaia and the squirrel • Claims posters from LS2, LS3, LS4, and LS5

able to occupy new niches (nocturnal and arboreal) and escape predators because of its size and tree adaptation. **Note:** This extinction was **not** a mass extinction event, although mass extinctions did occur. This extinction event mysteriously occurred before the comet and/or volcanic activity that followed the Triassic–Jurassic extinction and preceded the Cretaceous–Paleogene extinction.	

Lesson Segments	Estimated Time
Introduction	10 min
Sharing Ideas	10 min
Shared and Independent Writing	20 min
Sharing in Small Groups	15 min
Wrap Up	5 min
	Total Time: 60 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and introduce the DQ, *"How can we bring together everything we know to answer our Driving Question?"*** 1. Ask students to *turn-and-talk*, "*Can you answer the Driving Question? What else do you need to know*?" 2. Place and display (or make available around the room) all the artifacts and texts. Ask students to examine all of them. Work together to describe the artifacts. 3. With students, consider which changes could have taken place that might have caused the stegosaurus to become extinct but the Juramaia to survive. 4. Remind students what you learned in all the Learning Sets by reading the end of learning set claims. Also, point out the changes in the environment and in the plants and animals throughout the Jurassic period (more trees, more carbon dioxide but decreasing over time; increasing highs and increasing lows (seasons) in temperature across the planet).	**10 min**
2	**Sharing Ideas: Independent claims of important changes** 1. Distribute index cards or sentence strips, and ask students to write down important changes. 2. When they are finished with one or two ideas, collect the ideas, read them out loud, and display them in a prominent place in the room.	**10 min**
3	**hared and Independent Writing: Science "story" writing** 1. Show students in a quick write how they could use one of the changes to write a story of what happened to the Juramaia (eutheria) and the stegosaurus. 2. Write down some of the students' ideas and solicit more ideas until you have a lot of different changes. As students suggest ideas, have volunteers act out the ideas to support comprehension. Point out the crosscutting concepts that are being used: "This idea uses the lenses of *systems and system models* and *cause and effect*. Can anyone explain how they use these lenses?" 3. Give students 20 minutes to independently or collaboratively write their own stories in their science notebooks.	**20 min**

4	**Sharing in Small Groups: Share explanations of causality** 1. Students share their stories in small groups and choose one to act out or model in some other way (sketches, models, or dramatizations). 2. Some students share out about the stories they read or wrote.  **Discourse Move - Help students listen carefully and think about one another's ideas** **Assign Evidence Checkers:** *After each student reads what they have written (or shows it on the overhead projector), two additional students will be invited to consider if the story includes evidence.*	**15min**
5	**Wrap Up: Revisit the DQB** 1. Add questions and/or answers and any vocabulary to the DQB.	**5 min**

Learning Set Driving Question
LS6: Why did some animals die out and some live?

L6.2 Model Explanation - LS Claim

Lesson Snapshot

Learning Set Driving Question
LS6: Why did some animals die out and some live?

Lesson Driving Question
L6.2: How can we use our model to explain our thinking about what happened to the stegosaurus?
Note: This lesson takes two to three class periods.

Lesson Overview
1. Introduction: Have the students read the lesson DQ. Tell students that today they will act out the story chosen by their group.
2. Shared Modeling, Sketching, or Acting: Students work in small groups to make a model of one of their "extinction stories" or explanations (e.g., this can be a written model, they can create a presentation on a slide show, PowerPoint, create a skit with explanations).
3. Presentations: Each group will present their story to the class.
4. Wrap Up: Large group *whip-around*: All students share what they are doing for their model and ask any questions and give suggestions to other groups that may need support.

Objectives

Learning Performance
Students will communicate ideas to explain that the extinction event of the stegosaurus was caused by the changes in the environment, making it impossible for it to meet at least one need (through the lenses of *systems and system models* and *cause and effect*).

SEL Learning Performance - Belongingness
We ensure that everyone in our group is actively involved in the meaning-making and that all contributions are valued. We act so that others in our class are emotionally safe.

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out 1. **Students are figuring out that** the climate and the environment (including the plants and animals in the environment) changed during the Jurassic period and caused some animals to die out and others to survive. 2. **Students are figuring out that** the reasons for survival have to do with the changing environment (climate, other organisms	***Embedded Language Supports*** • Multiple domains for language development • Use of overarching structure to organize thinking • Support for metacognitive reflection • Comprehensible input scaffold through posters, photos, and graphic displays • Discourse moves from WIDA

moving in and replacing food sources, predators changing, etc.) favorably interacting with animals (i.e., providing new niches) and adaptation; inability to survive was caused by changes that resulted in organisms not being able to meet at least one basic need. **SEL: Students are figuring out that** they can all contribute and include all ideas. **Look Fors** 1. **Look for** students including in their models a connection between the change in the environment and the squirrel or stegosaurus responding to the change (*cause and effect*). 2. **Look for** and support students intentionally including another student in their work on the artifact or their discussion. **Evidence Statement** The artifact describes how the stegosaurus couldn't meet its needs, but the Juramaia (Eutheria) could because of how the environment was slowly changing and the Eutheria was adapting. The language in the model explanation and the way the interactions are depicted use the lenses of *systems and system models* and *cause and effect*. The model shows at least one piece of evidence of the changing world and how the stegosaurus was affected by this change and how the Juramaia (Eutheria) was not affected and was able to survive.	

Teacher Preparation	Materials
• Be ready to define the expectation for the final artifact (must include evidence, must cite sources, must allow for more than one point of view, etc.). • Write down each of the learning set DQs on big chart paper, or use this slide.	***Teacher Materials*** • Driving Question Board (DQB) ***Student Materials*** • Students' stories from the previous two lessons • Materials for creating some plays • Science notebooks or large poster paper for creating models as a group

Lesson Segments	Estimated Time
Introduction	20 min
Shared Modeling, Sketching, or Acting	20 min

Presentations	30 min
Wrap Up	30 min
Portions or all of this 100-minute lesson could be integrated into the Literacy Block.	**Total Time:** 100 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and introduce DQ, *"How can we use our model to explain our thinking about what happened to the stegosaurus?"*** 1. Read the lesson DQ as a class. Ask what students think they will be doing for the next few days. 2. Explain to the class that no scientist knows for sure why the stegosaurus became extinct. Stegosauruses were everywhere across Eurasia and North America, then millions of years before the comet hit the planet, the stegosauruses died out. 3. Remind students that during the last class, they decided which of the stories their group had written would be acted out by the group. 4. Do a "check-in" to make sure everyone knows which story and which group they are in. 5. Give students the parameters for their final artifacts. 6. Inform students that one option for their final artifact is to create a model. Invite students to share the different models they created during the unit and the reasons for making them (what did students use the models for?). As a class, record a list of characteristics for models (shows a system, interactions among parts of the system), forms they take (i.e., drawings, physical objects), and ways they are used (to explain or test ideas, share thinking, receive feedback). Keep this list of students' thinking to revisit and add to over the year as students continue to use and construct different models. 7. Solicit some suggestions for how students can show the comparison for what happened with respect to the two animals and how they might show the change in the environment (change in organisms, temperature, land use, vegetation, climate).	**20 min**

2	**Shared Modeling, Sketching, or Acting: Students create their skits or models in small groups** 1. Students work on getting the skits ready to perform for the class. During the preparation, focus on belongingness, and call out situations where students intentionally include another student. Describe what you observed, and name the move as important for doing the work of scientists and communicating ideas. You may choose to stop the class and discuss how important the move was for the work that is taking place. 2. Remind students that they need to have all the important details in their story. **Discourse Move - Emphasize a particular idea**  • **Possible Teacher Questions:** *"How can you show in your artifact that an environmental factor has changed? How are you going to show the changes in behavior the squirrel and the stegosaurus needed to make, or were unable to make, to survive?"*	**20 min**
3	**Presentations: Students share their models** 1. In their groups, students present to the class. 2. After presenting, the group picks one audience member to "tell the story" as they understand it. 3. The students who put on the skit can make any corrections or clear up any confusion at this time.	**30 min**

4	**Wrap Up: Students create a claim for the Learning Set** 1. This will be a quick *whip-around*. Students share appreciation of how someone else worked with them cooperatively. 2. Students create a claim for the learning set in one or two sentences, trying to incorporate all the students' ideas. 3. Read through the learning set questions that are listed on the chart papers or blank sheets of paper. • **LS1: What do squirrels need to survive?** • **LS2: How is the squirrel's structure unique and important?** • **LS3: What other organisms live in the squirrel's environment, and does the squirrel need them to survive?** • **LS4: How do scientists use evidence from the past and present to find out about the prehistoric organisms?** • **LS5: How can we use fossils to figure out how organisms change over long periods?** • **LS6: Why did some animals die out and some live?** 4. Have students divide into groups to write and draw their new thinking about each learning set DQ. They should explain what they did during that learning set to support the new ideas. 5. Ask each group to present their learning set DQ poster. Explicitly point out instances where students use the crosscutting concept lenses of *systems and system models* and *cause and effect*. Say, "This idea uses *cause and effect*. Can you describe how?" 6. Go back to the unit DQ. Have a few students share out, using the posters to support their idea. 7. Write these generalizations on the board, and discuss what each generalization means. • **Generalization(s):** Survival depends on change (adaptation). Change in the environment causes change in populations of organisms. Ask students to quick write about something they thought was important that they learned in the unit and something that they enjoyed doing. Then they should add any questions they still have.	**30 min**

Learning Set Driving Question
LS6: Why did some animals die out and some live?

L6.3 Koala Survival Story

Lesson Snapshot

Learning Set Driving Question
LS6: Why did some animals die out and some live?

Lesson Driving Question
L6.3: How can we use what we've learned to figure out why other organisms survived or became extinct?

Lesson Overview

1. Introduction: Read the lesson DQ together. Briefly review some of the "extinction stories" or explanations that students presented, as well as the generalizations the class developed in L6.2.
2. Interactive Reading and Discussion: Engage students in an interactive read aloud about another species—the koala—that, like the squirrel, managed to survive after major changes in its habitat.
3. Discussion and Making Comparisons: After the interactive reading, students discuss how they think the organisms in the text are similar to the squirrel and stegosaurus, and they make claims about why some organisms survive changes in the environment and others die out.
4. Wrap Up: Students do a quick write or draw comparing the survival stories of the squirrel and the koala or the extinction stories of the stegosaurus and large species from Australia.

Objectives

Learning Performance
Students will make claims that changes in the environment caused some organisms to die out because they could not meet some of their needs, whereas the koala survived (through the lenses of *systems and system models* and *cause and effect*).

Figuring Out, Look Fors, and Evidence Statements	Universal Supports
Figuring Out 1. **Students are figuring out that** the climate and the environmental (including the plants and animals in the environment) changes in Australia thousands of years ago may have caused some animals to die out while others survived. 2. **Students are figuring out that** changes in the environment (climate, other organisms moving in and destroying food sources or habitat, predators changing, etc.) and species' ability to respond to those changes affect survival; species must be able to meet their basic needs in	***Embedded Language Supports*** • Multiple domains for language development • Use of a model to support the practice of constructing explanations • Support for comprehensible input through photos and graphic displays • Discourse moves from WIDA

order to survive. **Look Fors** 1. **Look for** students discussing relationships between organisms and their environment (*systems* and *cause and effect* relationships) as they read and discuss the text. 2. **Look for** students' whole-class and small group contributions to discussion to include *cause and effect* relationships that can explain why the koala survived and to compare the story of the koala to what happened to organisms from the Jurassic period. **Evidence Statement** Students' discussion during the interactive read aloud and claims describe how the large species in Australia couldn't meet their needs but the koala could because of how the environment was changing. The ideas and claims that students share use the lenses of *systems and system models* and *cause and effect*. The writing or drawing includes at least one piece of evidence about the changing environment and how the large species in Australia were affected by this change and/or why the koala was able to survive.	

Teacher Preparation	Materials
• Read the text and interactive reading guide to prepare for enactment. • If you have a globe or world map in your classroom, you may want to have it available during reading to allow students to locate Australia.	***Teacher Materials*** • Driving Question Board (DQB) • The Koala: A Success Story! (text) • Interactive reading guide for The Koala: A Success Story! • "Structure" models of the Juramaia and the squirrel • Models produced in L6.2 • Students' extinction stories or explanations • Claims posters from LS2, LS3, LS4, and LS5 ***Student Materials*** • The Koala: A Success Story! (text) • Science notebooks • "Interactions" models of the squirrel and the Eutheria

Lesson Segments	Estimated Time
Introduction	10 min

Interactive Reading and Discussion	30 min
Discussion and Making Comparisons	15 min
Wrap Up	5 min
This 60-minute lesson could be integrated into the Literacy Block.	**Total Time:** 60 min

Part	Lesson Steps	Estimated Time / Materials
1	**Introduction: Engage with phenomenon and introduce DQ, *"How can we use what we've learned to figure out why some organisms survived or became extinct?"*** 1. Remind students that they have been working together to figure out what changes might have taken place in the Jurassic environment that could have caused the stegosaurus to become extinct but the Juramaia to survive. 2. Revisit some of the extinction stories or explanations that students presented and the generalizations that the class developed in L6.2. 3. Tell students that today they are going to read a success story about another organism - the koala—that, like the squirrel-like organism, managed to survive after major changes in its habitat. Students will use their learning from the unit to figure out what the squirrel and koala had in common that allowed them to survive when other organisms, like the stegosaurus, died out.	**10 min**
2	**Interactive Reading and Discussion: The Koala: A Success Story!** 1. Introduce the reading about the koala: The Koala: A Success Story! 2. Engage students in an interactive read aloud of the text. See the interactive reading guide for prompts and questions to support students in discussing the ideas in the text and make connections to their learning throughout the unit. Tell students that you will read aloud and pause to ask about their thinking and discuss ideas in the text, as students follow along using digital or printed copies of the text.	**30 min**

3	**Discussion and Making Comparisons: Compare the koala and other organisms in the text with the Juramaia and stegosaurus** 1. After reading, ask students to *turn-and-talk* about why scientists think the koala survived, but some other organisms did not. 2. Call on students to share their ideas with the class: ● **Suggested Prompts:** *"What changed about the environment in Australia? Why do scientists think the koala survived those changes? Why do scientists think the large species did not survive those changes?"* **Discourse Move - Make ideas public**  ● Write down students' ideas and invite more ideas until you have recorded several changes to the environment and how they affected the organisms in Australia. 3. Point out the crosscutting concepts that are being used: *"These questions use the lenses of ecosystems and cause and effect."* 4. With a partner, have students revisit their extinction stories or explanations: *"What is similar about their survival stories of the koala and the Juramaia?"* Then ask students to make claims about why some of the very large species in Australia (described in the text) and the stegosaurus were not able to survive in their habitats: *"What was similar about the large species and the stegosaurus? How did changes in the environment cause some organisms to die out?"*	**15 min**
4	**Wrap Up: Write or draw** 1. Students quick write or draw their response to one of the following questions: • *"What changed about the environment in Australia? Why do you think the koala survived those changes?"* • *"What changed about the environment in Australia? Why do you think the large species did not survive those changes?"* 2. If time allows, invite students to share what they wrote or drew with the class.	**5 min**

L6.3 Koala Interactive Reading Guide

Interactive Reading Guide for The Koala: A Success Story!

This text is included at the end of this unit because it provides a rich opportunity for the students to draw on several of the ideas they have been working with across the unit. In this text, the students read about another species—the koala—that, like the squirrel, managed to survive after a major change in its habitat. Students learn

- About the koala's traits and how those traits support its survival.
- About the unique habitat of the koala (the eucalyptus tree) and the key role it has played in the survival story.
- How scientists have used what evidence there is from 45,000 years ago to think through what might have happened to the other 23 species that lived at the same time as the koala and yet did not survive the major change to their habitat.
- What still threatens the survival of the koala.

The focus of the talk should be on supporting students to bring their rich background knowledge to this reading and to make connections between ideas they have been encountering throughout the unit and the ideas they encounter in this text. As always, the ideas in the second column are provided to support your discussion of the ideas in the text, but we know that you will bring your own knowledge of your students to this discussion.

Text	Ideas to Support Discussion of the Ideas in the Text
The Koala: A Success Story! Here is a mystery for you. Many thousands (45,000) of years ago, the koala (koe-wa-la) lived with 23 other species of animals on the continent of Australia. Today, it is the only surviving species in Australia from that period.	You might stop to ask the students what surprising information we learn in this paragraph.
Think about all you have learned about how organisms survive in their environment. Look closely at the pictures of the koala and its habitat. What do you think could explain how the koala survives? Why would it be the only species to survive from that period? What happened to the rest of the species?  	Given the students' experiences looking closely at living organisms to identify *structure and function* relationships, the students can be encouraged to study the two images and share what they notice (e.g., the claws on the koala that are useful for climbing, the fact that it appears to hang out in trees like squirrels).

The koala and its habitat[1]	
The hero in our survival story The koala is a very unlikely hero. When they are first born, koalas are the size of a jelly bean. They cannot see. They cannot hear. They have no fur. As soon as it is born, using the senses it does have (touch and smell), as well as its strong legs and tiny claws, the koala moves into its mother's pouch. It grows and develops there for 7 months. When it is 7 months old, it leaves the pouch to eat the leaves of the eucalyptus tree, returning to its mother's pouch to nurse. When the koala is a year old, it stops nursing and survives on eucalyptus leaves. The koala gets everything it needs from eucalyptus leaves, including its water. In fact, the meaning of the word *koala* is "no water."	After reading this paragraph, the students can be invited to describe why the author writes, "The koala is a very unlikely hero" in this survival story.
Because you have learned so much in Science, we have one more fact that we need to share with you about koalas. When they are about 6 months old, their mother begins to produce a special substance called *pap*. Pap comes from the mother's intestines and contains bacteria. The koala needs to have these bacteria in its own intestines so that it can eat and digest eucalyptus leaves and get the water from the leaves. Now you have an additional fact about why some bacteria are good! In fact, without these bacteria, the koala could never survive. What have we learned so far about the traits of koalas and their habitat that can help us explain their survival?	This paragraph provides the chance for the students to make connections to the text they read about the good and bad features of bacteria. Depending on time, you can elicit what the students remember about the importance of bacteria to our survival, then connect to the role of bacteria in koala survival. This is a moment to summarize the "Big Ideas" thus far in the text.
What about those other species that used to live in Australia? Look closely at the world map and find Australia. What do you notice about where it is located?	After locating Australia, the students can be encouraged to describe where it is and what is unusual about it (it is all alone, not connected to other larger land masses).

[1] "Koala sitting in an eucalpytus tree" by Pouts31 is licensed under CC BY-SA 3.0, "Female Koala" by Quartl is licensed under CC BY-SA 3.0

 **What do you notice about where Australia is located?**	
Australia is isolated from the rest of the world. It is not connected to any other land masses. For many hundreds of thousands of years, very different organisms lived in Australia than in the rest of the world. For example, there were 450-pound, 6-foot kangaroos. There were 2 ½-ton wombats. There were birds that were more than 4 times larger than emus and could not fly. Altogether, 23 very large species of animals have disappeared from Australia[2].  Modern-day Kangaroo Modern-day Wombat Modern-day Emu	
Before we read about how scientists explain why all those other organisms disappeared, think about what you have learned from studying why we see squirrels all around us but no dinosaurs. How would *you* explain the disappearance of these huge organisms?	This could be an ideal spot for a *turn-and-talk* in which students share with one another their ideas about how only the koala survived, followed by sharing with the class.
Scientists tackle the mystery Figuring out what might have caused the extinction of so many organisms is a challenging puzzle because, of course, there are no written records and no photographs. The most useful evidence scientists have is fossil evidence, which you know all about. There are also other bits of physical evidence (like pieces of wood and stone that were shaped to make weapons).	Discuss why the author writes that "figuring out what might have caused the extinction of so many organisms is a challenging puzzle."

[2] "Eastern Grey Kangaroo" by KereH is licensed under CC BY-SA 3.0, "Common Wombat" by JJ Harrison is licensed under CC BY-SA 3.0, "Emu Walking" by Eric Kilby is licensed under CC BY-SA 2.0

So, using this evidence, what do scientists think might have happened between 45,000 and 42,000 years ago? Scientists know that 45,000 years ago, *Sapiens* (the earliest name given to humans) built boats that could be used to travel across the ocean and reach Australia. Is it just by chance that, when *Sapiens* reached Australia, the huge species of animals disappeared? We cannot know for sure. Some scientists think that the disappearance was caused by changes in the climate. These scientists believe that these large animals could not survive the changes. But other scientists think there is evidence that *Sapiens* played a big role in the disappearance of these animals.	Stop to review the two Big Ideas that scientists think could explain why the other species—that were not koalas—disappeared (i.e., 1) a change in climate, 2) the fact that *Sapiens* reached Australia).
This is their reasoning: 1. Although Australia's climate did change 45,000 years ago, it was not enough of a change to explain the disappearance of so many species. 2. The species that died out had survived earlier and much greater change in climate in Australia. 3. Usually, when there is a major change in climate, the sea creatures are affected as much as the land creatures, but there is no evidence that the sea creatures at this time were affected. 4. This pattern, where *Sapiens* reach new places in the world and species disappear in those places, has happened many times.	This is a great spot in the text for the students to re-state these ideas and to reason along with the scientists who do not believe that the cause of the extinction of the other 23 species was climate change.
Why would *Sapiens* have been able to make such a difference in the animal population of Australia? The huge animals were very slow moving and would be quite easy to hunt. Their pregnancies were very long, and they would give birth to very few babies. For example, the koala gives birth to only one baby in a whole year. Just killing one giant wombat every few months would result in more deaths than births of wombats over a thousand years. The giant animals of Australia could not know how dangerous *Sapiens* were. *Sapiens* do not look like	In these paragraphs, we learn the explanations for why some scientists believe that early humans who had traveled to Australia were the cause of the extinction of so many species. If you are projecting the text on an interactive whiteboard, invite students to come to the board and highlight each of the explanations. Ask the students what they think about this reasoning; do they agree that these are possible explanations? Why or why not?

they could cause much harm; they do not have large teeth or big bodies. So the animals did not learn to be fearful of *Sapiens* before it was too late. *Sapiens*, when they reached Australia, knew how to use fire. It is very likely that they burned large areas of Australia so that they could hunt and travel more easily. They may have burned many sources of food for the animals. This is where we have a very important piece of evidence. A tree that managed to survive the fire and grew very well in Australia is the eucalyptus tree! Hmmm… why is that a key piece of evidence that could explain why koalas survived?  **Eucalyptus tree in Australia[3]**	
What threatens the koala today? People do not hunt koalas, but they are still threatened. In fact, they are a protected species because there is concern about their becoming extinct. If people do not hunt koalas and they have no other predators, why are they at risk of becoming extinct? If you thought about the fact that koalas can survive on eucalyptus trees only, then you are thinking like a scientist. With such a limited source of food and water, it is very important to protect eucalyptus trees. But that does not always happen. As people take land to develop for farmland and for homes and other buildings, they destroy eucalyptus trees.	Stop here to discuss the students' predictions about what might be endangering koalas today. Compare the students' ideas with the author's ideas.

[3] "Parramatta Red Gum" by Pete The Poet is licensed under CC BY-NC 2.0

But there are people who are now becoming heroes and are working to protect the eucalyptus trees, so koalas can continue to survive in their habitat.	

L6.3 The Koala A Success Story (text)

The Koala: A Success Story!

Here is a mystery for you. Many thousands (45,000) of years ago, the koala (koe-wa-la) lived with 23 other species of animals on the continent of Australia. Today, it is the only surviving species in Australia from that period.

Think about all you have learned about how organisms survive in their environment. Look closely at the pictures of the koala and its habitat. What do you think could explain how the koala survives? Why would it be the only species to survive from that period? What happened to the rest of the species?

"Female Koala" by Quartl is licensed under CC BY-SA 3.0

"Koala sitting in an eucalyptus tree" by Pouts31 is licensed under CC BY-SA 3.0

The koala and its habitat

The hero in our survival story

The koala is a very unlikely hero. When they are first born, koalas are the size of a jelly bean. They cannot see. They cannot hear. They have no fur. As soon as it is born, using the senses it does have (touch and smell), as well as its strong legs and tiny claws, the koala moves into its mother's pouch. It grows and develops there for 7 months. When it is 7 months old, it leaves the pouch to eat the leaves of the eucalyptus tree, returning to its mother’s pouch to nurse. When the koala is a year old, it stops nursing and survives on eucalyptus leaves. The koala gets everything it needs from eucalyptus leaves, including its water. In fact, the meaning of the word *koala* is “no water.”

Because you have learned so much in Science, we have one more fact that we need to share with you about koalas. When they are about 6 months old, their mother begins to produce a special substance called *pap*. Pap comes from the mother’s intestines and contains bacteria. The koala needs to have these bacteria in its own intestines so that it can eat and digest eucalyptus leaves and get the water from the leaves. Now you have an additional fact about why some bacteria are good! In fact, without these bacteria, the koala could never survive.

What have we learned so far about the traits of koalas and their habitat that can help us explain their survival?

What about those other species that used to live in Australia?

Look closely at the world map and find Australia. What do you notice about where it is located?

What do you notice about where Australia is located?

Australia is isolated from the rest of the world. It is not connected to any other land masses. For many hundreds of thousands of years, very different organisms lived in Australia than in the rest of the world. For example, there were 450-pound, 6-foot kangaroos. There were 2 ½-ton wombats. There were birds that were more than 4 times larger than emus and could not fly. Altogether, 23 very large species of animals have disappeared from Australia.

"Eastern Grey Kangaroo" by KereH is licensed under CC BY-SA 3.0

Modern-day kangaroo

"Common Wombat" by JJ Harrison is licensed under CC BY-SA 3.0

Modern-day wombat

"Emu Walking" by Eric Kilby is licensed under CC BY-SA 2.0

Modern-day emu

Before we read about how scientists explain why all those other organisms disappeared, think about what you have learned from studying why we see squirrels all around us but no dinosaurs. How would *you* explain the disappearance of these huge organisms?

Scientists tackle the mystery

Figuring out what might have caused the extinction of so many organisms is a challenging puzzle because, of course, there are no written records and no photographs. The most useful evidence scientists have is fossil evidence, which you know all about. There are also other bits of physical evidence (like pieces of wood and stone that were shaped to make weapons).

So, using this evidence, what do scientists think might have happened between 45,000 and 42,000 years ago?

Scientists know that 45,000 years ago, *Sapiens* (the earliest name given to humans) built boats that could be used to travel across the ocean and reach Australia. Is it just by chance that, when *Sapiens* reached Australia, the huge species of animals disappeared? We cannot know for sure. Some scientists think that the disappearance was caused by changes in the climate. These scientists believe that these large animals could not survive the changes. But other scientists think there is evidence that *Sapiens* played a big role in the disappearance of these animals.

This is their reasoning:

1. Although Australia's climate did change 45,000 years ago, it was not enough of a change to explain the disappearance of so many species.
2. The species that died out had survived earlier and much greater change in climate in Australia.
3. Usually, when there is a major change in climate, the sea creatures are affected as much as the land creatures, but there is no evidence that the sea creatures at this time were affected.
4. This pattern, where *Sapiens* reach new places in the world and species disappear in those places, has happened many times.

Why would *Sapiens* have been able to make such a difference in the animal population of Australia?

The huge animals were very slow moving and would be quite easy to hunt. Their pregnancies were very long, and they would give birth to very few babies. For example, the koala gives birth to only one baby in a whole year. Just killing one giant wombat every few months would result in more deaths than births of wombats over a thousand years.

The giant animals of Australia could not know how dangerous *Sapiens* were. *Sapiens* do not look like they could cause much harm; they do not have large teeth or big bodies. So the animals did not learn to be fearful of *Sapiens* before it was too late.

Sapiens, when they reached Australia, knew how to use fire. It is very likely that they burned large areas of Australia so that they could hunt and travel more easily. They may have burned many sources of food for the animals. This is where we have a very important piece of evidence. A tree that managed to survive the fire and grew very well in Australia is the eucalyptus tree! Hmmm… why is that a key piece of evidence that could explain why koalas survived?

"Parramatta Red Gum" by Pete The Poet is licensed under CC BY-NC 2.0

Eucalyptus tree in Australia

What threatens the koala today?

People do not hunt koalas, but they are still threatened. In fact, they are a protected species because there is concern about their becoming extinct. If people do not hunt koalas and they have no other predators, why are they at risk of becoming extinct?

If you thought about the fact that koalas can survive on eucalyptus trees only, then you are thinking like a scientist. With such a limited source of food and water, it is very important to protect eucalyptus trees. But that does not always happen. As people take land to develop for farmland and for homes and other buildings, they destroy eucalyptus trees.

But there are people who are now becoming heroes and are working to protect the eucalyptus trees, so koalas can continue to survive in their habitat.