



Stackable Instructionally- embedded Portable Science (SIPS) Assessments Project

Grade 8 Science Unit 3 Sample Lesson “What Was Their Life Like?” Understanding Earth History and the Origin of Species June 2023

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Science Grade 8

Unit 3: Understanding Earth History and the Origin of Species

Sample Lesson: What Was Their Life Like?

Suggested Time to Complete: 150 minutes

Purpose & Use Statement: This sample lesson was developed for state and local administrators and teacher leaders (e.g., curriculum directors, instructional facilitators, professional learning specialists) to (1) illustrate an example of an instructional lesson developed using a principled design approach, and (2) support accompanying process documentation about how to use the SIPS unit as an instructional framework to intentionally design high-quality lessons in an aligned curriculum, instruction, and assessment system. This sample lesson should be evaluated and refined, as necessary, to align appropriately with a standards-based curriculum, instruction, and assessment system prior to its use. Additionally, teachers should refine this lesson to meet the local, cultural, and individual needs of the students.

Desired Results

Overview of the Learning Goals

In this lesson, “What Was Their Life Like?”, students gather, analyze, and interpret data from fossil records using an online database, The Paleobiology Database. Students have the goal of determining similarities and differences between fossils. Students use these similarities and differences to find patterns within the data to draw conclusions about the origin of organisms and to begin developing an explanation about what caused these similarities and differences.

Connections to Prior Learning

DCI: LS4.A, LS4.B, LS4.C, ESS1.C

- **Prior Learning from 3-5 (NRC Framework)**
 - Fossils provide evidence about the types of organisms (both visible and microscopic) that lived long ago and about the nature of their environments. Fossils can be compared with one another and to living organisms according to their similarities and differences.
 - Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.
 - Changes in an organism’s habitat are sometimes beneficial to it and sometimes harmful. For any environment, some kinds of organisms survive well, some survive less well, and some cannot.
 - Earth has changed over time. Understanding how landforms develop, are weathered (broken down into smaller pieces), and erode (get transported elsewhere) can help infer the history of the current landscape. Local, regional, and global patterns of rock formations reveal changes over time due to Earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. Patterns of tree rings and ice cores from glaciers can help reconstruct Earth’s recent climate history.
- **Prior learning from this grade band (e.g., Grades 6 & 7):**
 - Minimal/not applicable

CCC: Patterns

- **Prior learning from 3-5:** Students identify similarities and differences, identify patterns related to time, and use patterns to make predictions and categorizations.
 - Ten PEs in Grades 3-5 use this CCC. Some uses are similar to the elements of the CCC used in this unit’s two PEs with the Patterns CCC (e.g., 3-PS2-2 involves making a prediction, which is possible because of cause-and-effect relationships; 5-ESS1-2 involves representing data in graphical displays to reveal patterns).

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- **Prior learning from this grade band (e.g., Grades 6 & 7):** Students are expected to use graphs, charts, and images to identify patterns in data. They are also expected to use cause-and-effect relationships to identify patterns in data (Appendix G).
 - Multiple MS PEs use this CCC, so students will likely have some experience with the MS CCC elements prior to starting Grade 8 Unit 3.

CCC: Cause & Effect

- **Prior learning from 3-5:** Students become adept at identifying/testing causes and effects and become aware that events can be correlated but not causally related.
 - Thirteen Grade 3-5 PEs use this CCC, so students will likely have substantial experience with the CCC prior to middle school. An example PE that uses the CCC in a way that presages this unit's CCC PE element (*Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability*) is 4-ESS3-2 (*Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans*), because solutions' effectiveness can be impacted by multiple factors and their intended effects might be best described probabilistically.
- **Prior learning from this grade band (e.g., Grades 6 & 7):** Students gain experience with multifaceted causal relationships, distinguishing between correlation and causation, and using cause-and-effect relationships to make predictions.
 - Fifteen middle school PEs use this CCC, so students will likely have substantial experience with the CCC during Grades 6 and 7. For example, MS-ESS2-5 (*Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions*) implies examining multifaceted causes and probabilistic outcomes.

CCC: Structure & Function

- **Prior learning from 3-5:** Students move beyond structures to also consider substructures, and how substructures can sometimes be observed and serve different functions.
 - No Grade 3-5 PEs use this CCC, so students will likely have minimal experience with this CCC prior to starting middle school.
- **Prior learning from this grade band (e.g., Grades 6 & 7):** Students visualize, model, and describe functions in terms of how they are enabled by different structures and how materials (and their properties) can enable these functions.
 - Five MS PEs use this CCC and MS-LS1-2 uses the same element of the Structure and Function CCC as used in this unit's PE.

SEP: Developing and Using Models

- **Prior learning from 3-5:** Students continue developing their modeling skills and abilities by developing and revising different types of models, along with beginning to consider that models can have limitations. [Appendix G]
 - PE 4-PS4-2 is an example of a 3-5 grade band PE that uses a Developing and Using Models SEP element that is very similar to the SEP element used in this unit.
 - **Prior learning from this grade band (e.g., Grades 6 & 7):** Students develop, use, and revise models to describe, test, and predict more abstract phenomena and to design systems.
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- Multiple middle school PEs use this SEP, so students will likely have some experience with the MS SEP elements prior to starting Grade 8 Unit 2. MS-PS4-2 is an example MS PE that uses the same SEP element as this unit's PE (MS-LS3-1).

SEP: Analyzing and Interpreting Data

- **Prior learning from 3-5:** Students will have experience with the collection of data using quantitative approaches to collecting data and conducting multiple trials of qualitative observations. They will be able to carry out the analysis and interpretation of the data using logical reasoning, mathematics, and/or computation.
 - In Grades 3-5, students will represent data in tables and/or various graphical displays to reveal patterns that indicate relationships. They will analyze data to refine a problem statement or the design of a proposed object, tool, or process.
- **Prior learning from this grade band (e.g., Grades 6 & 7):** Students will build understanding and skills with quantitative analysis of data. They will distinguish between correlation and causation and carry out basic statistical techniques of data and error analysis.
 - Multiple middle school PEs use this SEP, so students will likely have some experience with the SEP element of determining similarities and differences in their data prior to starting Grade 8 Unit 3.

SEP: Constructing Explanations and Designing Solutions

- **Prior learning from 3-5:** Students will have experience using evidence to (a) construct explanations for describing/predicting phenomena and (b) design solutions to problems.
 - In Grades 3-5, multiple PEs use this SEP and relate to the three elements of this SEP that are used in Unit 3. For example, in 3-LS4-2 students use evidence to construct an explanation for the phenomena of natural selection pressures; in 3-LS3-2 students use evidence to support an explanation of the relationship between environmental factors and trait expression; and in 4-ESS3-1 students identify evidence that supports an explanation that landscapes change over time.
- **Prior learning from this grade band (e.g., Grades 6 & 7):** During all middle school grades, students will construct explanations and design solutions that are supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
 - An example MS PE that uses a similar SEP element as MS-ESS1-4 (this unit) is MS-ESS2-2 *Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.*

Key Vocabulary

Students build conceptual meaning with and use key tier II and tier III vocabulary terms as they make sense of phenomena and phenomena-based design problems. This is not an exhaustive list of terms, and should be reviewed and modified by educators, as appropriate.

- Adaptation
- Stratigraphy
- Microfossil
- Cladogram
- Macrofossil
- Lithology
- Stratification

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Targeted Stage 1 Learning Goals

Acquisition Goals (AG)

A2: Use mathematical representations of time that are appropriate for representing events and time scale(s) necessary to support conclusions about events that occurred during Earth's history.
A5: Analyze and interpret data in the fossil record to make determinations about evolutionary changes that occurred in the past.
A7: Determine similarities and differences between organisms today and fossilized organisms using patterns found in fossil records.
A8: Use similarities and differences between structures of organisms today and fossilized organisms to find patterns that help draw conclusions about the origin of organisms.
A9: Develop an explanation about what caused the similarities and differences between organisms today and organisms from fossil records.


Common Core State Standards (CCSS):

WHST.6-8.2	RST.6-8.1	RST.6-8.4
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Enduring Understandings (EU)/ Essential Questions (EQ):

EU2/EQ2	EU3/EQ3
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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<input checked="" type="checkbox"/> Analyze & Interpret Data <input type="checkbox"/> Ask Questions <input checked="" type="checkbox"/> Construct Explanations <input type="checkbox"/> Define Problems <input type="checkbox"/> Design Solutions <input type="checkbox"/> Develop & Use Models <input type="checkbox"/> Engage in Argument from Evidence <input type="checkbox"/> Mathematics & Computational Thinking <input type="checkbox"/> Obtain, Evaluate, & Communicate Information <input checked="" type="checkbox"/> Plan & Carry Out Investigations	<input checked="" type="checkbox"/> LS4.A: Evidence of Common Ancestry and Diversity <input checked="" type="checkbox"/> LS4.B: Natural Selection <input checked="" type="checkbox"/> LS4.C: Adaptation <input checked="" type="checkbox"/> ESS1.C: The History of Planet Earth	<input checked="" type="checkbox"/> Cause & Effect <input type="checkbox"/> Energy & Matter <input checked="" type="checkbox"/> Patterns <input type="checkbox"/> Scale, Proportion, & Quantity <input type="checkbox"/> Stability & Change <input type="checkbox"/> Structure & Function <input type="checkbox"/> Systems & System Models

 **Formative Assessment Opportunities**

Monitoring	Success Criteria	Possible Instructional Adjustments
<ul style="list-style-type: none"> Listen while students share their ideas on how we can understand the world of the past by looking at fossil records. Pose questions that encourage students to consider additional data categories to explore to 	<p>Students can:</p> <ul style="list-style-type: none"> Identify important information about fossils that help understand their life. Accurately identify patterns found in fossil records by analyzing fossils living near the same time. 	<ul style="list-style-type: none"> Students who are new or need a refresher on the tool could revisit and watch the video Paleobio Database Navigator Intro. Provide students with scaffolding questions that break up the broad topic questions into manageable pieces for the student.

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| <p>understand what the world was like for fossils.</p> <ul style="list-style-type: none">• Monitor student research progress and provide guidance and feedback on the validity of sources.• Review annotated drawings for accuracy and provide students feedback before creating their summative report. (For example, students should not draw humans as part of their annotated drawings unless humans were alive at the time and there is evidence that they interacted.) | <ul style="list-style-type: none">• Identify information in fossil records that relate to the similarities and differences between organisms today and fossilized organisms.• Identify major Earth events that occurred around the time of their fossils' lives.• Develop logical reasoning between major Earth events, how they changed the world, and how the fossils changed between species.• Accurately describe similarities and differences between organisms today and fossilized organisms based on patterns found in fossil records.• Explain what caused similarities and differences between organisms today and fossilized organisms based on fossil records.• Draw a conclusion about events that occurred in the past based on data from fossil records.• Describe how data support conclusions about events that occurred in the past. | <ul style="list-style-type: none">• For advanced students, encourage them to gather additional fossil data and develop additional questions related to fossils and evolution for research.• Advanced students could utilize the data set to develop a larger-scale science fair research project of interest to them.• Students can create alternative representations to an annotated drawing that makes sense for them.• Provide students with sample graphic organizers for them to use as models as they conduct research and work to organize their data. |
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Instructional Plan

Lesson Overview

In this lesson, students create a more robust understanding of evolution related to their fossil by gathering information about their fossil's world, the world before it, and the world after it. Using the PBDB tool, students start by identifying other fossils discovered near their fossils in the same rock formation and age. Students expand their search outwards by finding other sites where their fossil has been discovered and gathering data on those sites as well.

Students utilize online searches or teacher-suggested resources to gather information about the world in which their species lived. Using their cladogram and Earth's history timeline as inspiration,

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students look back in time and forward in time to gather information about how the world changed and identify how those changes impacted the ancestors and descendants of their organism. Students create annotated drawings for three species: one ancestor of their organism, their organism, and one descendent of the organisms. The annotated drawings include other species the organisms would have interacted with in their environment, a drawing of their surrounding environment (fern forest, shallow sea, etc.), clear labels, and a representation of any major events, such as mass extinction, to show what facilitated a dramatic change.


Materials & Set-Up

- Computer with internet access for online research

To help prepare, teachers should familiarize themselves with the PBDB tool.

Anchor or Investigative Phenomenon: Using an online large-scale database, students select a fossil of interest and then conduct research on the fossil, its ancestors and descendants, and the world in which they lived.

Driving Question: What was the world like for our species? How did major Earth events impact the world our species lived in? How did these changes bring about its appearance and extinction?

Teacher Does	Students Do
<p>Engage</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Introduce object, event, phenomenon, problem, or question <input checked="" type="checkbox"/> Build background knowledge <input checked="" type="checkbox"/> Facilitate connections 	
<p>Explore</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Explore object, event, phenomenon, problem, or question <input checked="" type="checkbox"/> Guided exploration with hands-on activities 	<p>The teacher opens the class with the following question or something like it: “These fossils we are studying were living creatures, but what was their world like? How can we understand what the world was like for our fossils when we can’t go back and see it firsthand?” The teacher provides students with time to consider the question and reflect on it before facilitating a class discussion around their thinking. Students may suggest looking at other fossils and looking at the characteristics of the rocks the fossils are found in. The teacher may suggest conducting research and reading online as well, encouraging students to</p> <p> Students reflect on the question, “How can we understand what the world was like for our fossils when we can’t go back and see it firsthand?” and then discuss their thinking as a whole class. Students transition to exploring online resources to gather data from an online database of fossils, The PBDB Navigator. Students search using the tool to find additional fossils that were found near their fossils and around the same timeframe. Students also look at fossils found near other examples of their fossil. (For example, their fossil is a mastodon from the mid-west US. The students find another</p>

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consider what scientists might use as evidence.

The teacher transitions students from the opening activity to the main activity, where students work to gather information about the fossils by looking at other fossils found around the fossils. Then, they will research, gather information about organisms in their cladogram, and create an informative drawing about the organisms.

Other fossils:

To start understanding the world of their fossils, students explore the surrounding area of their fossils to find other fossils from the same time and location. The teacher asks the students to visit [The PBDB Navigator](#) to explore the data and find fossils that would have lived near and around the same time as their fossils. The teacher may want to provide students with *Appendix A: Exploring Fossil Data* for guidance. Students who are performing above grade level may work without the handout. The teacher encourages students to explore the information in [The PBDB Navigator](#) and utilize other reputable sources. Because the number of possible species is large, students will need to conduct online searches using a search engine. As they search, the teacher moves around the room to informally assess student understanding and provide guidance to students when conducting

example of a mastodon fossil from Europe and gather data on fossils found near that mastodon.)



After gathering data on their fossils, students analyze the data to find patterns about the fossils, where they lived, and how they lived. Using this data, students develop a visual representation such as an annotated drawing that shows the fossil in what the students think their environment would have looked like.

Working individually, students revisit their cladograms to select two more organisms to research that lived before and after their fossils. They create a series of representations that show what life was like for the oldest fossil, the younger fossil, and then create representations that show how major Earth events changed the world and how those events required organisms to adapt, resulting in the younger generations of fossils.

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research and ensure that students are utilizing reputable sources of information.

(Teacher Note: The standards do not require that students memorize the names of eras/periods/epochs or specific events. Additionally, some elements of [The PBDB Navigator](#) data go into advanced areas that are above grade-level expectations. For example, the exploration of the taxonomic classification for species.)

Students who need accommodations may be provided with suggested search terms to include with their species, guiding questions to focus their research, and support organizing and structuring their data from their research. Online tools such as Google Draw could be used by students to create concept maps as they work to help them organize their data and allow for easy reorganization.

After gathering data about their fossils and the other organisms that may have lived around the fossil, students create an annotated drawing of what the world was like for their fossils. To support students, the teacher encourages them to make predictions about what kind of world they would live in based on their anatomy and encourages them to conduct additional research if they have more questions or are unsure.

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After the teacher reviews the annotated drawings and provides feedback, the teacher supports students as they use the learning from this lesson, *Ancestors and Descendants: Where Did They Come From? What Became of Them?* and *Building a Tree of Life* to create a visual representation, such as a series of annotated drawings that show what life was like for one ancestor, the fossil, and one descendant. The series of drawings also include major Earth events from *Earth's History* and how those events may have impacted these organisms.

Students who are above grade level could be presented with this task with limited guidance and a more open approach.

Students who need additional support could utilize the instructions and guidance in *Appendix A: Exploring Fossil Data* and the teacher may provide the students with support to help them generate additional sub-questions to help them answer the main questions of the task.

Explain

- Explain understanding of concepts and processes
 - Introduce new concepts and skills to seek conceptual clarity
-

Elaborate

- Build on or extend understanding and skill
 - Apply concepts in new or related contexts
-

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Evaluate

- Self-assess knowledge, skills, and abilities
- Evaluate student development and lesson effectiveness

Closing

Students present their series of drawings/visuals to their small group for feedback such as areas of confusion, clarity, and ideas on what to add to their thinking. Students will use the drawings from this lesson and the peer feedback to craft a scientific explanation report on their organism in *What Was Their Past, Present, and Future?*

Differentiation Strategies and Resources

“Universal Design for Learning (UDL) is a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn” (CAST, 2022). Taking time to reflect on prior instruction when planning for accessible, differentiated, and culturally responsive instruction for diverse learners and culturally diverse classrooms serves to identify ways to improve future instructional practices. The UDL Guidelines provide a framework for this reflection. The guidelines include three principles as ways to focus on variety and flexibility in instructional practices:



Multiple Means of Engagement




Multiple Means of Representation



Multiple Means of Action & Expression

By examining instruction and instructional materials through the lens of each of these principles, teachers can identify and thus reduce or remove barriers to diverse learners.




Learning Opportunities	UDL Principle	Example Differentiation Strategies & Resources
Explore		
<i>Students brainstorm ideas of evidence that can help understand what the world was like</i>		Present clear and important goals and objectives. <ul style="list-style-type: none"> • Have students write goals into simple I can statements (e.g., I can use a model of applied forces to predict how a motion of an object will change using different forces.). • Explain scientific terms along with the goals so that students understand what they are working towards.

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<p><i>during the lives of fossils.</i></p>		<p>Supply or activate background knowledge.</p> <ul style="list-style-type: none"> • Provide background information prior to having students complete a task (e.g., classification systems prior to having students sort organisms; defining traits, etc.). • Check student responses on understanding the content and not on sentence structure and grammar. • Connect dominant language (e.g., English) with first language (e.g., Spanish). • Allow students to use preferred and possibly multiple ways to communicate. • Ensure that the needed vocabulary is in a student’s AAC system.
		<p>Support planning and strategy skills.</p> <ul style="list-style-type: none"> • Include prompts to check their thinking and strategy for gathering evidence about past environments. • Check in with students to see if they understand the task and if they need support to understand the concepts. • Model think-alouds to think through evidence to gather about other fossils.
<p><i>Students conduct research using an online database to identify fossils that lived at and near their chosen fossil and then gather evidence about their lives. Students then conduct research about two fossils related to their chosen fossil, one an ancestor and one a descendant.</i></p>		<p>Allow ownership of parts of instructional tasks.</p> <ul style="list-style-type: none"> • Have students set their own goals (academic or behavioral) that work towards the goals and objectives of the unit. • Have students identify and choose sources to locate information on animal structures, traits across organisms, classification systems, etc. <p>Make work authentic and relevant.</p> <ul style="list-style-type: none"> • Explain the research goal in clear and simple terms and connect it to real-world applications (e.g., similarities and differences between familiar animals). • Suggest websites with information on animals that will be compared to fossilized ancestors that feature print, images, and videos. • Highlight a diverse group of scientists, especially paleontologists, and their roles (e.g., incorporate in presentation, show videos, wall posters, etc.). <p>Provide safety and reduce distractions.</p> <ul style="list-style-type: none"> • Provide a variety of ways in which students can ask questions or seek help (e.g., individually, small group, asking a peer, etc.).

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	<ul style="list-style-type: none">• Offer opportunities for students to share in a way that is comfortable given their culture and family dynamics (e.g., Some cultures find talking over each other as normal while others wait for complete silence before contributing; some are comfortable with directness or do not have the language level to be polite. Some respond respectfully using facial movements. Eye contact varies by culture.)• Allow students to wear noise-canceling headphones during individual work. <p>Provide different levels of support and scaffolds.</p> <ul style="list-style-type: none">• Paraphrase fossil information to reduce overall complexity of the text while maintaining key information. <p>Encourage communication about frustrations and guide self-management of the frustrations.</p> <ul style="list-style-type: none">• When students show signs of frustration such as withdrawing or exhibiting distracting behaviors, encourage them to communicate what is frustrating them and what they think might help. For some students, this might require a simple chart that includes symbols to indicate how they feel and options for dealing with the frustrations (e.g., I need a break. I need help. I need to work alone. etc.).
	<p>Provide information in a variety of ways.</p> <ul style="list-style-type: none">• Have students research information (e.g., fossil records, traits of organisms, classification systems) in multiple ways such as grade-level science magazines, lower grade-level science magazines, books, the internet, wall chart, video, etc. <p>Describe the meaning of vocabulary and symbols.</p> <ul style="list-style-type: none">• Place descriptions with examples and possibly images on the wall or in students' notebooks of content vocabulary (e.g., fossilized, analogous, homologous, vestigial structures).• Provide a video explaining terminology (e.g., vestigial structures).• Describe meaning vs a formal definition. For example, "vestigial describes an organ or body part that continues to exist without retaining its original function, such as our appendix." Vocabulary.com• Speak slowly and clearly combined with gestures or acting out words, phrases, and directions to help English Learners and students develop science vocabulary. <p>Provide support for decoding written text and symbols.</p>

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		<ul style="list-style-type: none">• Allow students to use a screen reader to read online articles and information.• Provide digital text to allow students to choose to listen, enlarge, highlight, etc. <p>Support language acquisition.</p> <ul style="list-style-type: none">• Connect dominant language (e.g., English) with first language (e.g., Spanish). <p>Emphasize key information.</p> <ul style="list-style-type: none">• Use graphic organizers, outlines, underline or highlight key information in print materials, etc. <p>Provide models and scaffolds to aid in comprehension.</p> <ul style="list-style-type: none">• Provide sentence starters for writing tasks (e.g., This change was caused by _____).• Provide a variety of explicit prompts for each step or chunk of an activity (e.g., verbal, visual steps, checklist, checklist paired with graphics, tactile steps). <p>Support transfer and generalization of skills and knowledge.</p> <ul style="list-style-type: none">• Include opportunities to review and practice prior knowledge and skills along with new knowledge and skills.
		<p>Use technology or assistive technology (AT) to broaden access to instructional materials.</p> <ul style="list-style-type: none">• Make use of technology such as spellcheckers, word prediction software, and text-to-speech. <p>Provide varied levels of support and practice.</p> <ul style="list-style-type: none">• Provide prompts for the shared traits/characteristics to use in comparing similarities and differences between organisms. <p>Support planning and strategy skills.</p> <ul style="list-style-type: none">• Include prompts to check their thinking and strategy while conducting research.• Check in with students to see if they understand the task and if they need support to understand a concept.• Model think-alouds to think through the research task. <p>Provide supports to help with managing information and resources.</p> <ul style="list-style-type: none">• Provide articles on fossils in the students' first language as much as possible.• Bookmark additional online resources.• Create a digital resource document that includes a topic paired with graphics.

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<p><i>Students generate visual representations of the environment of their fossil, its ancestor, and its descendant.</i></p>		<ul style="list-style-type: none"> • Link to a specific part of a web page.
		<p>Provide choices.</p> <ul style="list-style-type: none"> • Encourage students to create representations that have meaning to them while including key features such as labels, arrows, and representations of the content. <p>Support self-reflection and evaluation.</p> <ul style="list-style-type: none"> • Have students use a self-reflection chart on which individual students can monitor his/her progress. Include ancillary behaviors such as asking questions, contributing to the group, and asking for help. Remind students to use the chart routinely.
		<p>Support language acquisition.</p> <ul style="list-style-type: none"> • Connect dominant language (e.g., English) with first language (e.g., Spanish).
	<p>Vary the ways for students to respond to questions or a task.</p> <ul style="list-style-type: none"> • Allow students to use a variety of ways to create a model/representation (e.g., drawing, digital pictures, physical objects). • Have students enter data online to organize and share research data using standard or adapted keyboards. • Provide a variety of ways in which students can “write” to share information about their fossils. <p>Provide varied levels of support and practice.</p> <ul style="list-style-type: none"> • Provide prompts for the shared traits/characteristics to use in comparing similarities and differences between organisms. • Set bookmarks to specific pages for students to find information. • For students who are just beginning to learn about classifying, provide categories represented with graphics for classification of organisms. • Provide differentiated homework or seatwork that still practices the key concepts of the assignment (e.g., some students complete sentence starters as opposed to writing paragraphs). 	

Resources

- [The PaleoBiology Database](https://paleobiodb.org/)
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Core Text Connections

- [The Evolution of Life on Earth: AsapSCIENCE YouTube](https://youtu.be/H2_6cqa2cP4)
[https://youtu.be/H2_6cqa2cP4]
 - [Layers of Time Fossil Game: American Museum of Natural History](https://www.amnh.org/explore/ology/paleontology/layers-of-time2)
[https://www.amnh.org/explore/ology/paleontology/layers-of-time2]
 - [Kahn Academy: Fossils and Rock Layers](https://www.khanacademy.org/science/middle-school-earth-and-space-science/x87d03b443efbea0a:the-geosphere/x87d03b443efbea0a:fossils-and-rock-layers/a/fossils-and-rock-layers)
[https://www.khanacademy.org/science/middle-school-earth-and-space-science/x87d03b443efbea0a:the-geosphere/x87d03b443efbea0a:fossils-and-rock-layers/a/fossils-and-rock-layers]
 - [Encyclopedia Britannica: Stratification](https://www.britannica.com/science/stratification-geology)
[https://www.britannica.com/science/stratification-geology]
 - [Encyclopedia Britannica: A Journey Through Time Since the Precambrian](https://www.britannica.com/list/a-journey-through-time-since-the-precambrian)
[https://www.britannica.com/list/a-journey-through-time-since-the-precambrian]
 - [Encyclopedia Britannica: Major Mass Extinctions](https://www.britannica.com/list/major-mass-extinctions)
[https://www.britannica.com/list/major-mass-extinctions]
 - [Our World in Data: Five Mass Extinctions](https://ourworldindata.org/mass-extinctions)
[https://ourworldindata.org/mass-extinctions]
 - [Encyclopedia Britannica: Geologic Time](https://www.britannica.com/science/geologic-time)
[https://www.britannica.com/science/geologic-time]
 - [Bozeman Science: Cladograms](https://www.youtube.com/watch?v=ouZ9zEkxGWg)
[https://www.youtube.com/watch?v=ouZ9zEkxGWg]
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Science Grade 8
Unit 3: Understanding Earth History and the Origin of Species
Sample Lesson: What Was Their Life Like?
Suggested Time to Complete: 150 minutes

Appendix A: Exploring Fossil Data¹

Part 1: Learning About Your Fossil Environment

Use the data on PBDB Navigator to identify the following information about your fossil:

Scientific name: _____ Common Name: _____

Era/Interval: _____ Environment: _____

On PBDB dots of the same color are from the same approximate time as others. Explore the data on the PBDB navigator to identify fossils from the same time as your fossil. Record information about each fossil, its name, its environment, the era, and the environment. Record this information in the table below:

Scientific Name:	Common Name:	Era/Interval:	Environment:

Look at the data you have collected about these fossils. What do you notice about the fossils? What patterns do you see?

¹ Teachers may want to modify these documents based on the individual needs of their students.

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Return to your original fossil record and click on the collection number. The collection number provides information about all of the fossils found at that particular site. Click on your particular fossil's scientific name to pull up the individual record for your fossil.

On this page you will find:

- Synonyms: Other names for the fossil.
- Parent taxon: This will take you up to the next classification level of the organism. If you are looking at the fossil's genus, it will take you to the family. You can see the entire classification listed at the top, starting with the class.
- Sister taxa: Other groups at the same classification level who are connected to the species.
- Sub taxa: Subdivisions/classifications of the organisms, if you are looking at genus for example, it will show you the species in that genus.
- Ecology: Information about the organism, if you are uncertain about a term conduct an internet search to find the definition.
- Distribution: Where these fossils have been found. Clicking on the name of the locations will bring you to a listing of the different dig sites where this fossil has been found and the records of what was found there.

Next, you need to gather more information about the other organisms that lived at the same time as your fossil, at least 5. To do this you will need to explore data on the PBDB and conduct research on other websites and internet searches.

First, as a group discuss and decide what information you need to know about the organisms to know what the world was like.

Next, write a plan on how you will explore the data to answer your questions about the fossils that lived around the same time as your fossil. After you come up with your plan share your plan with your teacher for feedback and approval.

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Sample Lesson: What Was Their Life Like?

Suggested Time to Complete: 150 minutes

Sub questions to help understand the past earth:²

- The environment where they lived.
 - Did it live in water or on land?
 - If water:
 - Was it marine/ocean (salt water), a swamp, a lake/river (freshwater), or a mixture of fresh/salt water (brackish)
 - Was it deep, shallow, or moderate water?
 - What else is important to know about the water in which it lived?
 - If land:
 - Was it arid/dry, wet/rainy, tropical, tundra, glacial, or forest?
 - What else would be important to know about the land it lived on?
 - What other kinds of organisms lived or interacted with the fossil?
- The physical characteristics of the organism.
 - What did it look like?
 - How did it move around?
 - What did it have for defense from predators?
 - Did it have any special features to help it survive?
- How it got the energy.
 - How did it either capture energy from the environment (like plants and photosynthesis) or how did it capture prey (if a predator)?
 - If a predator, what did it eat?
 - If a producer, how did it make energy?

After you have gathered information about each of the five species selected, review the information you have for patterns across your fossil and the five additional fossils.

- What is common between all the fossils?
- How are the fossils different?

Draw/create an annotated drawing of what you think your fossil would look like in its environment. Add labels to identify the different species and important features of the environment. Add arrows that show the flow of energy from its original sources through the ecosystem.

² Teachers could use these questions to either scaffold students while they are working or to help break up the process for students who need additional support.

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Sample Lesson: What Was Their Life Like?

Suggested Time to Complete: 150 minutes

Part 2: What Happened?

The world has changed several times. We have studied major events in the earth's history that led to the world in which your fossil lived, and events that changed the world where your fossil lived. We also created cladograms to help visualize the ancestors and descendants of our fossils to see how species evolve over time. Next, create a visual representation (such as a series of annotated drawings) of how your fossil evolved by focusing on your fossil, an ancestor, and a descendant. On your representation show:

- What was the world like for the ancestor?
- What major earth events happened between the ancestor and your fossil that caused the world to change?
 - How was the world different because of these events?
- What was the earth like when your fossil was alive?
 - Include your annotated drawing for your fossil.
- What major earth events happened that caused the world to change for your fossil?
- How did those events change the world for the descendant?
- What was the world like for the descendant?

Include:

- Connections between the three fossils. What is similar between them?
- Differences between the three fossils.
- How might the major world events connect to the differences between the fossils?