



## Oceans of Ohio 5E Unit

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**Description:** Students will examine fossils and reconstruct the environment of the Cincinnati, Ohio region 450 million years ago.

**Standards Targeted:**

- LS4: Earth's Living History –*Using fossil evidence and living organisms to observe that suitable habitats depend on a combination of biotic and abiotic factors*
- LS4: Earth's Living History – *Fossils can be compared to one another and to present day organisms according to their similarities and differences*
- LS5: Interactions within Ecosystems – *Organisms perform a variety of roles in an ecosystem*
- LS7: Cycles of matter and flow of energy- *Matter is transferred continuously between one organisms and another and between organisms and their physical environments*
- LS7: Cycles of matter and flow of energy- *In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors*
- ESS8: Physical Earth- *Evidence of the dynamic changes of Earth's surface through time is found in the geologic record*
- LS8: Species and Reproduction- *Diversity of species occurs through gradual processes over many generations. Fossil records provide evidence that changes have occurred in number and types of species*
- LS8: Species and Reproduction- *Reproduction is necessary for the continuation of every species*
- LS8: Species and Reproduction- *The characteristics of an organism are a result of inherited traits received from parent(s)*

**Skills Targeted:** Observe fossil data, classify organisms, reconstructing ancient environments

**Goals:**

1. To encourage students to make observations of anatomical features
2. To demonstrate how fossils preservation provides specific biological information
3. To demonstrate the organisms colonizing the same environment change through time
4. To demonstrate that environments shift their location on Earth's surface through time

**Objectives**—By the end of this activity, students will be able to:

1. Use drawings and descriptions to identify key fossil groups
2. Use organisms to reconstruct ancient environments
3. Explain the evidence for oceans in Ohio in the geologic past

**Time Needed:** One to several 45-60 minute class period(s); activity can be adjusted for shorter or longer class times.

**Materials:**

- Set of fossils (brachiopods, horn corals, bryozoans, trilobites)
- Set of modern shells/corals
- Reference materials/list of websites
- Handouts
- (Optional) small magnifying glasses or 10x hand lenses

### Structure of the 5E Unit

5E Phase	Description	Assessment	Literacy
Engage	<p>Tell students that today we are going to be paleontologists, ask them what a paleontologist is/does.</p> <p>Brainstorming activity: Ask students to list on a piece of paper as many types of fossils as they can in two minutes. This is a relatively vague prompt; answers could be species names (like <i>Tyrannosaurs rex</i>) or clades (like trilobites).</p> <p>Then ask students to share the fossils from their lists and generate a class list on the board. Use the class list as a springboard for a basic discussion.</p> <ul style="list-style-type: none"> <li>• Can the class present ideas about how to group the organisms on the list? (land. vs ocean, vertebrate vs. invertebrate vs. plant)</li> <li>• What were the most commonly mentioned fossils? (hint: it WILL be dinosaurs)</li> <li>• Ask students what they think the most common types of fossils in Ohio are (the right answer here is marine invertebrates. We do have a bunch of Pleistocene mammals like Mastodons, but they are MUCH less common)</li> </ul>	Collect brainstorming lists	<p>Think-Pair-Share:</p> <ol style="list-style-type: none"> <li>1. Think of fossils (individual)</li> <li>2. Share list with a partner (pairs)</li> <li>3. Share fossils with whole group (share)</li> </ol> <p><i>Speaking &amp; Listening (Comprehension &amp; Collaboration) standard</i></p> <p>After grouping the fossils, add to the Science Vocabulary Word Wall (<i>Language Standard: Acquire and use accurately grade-appropriate general academic and domain-specific words</i>)</p>
Explore	<p>Distribute the fossil sets (or photos of fossils) to groups of students (one fossil set per group) or have students move between stations. If you have them, also distribute hand lenses and rulers.</p> <p>Remind them that fossils are the remains of ancient life that are preserved inside rocks. Explain that the first step, once a fossil is found, is to observe it carefully and describe it. This way, the paleontologist can identify the important characters of the fossil that determine what kind of animal or plant it is. The paleontologist can also share this information with others, which is a very important part of science. Ask students to examine fossils and categorize them by type of organisms on the handouts (brachiopod, bryozoan, etc.).</p>	<p>Circulate the classroom to help students identify the key features of the different taxa within their fossil sets. Assess accuracy of observation statements and help students construct hypotheses.</p> <p>This involves think/pair/share, written observations, sorting, making claims</p> <p>Can also employ: Drawings Science notebook</p>	<p>This involves generating written descriptions of observations and making claims based on data and inferences</p> <p><i>Writing Standard: Write arguments focused on discipline-specific content</i></p>

	<p>On their handouts, they should describe in a few sentences how they can distinguish their fossil as a member of that group rather than other on the worksheet.</p> <p>For more advanced classes, you could distribute references (fossil field guides, list of websites) and ask students to identify fossils to a higher degree of taxonomic precision.</p> <p>Students are asked to hypothesize what the environment these organisms lived in when they were alive 450 million years ago. Each group should generate a claim and supporting evidence for the following question: In what environment did these animals live?</p>		
Explain	<p>After students make their claims with cited evidence and develop a hypothesis, we reconvene as a whole group. I then facilitate a class discussion in which student groups present claims and their evidence. As different groups present their claims, I synthesize the evidence on the board.</p> <p>I then ask students to use the synthesized evidence on the board to write out their explanation of the environment in Ohio 450 million years ago.</p>	<p>This can utilize meaningful paragraphs, make a claim</p>	<p>After demonstrating how to synthesize evidence, prompt students to give summarizing statements as new information is added (<i>Speaking &amp; Listening (Presentation of Knowledge &amp; Ideas)</i>)</p>
Elaborate	<p>Consider the question: Does the same environment exist in Ohio today? Why not?</p> <p>--Consider plate tectonics, paleoplate locations (smaller continents, we were tropical), global sea level (higher), global climate (warmer, no ice in Late Ordovician)</p> <p>Consider the question: What would the fossil record of a modern sea look like? Why would it not be the same? Discuss difference with the Ordovician and modern ocean (diff corals, fish vs. no fish, etc., modern animals had not evolved yet!), I use modern corals, clams, etc. to contrast with the morphology of the Ordovician.</p> <p>(Alternately, you could also add rocks from another interval in Earth history and ask</p>	<p>Involves thought experiment, application problem</p>	<p><i>Speaking &amp; Listening (Presentation of Knowledge &amp; Ideas) standard addressed through this type of discussion</i></p>

	students to consider that environment. Local rocks in SE Ohio include coal (consider coal swamp), limestone (similar marine system to Ordovician sea), sandstones (ancient beaches and rivers), red mudstone (mostly ancient soils), and grey shale (both ancient soils and shallow marine environments)		
Evaluate	Draw or describe an idea of what that ecosystem of Ohio might have looked like in the geologic past (Ordovician sea, Pennsylvanian coal swamp, Pleistocene glacial plain...)	Could employ: Poster, presentation, comparison essay, or final reflection	If creating a poster (visual), include labels with vocabulary terms; utilize Science Vocabulary Word Wall to help through creation of final product  Various <i>Writing</i> and <i>Language</i> standards addressed here, depending on final product

### **Key web references for Oceans of Ohio / Paleontology in general**

The Ohio Historical Society's Ohio History Central website: Ohio's Geologic Periods

[http://www.ohiohistorycentral.org/w/Ohio%27s\\_Geologic\\_Periods](http://www.ohiohistorycentral.org/w/Ohio%27s_Geologic_Periods)

Ohio Geological Survey:

-Education resource site (K-12 activities, free posters, GeoFact sheets, maps, and more):

<http://www.dnr.state.oh.us/tabcid/7921/Default.aspx>

-Free rock and mineral sets (schools just pay shipping): <http://www.dnr.state.oh.us/tabcid/22338/Default.aspx>

-GeoFacts Sheets about Ohio's fossils:

[http://www.dnr.state.oh.us/geosurvey/geo\\_fact/geo\\_fact/tabcid/7882/Default.aspx](http://www.dnr.state.oh.us/geosurvey/geo_fact/geo_fact/tabcid/7882/Default.aspx)

The Paleontology Portal: Exploring Time and Space (click on Ohio!)

[http://www.paleoportal.org/index.php?globalnav=time\\_space](http://www.paleoportal.org/index.php?globalnav=time_space)

Fossils of Kentucky at the Kentucky Geological Society's Website (very similar to those of Ohio)

<http://www.uky.edu/KGS/fossils/>

University California Museum of Paleontology: Geologic Time Scale with links for each time interval

<http://www.ucmp.berkeley.edu/help/timeform.php>

National Geographic: Prehistoric Time Line

<http://science.nationalgeographic.com/science/prehistoric-world/prehistoric-time-line/>

PaleoMap Project: Images of plate reconstructions and climate history for all intervals in Earth history

[www.scotese.com](http://www.scotese.com)

Colorado Plateau Geosystems, Inc.: Fantastic paleogeographic reconstructions

<http://cpgeosystems.com/index.html>

Palaeocast: Palaeontology podcasts created by and funded professional paleontologists

<http://www.palaeocast.com/>

Evolution of Life Activities: Activities on various aspects of paleontology with some video demonstrations; check out the ELI blog as well for new ideas on all aspects of earth science learning.

[http://www.earthlearningidea.com/English/Evolution\\_of\\_Life.html](http://www.earthlearningidea.com/English/Evolution_of_Life.html)

Paleontological Society: Hands on activities (complete with national standards), educational brochures, and trustworthy links to more excellent references

[http://www.paleosoc.org/ed\\_resources.html](http://www.paleosoc.org/ed_resources.html)

**Book:** "Fossils of Ohio" Rodney Feldman (ed). Bulletin 70 of the Ohio Geological Survey (1996, reprint 2005). But it here: <http://www.ohiogeologystore.com/browse.cfm/fossils-of-ohio/4,2.html>. AMAZING BOOK for only \$30!

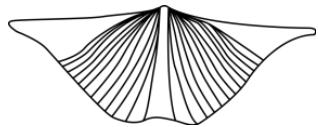
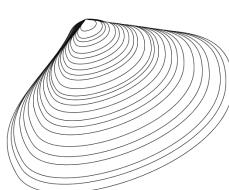
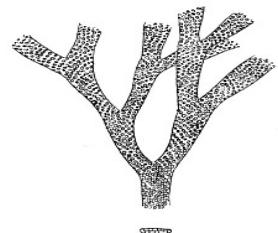
**Book:** "A Sea Without Fish: Life in the Ordovician Sea of the Cincinnati Region" by David Meyer and Richard Davis (2009). Indiana University Press.

**University California Museum of Paleontology:** A series of interactive modules that explore the history of life on Earth, while focusing on the processes of science. Each module contains suggested lesson plans and an extensive teacher's guide. These are truly fantastic units! Titles include: Life has a history, Getting into the Fossil Record, Understanding Geologic Time, Stories from the Fossil Record, What did *T. rex* taste like?, Evolution of flight, The arthropod story, Adventures at Dry Creek

<http://www.ucmp.berkeley.edu/education/explotime.html>

Name \_\_\_\_\_

### Identification sheet for Key Ordovician Fossils

<b>Brachiopoda</b>		<b>Bivalvia (=clams)</b>	
<b>Rugosa (=horn corals)</b>		<b>Bryozoa</b>	
<b>Trace fossil</b>		<b>Gastropoda (=snails)</b>	