Indiana's Ancient Seas

Key Objectives

Students will understand that 400 million years ago when what is now Indiana was located near the equator, it was covered by a shallow sea. Students will also learn that the fossils found in many of our state parks are evidence left behind after the shallow sea disappeared.

State Parks Featured

- Falls of the Ohio State Park www.stateparks.in.gov/2984.htm
- Clifty Falls State Park www.stateparks.in.gov/2985.htm

Activity:	Standards:	Benchmarks:	Assessment Tasks:	Key Concepts:
Fossil Match	SCI.4.3.2 2010	Observe, compare and record the physical characteristics of living plants or animals from widely different environments. Describe how each plant or animal is adapted to its environment.	Understand that species in the seas today come from species that lived when Indiana was covered by ancient seas.	Fossils Adaptations Geologic Time Indiana's history of an ancient sea
	SCI.4.3.3 2010	Design investigations to explore how organisms meet some of their needs by responding to stimuli from their environments	Explain how a fossil is formed.	
	SCI.4.3.4 2010	Describe a way that a given plant or animal might adapt to a change arising from a human or non-human impact on its environment.	Explore how ancient sea species adapted to survive or died.	
	SS.4.3.1 2007	The World in Spatial Terms: Use latitude and longitude to identify physical and human features of Indiana. Example: Transportation routes and major bodies of water (lakes and rivers)	Identify the location of Indiana State Parks using latitude and longitude	
	ELA.4.SL.2.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) on grade-appropriate topics and texts, building on others' ideas and expressing personal ideas clearly.	Understand ways that the valuable resources at Falls of the Ohio and Clifty Falls are protected.	
	ELA.4.SL.2.4	Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.	Understand ways that the valuable resources at Falls of the Ohio and Clifty Falls are protected.	
A Walk Through Time	ELA.4.SL.2.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) on grade-appropriate topics and texts, building on others' ideas and expressing personal ideas clearly.	Understand the formation of geological layers at Clifty Falls	
	ELA.4.SL.2.4	Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.	Understand ways to present geological information in an understandable format	

Key Resources

- Falls of the Ohio Foundation www.fallsoftheohio.org
- Indiana Geological Survey, Fossils and Time http://igs.indiana.edu/FossilsAndTime/

Activity 1: Fossil Match

Activity Summary

During this activity students will use specimen pictures of fossils and match them to an ID sheet, describe why the pictures match, determine if the fossils are scavengers, herbivores or carnivores, then draw what they think the fossilized creature might have looked like alive. The drawing will be used in lesson two of this unit.

Activity Length: 60 minutes

Background

Indiana's limestone **bedrock** formed 570 - 245 million years before the present. During this time, our **continent** was much further south, closer to the **equator**. Temperatures were warmer, and the area was covered by a shallow ocean.

The shallow ocean was filled with clams, snails and other animals. These animals had shells and **structures** that were rich in **calcium**. As they died, their shells formed layers on the ocean floor. As more and more layers piled up, their weight pressed down to form solid rock-- limestone.

Limestone is a sedimentary rock. All sedimentary rock is formed by layers **deposited**, one on top of the other, over a long period. Sedimentary rock can form from layers of dirt, sand, shells, plants or other material. Which layers of sedimentary rock would be the oldest rock layers -- the bottom layers or the top layers?

Fossils form when an animal's shell or other hard structure is buried without being broken into smaller pieces. Over time, the shell is replaced with limestone forming a fossil **replica** or print of the shell.

Vocabulary

Bedrock: solid rock underlying the soil

Continent: one of the earth's seven major areas of land

Equator: the imaginary east-west line circling the Earth halfway between the North and South poles

Structure: a thing constructed

Calcium: a common element found in our bones and teeth

Deposited: to put or leave (someone or something) in a particular place

Fossil: a trace or print or the remains of a plant or animal of a past age preserved in earth or rock

Replica: a copy or reproduction

Scavenger: eats whatever is available (plants, animals, other living things, dead things)

Herbivore: eats primarily plants

Carnivore: eats primarily animals

Omnivore: eats both animals and plants

Materials Required

- Fossil pictures www.fallsoftheohio.org/FeaturedFossil.html has hundreds of fossil pictures with which to compare your fossil(s).
- Fossil Match Sheet (Also available at www.fallsoftheohio.org/Matchthefossil.html)
- Fossil Match Answer Sheet
- Markers and Crayons

Focus Questions

- How is a fossil formed?
- How do ancient sea species compare to today's ocean species?
- How has Indiana moved over time?
- Why don't we find ancient seas fossils throughout the state of Indiana?

Step-By-Step Directions

1. Travel back 400 million years to a time when Falls of the Ohio State Park was covered by an ancient sea. The water would have come up to students' knees in most places. In others, it would be over their head. The seas were filled with life. We know this because of the fossils the students see before them. Use the focus questions and resources to facilitate a discussion of the ancient seas in relation to Indiana.
2. Spend a few minutes looking at the Falls of the Ohio website and locating Falls of the Ohio on a map of Indiana and identifying its latitude and longitude in comparison to where your school/town are located.
3. Distribute "Fossil Match" Worksheets.
4. Explain that they are to match the fossil pictures with the correct hint on the page.
5. After they have identified the fossils, use the answer key to check their work and learn about where the fossil lived and what it ate.
6. Have the students choose a favorite ancient sea creature fossil and draw what it might have looked like when it was alive. Make sure they add color.
7. Ask these questions about the selected sea creature:
    a. What did it eat?
    b. How did it move? (Or was it stationary?)
    c. How did it protect itself from being eaten?
    d. What animal lives today that resembles this creature, if any? What is one thing that this creature has or does that no other creature does?
8. As a wrap-up to this activity, talk about the challenges of protecting these internationally known fossil beds. What are the challenges? (Ignoring posted rules about not collecting fossils, littering). What is being done already? (Fossil collecting piles are available near the Interpretive Center to provide the collecting experience without damaging the fossil beds; volunteers rove fossil beds during the summer to answer questions/talk with visitors) What are some other ways they might be protected?

Fossil Match

Name: _____

Directions: Match the fossil with the description.

1. 
Blastoid

2. 
Brachiopod

3. 
Bryozoan

4. 
Cephalopod

5 
Clam

6. 
Crinoid

7. 
Honeycomb Coral

8. 
Horn Coral

9. 
Snail

10. 
Stromatoporoid

11. 
Trace

12. 
Trilobite

A. Related to Octopus

B. Bivalve usually moves

C. Three body sections

D. Type of sponge

E. Nut-shaped body

F. Shaped like a bull horn

G. Evidence an animal passed by

H. Sometimes called "moss animal"

I. Anchored with peduncle

J. Stalked with feathery arms

K. Coiled mollusk of land, sea, river

L. Contains polygonal chambers

Answer key to Fossil Match activity

1-E
Blastoid

2-I
Brachiopod

3-H
Bryozoan

4-A
Cephalopod

5-B
Clam

6-J
Crinoid

7-L
Honeycomb Coral

8-F
Horn Coral

9-K
Snail

10-D
Stromatoporoid

11-G
Trace Fossil

12-C
Trilobite

Activity 2: A Walk Through Time

Activity Summary

This activity takes students on a geological tour back through time from the top of the Clifty Canyon to the bottom at Clifty Falls State Park.

Activity Length: 60 minutes

Background

Clifty Falls was created during the Ice Age when the southward flowing waters of Clifty Creek met the newly formed Ohio River in a spectacular plunge, a waterfall that may once have been 200 feet high. The falls has since cut its way into bedrock to a point more than two miles north of its original position.

The park's 425-million-year-old shale and limestone rocks contain numerous marine fossils and are among the oldest bedrock exposures in Indiana. These layers of shale, limestone and fossils were formed when shallow seas formed, deepened and then receded, leaving behind marine animals buried in layers of mud of varying types that hardened into rock. Clifty Creek's stony bed is littered with fossil remnants including ancient corals, ancestral squids, brachiopods and more.

Fossil collecting within Clifty Falls State Park is prohibited but nearby collecting locations are readily accessible.

Vocabulary

Ice age: a time in the distant past when a large part of the world was covered with ice

Bedrock: solid rock underlying the soil

Shale: a soft kind of rock that splits easily into flat pieces and is formed by the consolidation of clay, mud, or silt

Limestone: a rock that is formed chiefly from animal remains (as shells or coral) and consists mainly of calcium carbonate

Fossil: a trace or print or the remains of a plant or animal of a past age preserved in earth or rock

Materials Required

- Clifty Falls Rocks and Water https://vimeo.com/126168945

Focus Questions

- How can geologists learn how the Earth's layers were formed?
- Have you visited Clifty Falls State Park before? If so, what do you remember?

Step-By-Step Directions

1. Spend a few minutes locating Clifty Falls State Park on a map of Indiana and identifying its latitude and longitude in comparison to where your school/town are located.
2. Use the enclosed hand-out describing the formation of Big Clifty Falls at Clifty Falls State Park. Look at the hand-out and discuss the following questions:
    a. Where do geologists believe the waterfall was located after the last glacier over a million years ago?
    b. Find the location of Big Clifty Falls on the Clifty Falls property map, and locate the Ohio River. How far has the waterfall moved upstream and how did it happen?
    c. Looking at the rock layer diagram, what has the erosion of Clifty Falls down through the different rock layers allowed us to see and understand about what the land looked like through time?
3. Watch the virtual tour as the interpretive naturalist at Clifty Falls talks about the formation of layers of rock and fossils in Clifty Canyon.
4. Clifty Canyon is a state dedicated nature preserve. Create a poster that illustrates the formation of geological layers through time at Clifty Canyon and present it to another classroom. Include a message about the value of this natural resource and how it is protected.

Extension Ideas

- Take a field trip to Clifty Falls State Park to examine fossils and geologic layers that describe our landscape millions of years ago.
- Take a field trip to Falls of the Ohio State Park to explore the interpretive center and visit the Devonian fossil beds that have international significance.
- Use this fossil guide to identify fossils on the Falls of the Ohio's fossil beds: www.fallsoftheohio.org/fossil_id.html.
- Use brochures found here to identify Devonian fossils: www.fallsoftheohio.org/fossils.html.
- Special fossil and mineral collecting piles are at the Falls of the Ohio for visitors to dig in. This Web page: www.fallsoftheohio.org/KidsCollectingPileInfo.html, contains identification sheets and tips.
- Use this quiz: www.fallsoftheohio.org/FossilQuiz.html

Resources

- Create your own Discovery Pack to investigate fossils: www.fallsoftheohio.org/KidsDiscoveryPack.html

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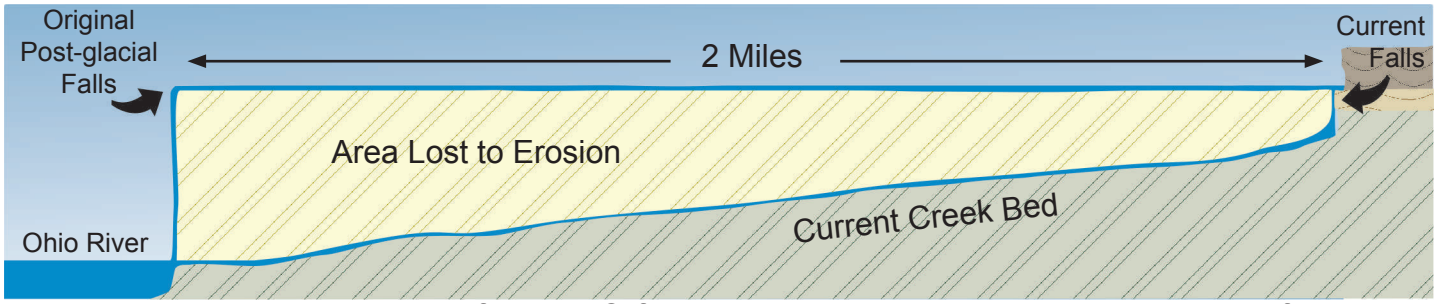
Clifty Falls: Rocks and Water

The falls continue to move upstream, further from their Ohio River origin.

Waterfalls occur when a hard rock layer rests on a softer rock layer. The softer, lower layer erodes more quickly, creating an overhang from the harder layer. Eventually, the unsupported overhang collapses and the waterfall recedes upstream. The process repeats itself.

Early in the Ice Age the young Ohio River eroded its path 500 feet down into the solid shale and limestone bedrock. Clifty Creek, a small stream, poured over the new Ohio River bluffs and fell to the Ohio River, hundreds of feet below. Clifty Falls was born.



In its estimated one million year life span, Clifty Falls has eroded over two miles upstream from the Ohio River. The fall's erosion continues today, receding one foot every fifty years.

What the Rocks Reveal

As Big Clifty Falls cut through the rock, layers of stone were revealed, telling a story about what the park looked like a million years ago. All rock formations at Clifty Falls formed when seas spread over the land. We know this from the types of rocks and their fossils.

Deeper seas carrying clay and limy mud formed this limy shale. The rock layer is soft and erodes easily.

Ripple marks formed from waves and flowing water show that this rock layer formed when seas were very shallow. This hard layer forms the lip of the falls, and so erodes more slowly than the Dillsboro layer below it.

Sea currents spread mud across the ocean floor. The mud was compressed to form shale. Between shale layers are limestone layers that formed when no mud was present and the ocean floor was rich with animal life. Fossils are most common in this layer.

Because of its unique geologic nature, the upper gorge and falls of Clifty Creek have been dedicated as a State Nature Preserve.