TEACHERS

A CHANGING LANDSCAPE
Activity Overview

BIG IDEA

The Earth and its landscapes change over time. Scientists use the fossil record to understand the Earth's environments and climates millions of years ago.

OBJECTIVE

Students will use representations of the fossil record to explore large-scale geographical changes that occur over a long period of time in what is now Montana.

BACKGROUND

The Western Interior Seaway was a shallow inland sea that split North America in two during the Middle to Late Cretaceous. Coinciding with the rise in global sea levels during the Early Cretaceous, two great arms of water—one from the north and one from the south—flooded the central low-lying interior of North America. By the start of the Late Cretaceous, approximately 100 million years ago, these two arms linked to form the Western Interior Seaway. To the west, the seaway was flanked by the rising Rocky Mountains, while relatively low and flat areas existed along its eastern shore.

The existence of the Western Interior Seaway is recorded in the rocks. Within the seaway, blankets of sand and silt were laid down along the shorelines and in shallow water settings, eventually becoming rock formations such as the Eagle Sandstone, which now form the cliffs above Billings, Montana. Deeper portions of the sea were carpeted in mud, found today in formations such as the Thermopolis Shale and Belle Fourche Shale.

The Western Interior Seaway was a defining feature of the Middle and Late Cretaceous in Montana. It was inhabited by abundant marine life including aquatic birds. Periodically, volcanic eruptions in the Rocky Mountains dumped loads of ash into the sea, found today as beds of bentonite clay. As time moved on, sea levels continued to fluctuate, repeatedly flooding and then exposing low-lying areas along the shoreline. In Montana this resulted in an alternating record of marine and terrestrial rocks, some of which have been exposed to reveal fossils like those seen in the display below the marine mural.

A CHANGING LANDSCAPE
Museum Instructions (Cont.)

INSTRUCTIONS (CONT.)

Ask your students how scientists know the Earth has changed or what it looked like if no one was alive to see the dinosaurs. How do we know dinosaurs existed? (We find their fossils.) How do we know what plants surrounded the dinosaurs? (We find trace fossils in the sedimentary rocks. Trace fossils are impressions, like a footprint, that preserve the imprint of an organism in the sediment.) If available, use examples of fossils provided in MOR's Geologic Time Outreach Kit to show examples of fossils. Then ask the students, "How do we know if fossilized plants or animals were found on land or water?". In this discussion, help students understand that the types of fossils we find (marine vs. terrestrial) provide clues, but so do the rocks themselves.

Tell your students that in this activity, they will use an activity sheet to use the same science practices to identify how Montana's landscape changed during the time of the dinosaurs.

Using the activity sheet, instruct your students to identify the different fossils in both maps. By identifying where terrestrial fossils and rock formations are found and where marine fossils are found, help students estimate the boundary of the Western Interior Seaway.

Encourage your students to explore this concept more in depth. Using the activity sheet, ask students to compare and contrast these two time periods. Have students apply this knowledge by thinking about what their hometown would look like in the fossil record. Have students estimate the location of their hometown on the map. Discu s what types of rocks and fossils may be found.

Conclude the lesson by emphasizing that the Earth, its landscape, and its climate changes over time. Scientists can identify changes by studying the fossil record. Fossils help us understand how animals, like dinosaurs, may have behaved, but fossils also provide clues to larger Earth systems.

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A CHANGING LANDSCAPE
Classroom Instructions

MATERIALS

MOR "A Changing Landscape" PowerPoint slides (or printed images of these slides); MOR Outreach Kit: Geologic Time including examples of the four rock formations highlighted in this activity and fossil specimens from highlighted species

ACTIVITY TIME

45 Minutes

INSTRUCTIONS

This activity can be used to support geology lessons involving plate tectonics or sedimentary rocks.

Provide your students with an example of something that has changed in your hometown in the past two years (buildings, trees, etc.). Ask your students if they can think of anything else that has changed in their landscape.

Tell the students that they will be exploring how the Earth has changed over a long period of time, millions of years, and how we know that even though no human was alive during this time.

If your students have not yet been introduced to plate tectonics, geologic time, or the Western Interior Seaway, use the PowerPoint slides to briefly show that the Earth has changed over millions of years. Focus your brief introduction on change; it is not critical to know details of each of the highlighted maps. Instead, help students understand that while we may not see changes in the landscape in our lifetime, what is now Montana looks very different than it did at the time of the dinosaurs.

Ask your students how scientists know the Earth has changed or what it looked like if no one was alive to see the dinosaurs. How do we know dinosaurs existed? (We find their fossils.) How do we know what plants surrounded the dinosaurs? (We find trace fossils in the sedimentary rocks. Trace fossils are impressions, like a footprint, that preserve the imprint of an organism in the sediment.) If available, use examples of fossils provided in MOR's Geologic Time Outreach Kit to show examples of fossils. Then ask the students, how we know if fossilized plants or animals were found on land or water. In this discussion, help students understand that the types of fossils we find (marine vs. terrestrial) provide clues, but so do the rocks themselves.

A CHANGING LANDSCAPE
Classroom Instructions (Cont.)

INSTRUCTIONS (CONT.)

Tell your students that in this activity, they will use an activity sheet to use the same science practices to identify how Montana's landscape changed during the time of the dinosaurs.

Using the activity sheet, instruct your students to identify the different fossils in both maps. By identifying where terrestrial fossils and rock formations are found and where marine fossils are found, help students estimate the boundary of the Western Interior Seaway.

Encourage your students to explore this concept more in depth. Using the activity sheet, ask students to compare and contrast these two time periods. Have students apply this knowledge by thinking about what their hometown would look like in the fossil record.

Conclude the lesson by emphasizing that the Earth, its landscape, and its climate changes over time. Scientists can identify changes by studying the fossil record. Fossils help us understand how animals, like dinosaurs, may have behaved, but fossils also provide clues to larger Earth systems.

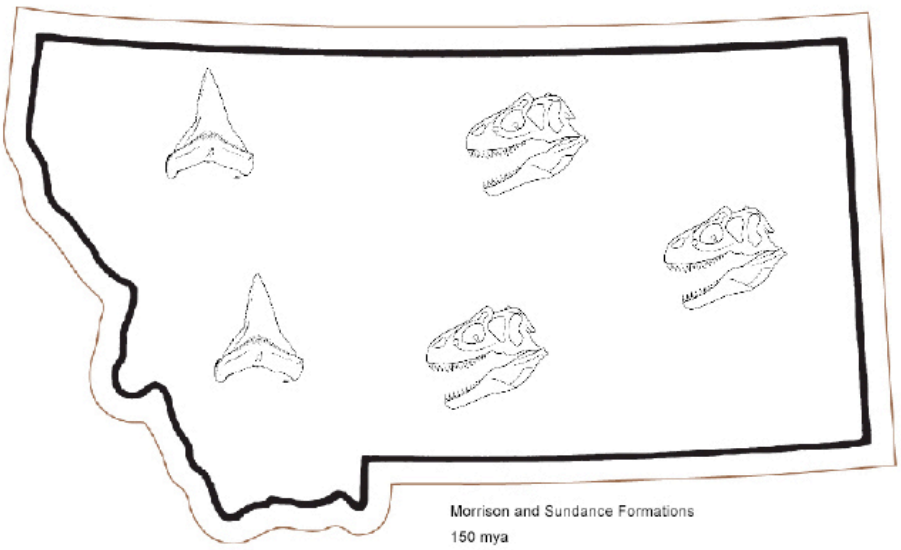
TEACHERS

NAME _____

A Changing Landscape

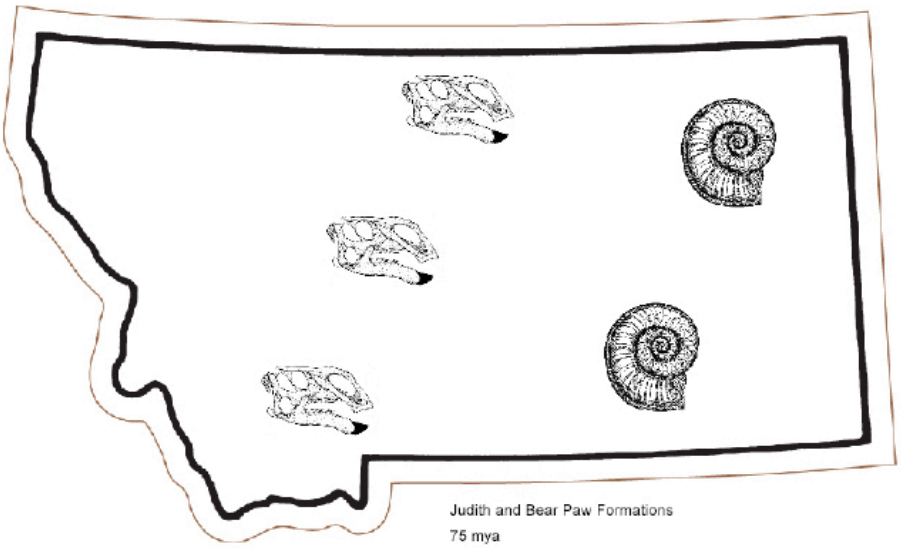
What did the Earth look like during the Mesozoic Era? In the area that is now Montana, what did the landscape look like and how do we know?

150 Million Years Ago



This map generally symbolizes the types of fossils that have been found and where they have been found in the rock formations dated 150 millions of years ago (mya). In this map, find and circle the shark teeth fossils. Shark teeth fossils are found in shale. Shale is formed in shallow seas. Find the *Allosaurus* fossils and draw squares around them. *Allosaurus* fossils are found in sandstone. This sandstone was formed in rivers. Using colored pencils, color in the parts of this map that were a shallow sea with blue and the areas that were land with rivers in green.

75 Million Years Ago



This map generally shows the types of fossils that have been found and where they have been found in the rock formations dated 75 millions of years ago (mya). In this map, find and circle the Ammonite fossils. Ammonite fossils are found in shale. Shale is formed in shallow seas. Find the *Brachylophosaurus* fossils and draw squares around them. The *Brachylophosarus* fossils are found in sandstone. This sandstone was formed in rivers. Using colored pencils, color in the parts of this map that were a shallow sea with blue and the areas that were land with rivers in green.

A Changing Landscape (Cont.)

Why would *Allosaurus* or *Brachylophasaurus* fossils be found in river deposits?

How many years passed between these two maps?

Which map is older?

Based on the fossil evidence, describe how the landscape and shoreline change between 150 million years ago and 75 million years ago in what is now Montana?

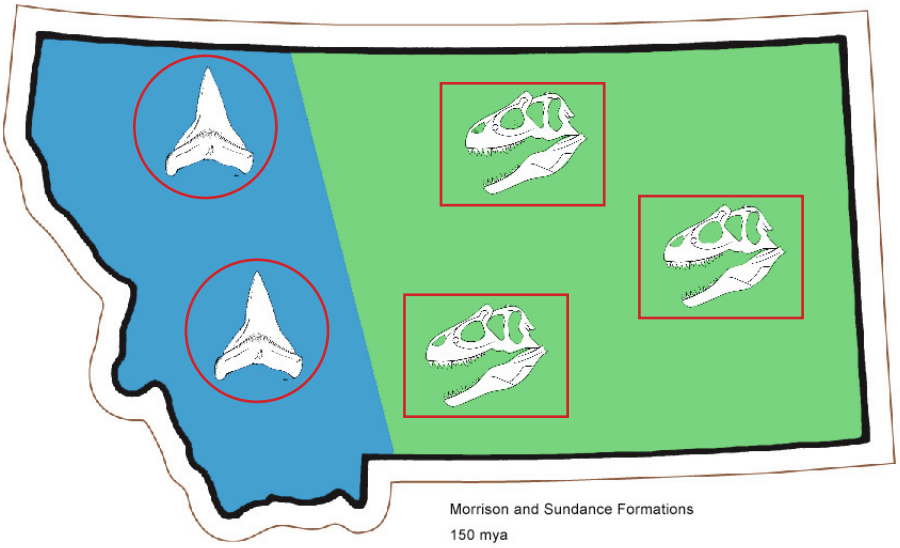
What types of rock formations would future scientists find in your hometown if your landscape today was preserved in the fossil record?

NAME ANSWER KEY

A Changing Landscape

What did the Earth look like during the Mesozoic Era? In the area that is now Montana, what did the landscape look like and how do we know?

150 Million Years Ago



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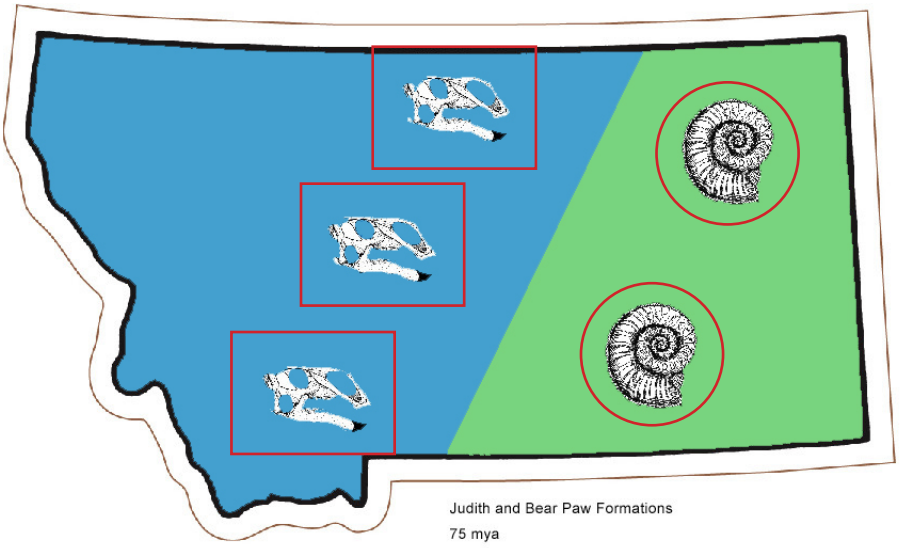
75 Million Years Ago



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A Changing Landscape

Why would Allosaurus or Brachylophasaurus fossils be found in river deposits?

***Allosaurus* and *Brachylophasaurus* both lived on land. Rivers carry sand and mud, which can bury dinosaur bones after a dinosaur dies. These deposits can become rock formations with many fossils.**

How many years passed between these two maps?

150 - 75 = 75 million years

Which map is older?

The map of 150 Million Years Ago with *Allosaurus* and shark teeth.

Based on the fossil evidence, describe how the landscape and shoreline change between 150 million years ago and 75 million years ago in what is now Montana?

Dinosaurs (which lived on land) and marine fossils suggest that the seaway and shoreline changed from 150 to 75 million years ago. Around 150 mya what is now western Montana was covered by water. Around 75 Million Years Ago, the western part of Montana was land and the east was covered by water.

What types of rock formations would future scientists find in your hometown if your landscape today was preserved in the fossil record?

Answers will vary.