



Yellowtail Dam NPS Photo

Level II

Fifth Grade to Eighth Grade

The activities in this section are designed for students in fifth through eighth grade. All activities can be changed to best suit the teachers need. The activities and levels are designed as building blocks. All of the items in Level I correspond in some way and are introductory to the items in Level II.

Activity 1

Geology

The Water's Work is Never Done

By Paul Gordon

About sixty-million years ago, a river meandered north to the Arctic Ocean across a continent vastly different from the North America of today. The land was already old, so old it is hard to grasp its antiquity. Even then, where the north bound river ran, change after change had taken place. Great oceans had come and gone; mountain ranges had appeared and eroded away. Beneath the place where the river flowed, bygone

seas had deposited layer upon layer of sedimentary rock, including the massive formation today called the Madison Limestone through which modern Bighorn River has cut its way. There had also been climatic changes: long periods of warm or cool weather, times when rains poured upon the land, times when desert-like conditions prevailed. Life had changed as well as the land and

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the climate. The early seas that covered this land had been home to myriads of creatures whose fossils are entombed today in Bighorn Canyon's limestone. Land creatures had also walked this country; the long age of the dinosaur had already come and gone. These great creatures had roamed this land and disappeared, leaving only enough evidence of their existence to tantalize and intrigue us. Mammals had inherited the plains and the banks of the river. Camel, horse, mammoth, musk-ox, and lion were among their number. Like the dinosaur, they in turn would vanish. Plants had also changed. Simple one-celled species, flowering shrubs, grasses, and finally massive trees had appeared, lived their span, and disappeared.

But still change was ongoing, as deep beneath this scene, the earth stirred and rumbled. The land rose, at times rapidly and at other times only infinitesimal fractions of an inch in decades. The river clawed at its bed, at times keeping pace with the rising of the land, at times blocked in its rush to the sea forming natural lakes. In time natural dams were eroded, allowing the river to travel on, in its never ending alteration of the land.

This process has continued throughout the ages. In time the Bighorn and Pryor mountains came to dominate the landscape, at times rising slowly, and at other times pushing upward through seismic activity.

Side canyons draining the Bighorn and Pryor Mountains; have cut down to the level of the mother stream. In so doing, these canyons have carved and created mini-climates and little hidden worlds of their own. These places are often oases in the drier, harsher climate on the

Geology Rocks at Horseshoe Bend

The rocks in the ridge overlooking Horseshoe Bend are a record of dramatic changes in the climate and environment of this region over time. All of the rock layers visible at Horseshoe Bend were deposited during the Mesozoic Era (66-245 million years ago). During this time, amphibians, reptiles (including dinosaurs) and primitive plant forms dominated the land. Mammals and flowering plants began to appear near the end of this Era.

The red rocks at the base of the ridge (Chugwater Formation) records a time when the area probably had an arid, coastal plain environment. The overlying gray beds (Gypsum Springs Formation) probably indicate a similar environment persisted with the addition of shallow, warm seas.

The Sundance Formation contains abundant

southern end of the recreation area and warmer spots in the wetter, cooler northern portion. As the water whittled away at the landscape, carving Bighorn Canyon and its tributaries, the Bighorn was loaded with vast amounts of sediment. This served as an abrasive, wearing away the rock beds of the river and drainages, gouging loose more material to be carried downstream, some as far as the Gulf of Mexico.

The construction of Yellowtail Dam in the 1960s had the most dramatic influence of any event ever on the canyon-cutting actions of the Bighorn River. The dam changed the rapidly flowing, silt-laden stream into a gentle moving lake. When the river lost its velocity, it also lost its ability to maintain its load of eroded material. Mud and silt quickly settled to the lake bottom, creating deposits over thirty feet thick in the southern portions of the lake.

Prior to the construction of Yellowtail Dam, the Bighorn was not only muddy and silt-laden, but its water volume also fluctuated. The dam regulates downstream flows and the river runs clear, its load of sediments left behind in Bighorn Lake.

Although Yellowtail Dam has greatly altered the recent canyon-cutting activities of the Bighorn, it has not stopped them. The upper reaches of the tributary canyons are still being whittled away, be it ever so slowly.

Yellowtail Dam, like all man-made objects, is temporary, when measured in geological time. Canyon cutting and mountain building are measured in millions of years. The life of a dam is measured in hundreds. So even now, the water's work continues.

marine fossils and records a time when an ocean flooded the area. The most common fossils are Crinoid stem fragments (Pentacrinus), belemnites (Pachyteuthis), and oysters (Gryphaea). These fossils are the remains of marine organisms that settled to the sea floor, were buried, and preserved in the sea-floor mud. The Morrison Formation records a retreat of the ocean and return to a coastal plain environment, now more tropical with lush plant growth. Dinosaurs roam the region. Dinosaur fossils have been found in the Bighorn Canyon Area and surrounding basin.

The Pryor Conglomerate forms the top to the ridge and is the base of the Cloverly Formation. This coarse-grained rock resulted from the sand and gravel left behind by eastward-flowing streams that drained rising mountains in the area of present day western Montana.

Bighorn Canyon Fossils, Paleontologist for a Day



Science, Language Arts, Speaking and Listening

Standards:	Wyoming Science: Standard 1, Benchmark 9 Standard 2, Benchmark 2 & 3 Wyoming Language Arts: Standard 3, Benchmark 1, 2, 5, & 6 Montana Speaking and Listening: Standard 2, Benchmark 1 & 2
Duration:	On Site 45 min., tour Horseshoe Bend Off Site 1 hour lesson using the Horseshoe Bend geology layers word document and fossil photos found in the geology section of the teacher supplement disc.
Class Size:	Any

Objectives

In their study of Bighorn Canyon geology, students will:

1. Identify the geologic layers at Horseshoe Bend.
2. Identify fossils and the layers they can be found in.
3. Describe the landscape around Horseshoe Bend and how it has changed through time.

Materials

On Site

1. Fossil worksheet
2. Magnifying glass
3. Notebook and pencil to make notes
4. Bighorn Canyon Stratigraphy card (Found under handouts in the geology section of the teacher supplement disc.)
5. Sturdy shoes
6. Water

Off Site

1. Create a virtual tour or Power Point presentation of Horseshoe Bend by using photos and handouts found on the teacher supplement disc.
2. Notebook and pencil to take notes

Vocabulary

Paleontologist: is a person that studies fossils.

Belemnite: is a fossil of a squid-like creature with a long bullet-shaped shell.

Crinoids: are star shaped fossil of marine sea lilies which attached themselves to the sea floor.

Mesozoic Era: records a time 230 to 65 million years ago also referred to as the Age of Reptiles.

Paleozoic Era: records a time 570 to 230 million years ago also referred to as the Age of the Fishes.

Cenozoic Era: records a time 65 millions years ago to present day, also referred to as the Age of Mammals.

Bighorn Canyon Fossils, Paleontologist for a Day Cont.



Science, Language Arts, Speaking and Listening

Setting the Stage

Discuss how nature has a way of changing over time. What are some of the reasons nature changes? (hurricanes, tornadoes, flash floods, fire, and climate changes.) Discuss how the area of Horseshoe Bend has changed over time, including the recent droughts and how there is evidence of all these changes recorded in the rocks and dirt surrounding them.

Procedure

On Site

1. Explore the Horseshoe Bend area with the Park Ranger.
2. Listen to the Ranger Talk about the fossils and layers.
3. Draw pictures of the fossils found, take notes of where they were found, what they are and what geologic layer they came from.
4. Return to the classroom and share your notes with the class.

Off Site:

1. Show the slide/power point presentation of Horseshoe Bend to the students. Discuss the different layers and pass around fossils from that area.
2. Fossils could be hidden in buckets of sand. Students could use their imagination to put themselves at Horseshoe Bend. They could then record their findings and report back to the class.

Additional Activities

Students could assist in creating a fossil bulletin board using their drawings and journal pages. Teachers could plan a trip to the library to learn more about fossils and paleontologists.

Bighorn Canyon Fossils



Student Handout

The following fossils are found in the Bighorn Canyon Area.
Match the fossils with their correct names.

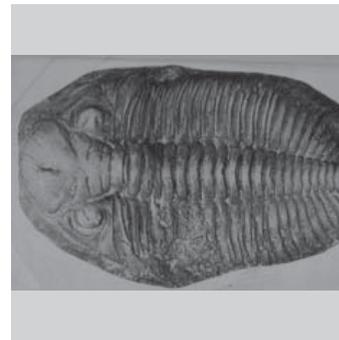
1. Trilobite (Cambrian Era)



2. Crinoids (Jurassic Era)



3. Belemnite (Jurassic Era)



4. Graphaea (Jurassic Era)



Finding the Treasures of Bighorn Canyon



Student Handout

Many people hiking Bighorn Canyon National Recreation Area will use the trails and hiking guide, but some go off trail. The off trail users use maps and compasses to return to their starting point or an interesting geologic formation. Practice your orienteering skills with the three activities below.

Destination Bighorn Canyon - On Site

1. Your teacher has chosen a trail for you to hike.
2. You are on one of two teams. Each team will go to different destinations.
3. Each team will choose their destination.
4. The team needs to take notes on how they got to their destinations using a map and a compass.
5. The teams will return to the starting point and exchange notes.
6. The opposite team must use a map and compass to find the other team's destination.
7. Teams return to the starting point.
8. Did your team find the other's destination? If not, what should have been done differently.
9. Did the other team find your destination? If not, what should have been done differently.

Rock Hunt - Off Site

1. Find a rock and drop it at your feet.
2. Follow the directions below correctly and you should end up at the same place you started.
 - a. Walk 10 steps at 300 degrees
 - b. Walk 10 steps at 60 degrees
 - c. Walk 10 steps at 180 degrees
3. Did you end up back at your rock? If not, try again.

Orienteering Competition

Break into teams. The teacher has chosen 10 destinations. Follow the steps from your starting point to test your directional skills. When you find your destination write it in the blank before the number. Good Luck. Remember, you need to begin each direction at the starting point.

1. Walk 100 feet at 60 degrees.
2. Walk 100 feet at 310 degrees.
3. Walk 30 feet at 180 degrees.
4. Walk 180 feet at 340 degrees.
5. Walk 30 feet at 280 degrees.
6. Walk 180 feet at 40 degrees.
7. Walk 140 feet at 20 degrees.
8. Walk 90 feet at 0 degrees.
9. Walk 50 feet at 220 degrees.
10. Walk 150 feet at 240 degrees.

When you are finished, check your answers with the teacher. The first team with the correct answers wins.